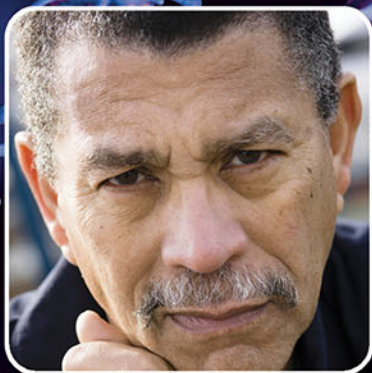


Pathophysiology

Concepts of Human Disease



Matthew Sorenson

Laurie Quinn

Diane Klein

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Concepts of Human Disease

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The pre-nursing career of Matthew Sorenson includes experience as a recovery room orderly, paramedic, and child care worker and an initial collegiate major in history. His nursing career began with a BSN degree from Northern Illinois University (with a minor in history). After graduation, he worked primarily in physical rehabilitation, focusing on neurologic conditions and injury, an area in which he remains active. He holds an MS in Applied Family and Child Studies (Focus on Abuse and Neglect) and an MS in Nursing (Community Health Focus).

His doctorate is from Loyola University Chicago, where he studied stress-related changes in immunologic function in those with multiple sclerosis. Postdoctoral education includes a three-year fellowship with the neurology service at Edward Hines Jr. VA Hospital (focus on multiple sclerosis) and a year-long fellowship in Disability Ethics through the Rehabilitation Institute of Chicago. He is an Adult Nurse Practitioner. His time as a nurse practitioner is spent primarily with street outreach programs targeting the homeless and working poor. His research focuses on immunologic correlates of fatigue, particularly in those with multiple sclerosis. He is currently funded to investigate viral epigenetics in multiple sclerosis. He teaches physical assessment, pharmacology, medical-surgical nursing, and pathophysiology. Academically, Dr. Sorenson teaches at DePaul University with an additional appointment in the School of Medicine (Physical Medicine and Rehabilitation) at Northwestern University. He served as a program director for several years and was recently named Director of the School of Nursing.

To my grandmother, Gertrude, for her inspiration. To my parents, Robert and Joyce, for their encouragement and support. Janet, your love and support was and always will be the cornerstone of my life.

Laurie Quinn, PhD, RN, FAAN, FAHA, CDE

Laurie Quinn is a Clinical Professor in the Department of Biobehavioral Health Science in the College of Nursing at the University of Illinois at Chicago (UIC). Dr. Quinn earned her PhD from UIC in Nursing Science and has been on the UIC College of Nursing faculty for 20 years. Her primary research focus is the study of metabolic alterations associated with diabetes mellitus, especially their role in the development of cardiovascular disease. Her research has focused on examining the effect of aerobic exercise on the metabolic derangements of both type 1 and type 2 diabetes. She is currently part of an

interdisciplinary team from University of Chicago, Illinois Institute of Technology, and UIC that is developing an artificial pancreas.

Dr. Quinn is a Certified Diabetes Educator and worked as a Clinical Nurse Specialist at Rush University Medical Center. She has received several awards for teaching excellence and has lectured in graduate and undergraduate physiology, pathophysiology, and pharmacology classes. She has published and presented extensively in research and clinical practice venues on diabetes-related topics.

Dr. Quinn is an active member of the American Diabetes Association and American Heart Association. She has been a healthcare coordinator at an American Diabetes Association summer camp for children with diabetes for several years. In this role, she has cared for numerous children with type 1 diabetes and helped to educate clinical staff and students from various healthcare specialties on the treatment of type 1 diabetes.

To my parents Lauretta and Thomas Quinn and sister Margaret Quinn for all of their support throughout the years.

Diane Klein, PhD, RN

Diane Klein earned a BSN degree from Loyola University Chicago and then worked as a nurse in the trauma unit and later in a medical unit at Cook County Hospital. During her clinical practice, she became interested in research, which led her to earn a PhD in physiology from the University of Illinois at the Medical Center Campus in Chicago. Her dissertation research focused on intracellular signaling systems in cancer cell growth. Her research interests as a faculty member at Loyola University Chicago included the role of cyclic nucleotides in altered lung metabolism during septic shock, myocardial metabolism and function during septic shock, effects of chronic ethanol intake on metabolic alterations during sepsis, and the use of nebulized morphine in the treatment of dyspnea.

Dr. Klein was an Associate Professor in the School of Nursing at Loyola University Chicago, where she taught undergraduate and graduate pathophysiology courses for over 30 years. She believed that nursing students require a strong foundation in pathophysiology because it is the basis for their understanding of pharmacology and the rationale for clinical assessments and interventions. In addition to pathophysiology courses, Dr. Klein taught undergraduate adult health clinical courses, undergraduate and graduate pharmacology, advanced physiology for clinical practice, and stress in health and illness.

In addition to teaching pathophysiology courses, Dr. Klein presented topics related to pathophysiology at local and national meetings of both nursing and basic science organizations. Selected topics presented included resources for teaching genetics and genomics, problems of

mechanically ventilated patients, biotrauma, the immune system and sepsis, fluid and electrolyte imbalances associated with trauma, effects of endotoxin and cyclic nucleotides on lung glucose oxidation, pathophysiology update for practicing nurses, and oxidative stress in critical illness and therapeutic strategies.

Diane Klein passed away in July of 2017, just as this book, on which she had worked for almost 10 years, was going to press. This book would not have existed if not for Diane's interest and hard work. Matthew Sorenson, Laurie Quinn, and the staff at Pearson are grateful for Diane's contributions and commitment to this project.

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Our appreciation first and foremost goes to Pamela Fuller for believing in this project. Without the editorial skill and patience of Laura Horowitz, this project would not have seen final fruition. We would be remiss if we did not acknowledge the valuable work of the contributors who provided time, energy, and depth to this work. The feedback of the reviewers was also crucial in shaping this book. Finally, thanks go to the students in our classrooms whose energy, questions, and drive for knowledge provided the genesis of this project.

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Preface

Why We Wrote This Text

One of the challenges of teaching pathophysiology is helping students understand the underlying concepts behind the details. This book started with conversations on how best to facilitate student understanding. We chose to create this book as a way of fostering student learning and clinical application.

The goals of *Pathophysiology: Concepts of Human Disease* are not only to provide students with the latest information about pathophysiology that is relevant to clinical practice, but also to empower students with competencies that will endure throughout their nursing career. The approach we have taken to pathophysiology reflects the shift in focus of healthcare from mainly understanding diseases in their later stages to understanding risk factors and interventions that can maintain good health and slow progression of disease in humans. For example, obesity, lack of regular physical activity, and tobacco use are risk factors for many common diseases such as diabetes mellitus, hypertension, atherosclerosis, cancer, and asthma. Therefore, we address risk behaviors that underlie leading causes of morbidity and mortality. The focus of this book will enhance students' understanding of disease processes and their ability to explain and motivate patients in their care to make therapeutic lifestyle changes.

Because of the rapid expansion of knowledge related to pathophysiology and the content saturation experienced by students in pathophysiology courses as well as other nursing courses, the concept-based approach for organization of content is used *Pathophysiology: Concepts of Human Disease*. This will help students to understand the elements common to many disease states. An explanation of the major physiologic concept addressed in each chapter and a list of related concepts are provided in the Chapter Overview of each chapter. The concepts we have used include the following:

Acid–Base Balance
Addiction
Cellular Regulation
Cognition
Comfort and Pain
Elimination
Energy Balance
Environment
Fluid and Electrolyte Balance
Hemostasis
Immunity
Infection
Inflammation and Oxidative Stress

Intracranial Regulation
Metabolism
Mobility
Mood and Affect
Nutrition and Digestion
Oxygenation
Perfusion
Reproduction
Sensory Perception
Sexuality
Stress and Coping
Thermoregulation
Tissue Integrity
Trauma

The most extensive coverage for each concept addressed is given to conditions, risk factors, and behaviors underlying the leading causes of morbidity and mortality. This ensures that the most prevalent disorders are given the most coverage. Identification of the conditions emphasized in the book is based on the Centers for Disease Control and Prevention's National Center for Health Statistics (<http://www.cdc.gov/nchs/index.htm>) and the national healthcare agenda as described in *Healthy People 2020*, published by the National Institutes of Health (NIH). According to the NIH, "The leading health indicators reflect the major health concerns in the U.S. at the beginning of the 21st century. The leading health indicators were selected based on their importance as public health issues." Chapter content related to *Healthy People 2020* focus areas is highlighted in special boxes. Summary tables are used to cover less common conditions.

The Cover

Starting with the cover, we emphasize the major focus of this text: human beings. Pathophysiology does not occur in a vacuum. Diseases, disorders, and syndromes occur in people—in individuals—and happen to neonates and infants, to children and adolescents, to men and women, to older adults. We call them "patients," but they are people first: parents, workers, students, lovers, siblings. The people shown on the cover appear as patients in case studies in the text.

Connor Whelan

Connor Whelan is the infant son of parents who are delighted to welcome him to the world. Connor has Down syndrome and a congenital heart defect. You will meet Connor in Chapter 25, "Cardiac Structural Disorders."



Angela Wang

Jennifer Yang hears from her daughter's school that Angela should be tested for cognitive difficulties. The tests reveal possible toxins. You will meet Jennifer and Angela in Chapter 3, "Environmental Influences on Disease and Injury."



Matthew Horn

Matthew Horn visits his healthcare provider for an annual checkup and complains that his right hand shakes when he's just sitting around or watching TV. The shaking seems to disappear when he's actively using his hand. That, along with other symptoms, leads to a suspicion of Parkinson disease. You will meet Matthew in Chapter 34, "Disorders Affecting Motor Function."

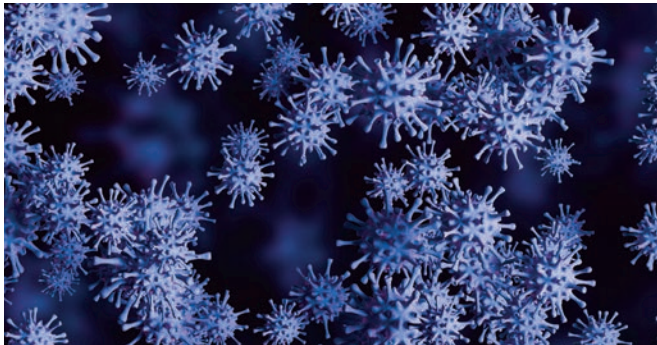


Irene Rollins

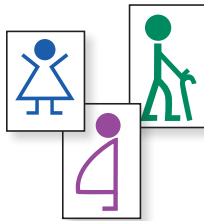
Irene Rollins, age 67, has ovarian cancer and is near the end of her life. You will meet Irene in Chapter 53, “Pathophysiology at the End of Life.”



The background image on the cover depicts a strain of the influenza virus. Influenza is a contagious respiratory illness that can be mild, moderate, or deadly. Every year in the United States, millions of people are infected with an influenza virus, hundreds of thousands are hospitalized, and tens of thousands die.



The individuals featured on our cover highlight another important aspect of *Pathophysiology: Concepts of Human Disease*: We cover the lifespan from birth to death. Information specific to infants and children, pregnant women, and older adults is highlighted with icons to draw attention to these specific populations.



Unit Structure

Pathophysiology: Concepts of Human Disease comprises 53 chapters divided into 15 units. The first four units provide in-depth coverage of pathophysiologic mechanisms; the rest of the units cover disorders, diseases, syndromes, and injuries grouped by concept. On each unit opener there is a visual that summarizes the content of the unit. These are great tools for students to review the unit.

Unit I: Foundations of Pathophysiology

Unit I introduces students to the foundational concepts and key components of the study of pathophysiology, including everything from terminology to genetics and the influence of the environment and stress on the human condition.

- **Chapter 1: Introduction to the Basics of Pathophysiology** introduces the readers to the basics of pathophysiology, including essential terminology, an overview of health and illness, the leading indicators of morbidity and mortality, and the importance of

evidence-based practice. It also provides an overview of the structure of the chapters and features. With the Human Genome Project ushering in an era of genomics and proteomics, healthcare providers require increased understanding of the molecular biologic aspects of disease. This includes not only genetics, (e.g., inherited single-gene disorders), but also genomics, which involves the interactions among many genes in the human genome and the influence of environment and lifestyle on gene expression.

- **Chapter 2: Genetics, Genomics, and Epigenomics** addresses new knowledge and technologies related to genomics being used in molecular diagnostic and predisposition testing, as well as ways to increase customization of preventive strategies and treatment regimens for people with different phenotypes of many acute and chronic conditions.
- **Chapter 3: Environmental Health Influences on Disease and Injury** covers environmental influences on disease and injury. This topic is essential to pathophysiology but is rarely included in textbooks. The impact of the environment on the development of disease in humans is enormous. This chapter covers everything from environmental hazard classifications to the impact of the environment on assessing patients to the pathophysiologic mechanisms underlying alterations caused by environmental hazards.
- **Chapter 4: Stress and Adaptation** is another topic that is underrepresented in other pathophysiology texts. The effects of stress on physical and mental health are a key component of human disease, and we cover it in detail.

Unit II: Risks Underlying the Leading Causes of Morbidity and Mortality

Unit II stresses one of the major themes of *Pathophysiology: Concepts of Human Disease*: health promotion and disease prevention. Each of the major risk categories underlying the leading causes of morbidity and mortality are covered in this unit. Again, most other pathophysiology texts devote little or no coverage to these important topics.

- **Chapter 5: Health Risks of Obesity and Physical Inactivity**
- **Chapter 6: Risks Related to Substance Use Disorders**
- **Chapter 7: Risks Related to Sleep Alterations**

Unit III: Fluid, Electrolyte, and Acid–Base Imbalances

Unit III covers the critical content of fluid and electrolyte balance and acid–base balance, both of which are key factors in maintaining health.

- **Chapter 8: Fluid and Electrolyte Imbalances**
- **Chapter 9: Acid–Base Imbalances**

Units IV: Cell Injury, Inflammation, and Alterations of Cell Growth and Regulation

Unit IV completes the foundational content by covering cell injury and aging, inflammation, and neoplasia.

- **Chapter 10: Mechanisms of Cell Injury and Aging**
- **Chapter 11: Inflammation**
- **Chapter 12: Neoplasia**

Units V through XIV

In Units V through XIV (Chapters 13 – 49), we cover the most prevalent disorders within each concept. We have endeavored to cover the essential “need to know” content and to keep “nice to know” material to a minimum in an effort to combat the content saturation students face. Each unit covers one or more concepts:

- **Unit V: Infection and Disorders of Immunity**
- **Unit VI: Disorders of Oxygenation**
- **Unit VII: Disorders of Perfusion**
- **Unit VIII: Disorders of Mood and Cognition**
- **Unit IX: Disorders of Sensory Perception and Thermoregulation**
- **Unit X: Disorders of Mobility**
- **Unit XI: Disorders of Endocrine Regulation**
- **Unit XII: Altered Tissue Integrity**
- **Unit XIII: Disorders of Digestion, Metabolism, and Elimination**
- **Unit XIV: Disorders of Sexuality and Reproduction**

Unit XV: Trauma and Multisystem Conditions

The last unit is unique to *Pathophysiology: Concepts of Human Disease*. Trauma is a major cause of morbidity and mortality, but it is not covered in most other pathophysiology texts. And our last chapter covers a phenomenon that every patient and every nurse will experience. It is an important topic that is often overlooked, but we have covered it in detail.

- **Chapter 50: Mechanisms of Traumatic Injury**
- **Chapter 51: The Pathophysiology of Primary and Secondary Traumatic Injury**
- **Chapter 52: Biologic, Chemical, and Radiologic Agents of Disease**
- **Chapter 53: Pathophysiology at the End of Life**

Unique Content

Pathophysiology: Concepts of Human Disease endeavors to cover all topics related to human disease and injury, including many that are rarely covered in pathophysiology textbooks. Our unique chapters include:

- **Chapter 3: Environmental Health Influences on Disease and Injury**
- **Chapter 6: Risks Related to Substance Use Disorders**
- **Chapter 7: Risks Related to Sleep Alterations**
- **Chapter 29: Emotional Regulation and Mood**
- **Chapter 30: Neurocognitive and Neurodevelopmental Disorders**
- **Chapter 50: Mechanisms of Traumatic Injury**
- **Chapter 51: The Pathophysiology of Primary and Secondary Traumatic Injury**
- **Chapter 52: Biologic, Chemical, and Radiologic Agents of Disease**
- **Chapter 53: Pathophysiology at the End of Life.**

In-Chapter Assessments

While developing this first edition of *Pathophysiology: Concepts of Human Disease*, the authors – who are experienced classroom teachers – wanted to build in many opportunities for students to assess their understanding of the material as they are reading the content. Therefore, every chapter includes the following sets of questions:

- **Check Your Progress:** Found at the end of each numbered section, these questions are designed to assess students’ understanding of the content.
- **Case Studies:** Each part of each case study ends with questions that cover the content in the section as well as the content of the case study.
- **Review Questions:** These are NCLEX-style questions found at the end of each chapter. They are written at the Understand, Apply, Analyze, and Evaluate levels of Bloom’s taxonomy.

Answers to the Check Your Progress and Case Study questions are in the instructor resources for the print book and are pop-ups in the student eText. Answers for the Review Questions are in Appendix A in the print book and are given, along with rationales, as the student answers the questions in the eText.

Chapter Guide

The chapters in **Pathophysiology: Concepts of Human Disease** have been developed in a consistent structure to facilitate learning. Readers will see the same basic format used throughout the book.

Each chapter starts with **Chapter Outline and Learning Outcomes**, a list of the numbered sections in the chapter along with the learning outcome for each.

Key Terms and **Abbreviations** come next. Each Key Term is included in the glossary at the end of the print book and is hyperlinked to its definition in the eText. The Abbreviations list contains the abbreviations specific to the topic that are used throughout the chapter.

Chapter 5 Health Risks of Obesity and Physical Inactivity

Jean Barry

Chapter Outline and Learning Outcomes

5.1 Chapter Overview and Case Studies

Outline the global prevalence of, medical conditions associated with, and concepts related to obesity and physical inactivity.

5.2 Etiology and Pathophysiology of Obesity

Describe the etiology of obesity and outline the pathophysiologic consequences, including chronic diseases and metabolic syndrome.

5.3 Health Risks of Obesity

Outline the health risks and functional outcomes associated with obesity.

5.4 Health Risks of Physical Inactivity

Discuss the role of physical inactivity/activity in the development and progression of chronic diseases and recommendations for physical activity.

KEY TERMS

Adipocytes, 12
Anorexic, 5
Body mass index (BMI), 11
C-reactive protein, 10
Epigenetics, 8
Exercise, 16
Hepatomegaly, 13
Hyperinsulinemia, 8
Insulin resistance, 8

Metabolic equivalent of task (MET), 17
Metabolic syndrome, 10
Monogenic, 7
Nonalcoholic fatty liver disease (NAFLD), 13
Nonalcoholic steatohepatitis, 13
Obesity, 3
Orexigenic, 5

Physical fitness, 16
Polygenic, 7
Polymorphisms, 7
Reactive oxygen species (ROS), 8
Satiety, 6
Steatohepatitis, 13
Steatosis, 13
Visceral adiposity, 8

ABBREVIATIONS

α -MSH— α -melanocyte stimulating hormone
AGE—advanced glycosylation end product
AGRP—agouti-related peptide
ARC—arcuate nucleus
BMI—body mass index
CART—cocaine and amphetamine-regulated transcript peptide

CCK—cholecystokinin
GLP-1—glucagon-like peptide-1
HDL—high-density lipoprotein
IL-6—interleukin 6
LDL—low-density lipoprotein
MC4R—melanocortin 4 receptor
NAFLD—nonalcoholic fatty liver disease

NPY—neuropeptide Y
POMC—pro-opiomelanocortin
ROS—reactive oxygen species
PYY—peptide YY
T2D—type 2 diabetes mellitus
TNF α —tumor necrosis factor alpha

5.1 Chapter Overview and Case Studies

One of the major challenges of the 21st century is the prevention and treatment of obesity. The World Health Organization (WHO) defines **obesity** as abnormal or excessive fat accumulation that may impair health.^{1,2} More than 33% of U.S. adults and 17% of U.S. children are obese.³ Obesity is a factor in the development of a number of medical conditions, including diabetes, cardiovascular disease (coronary artery disease, myocardial infarction, angina pectoris, heart failure, stroke, hypertension, and atrial fibrillation), metabolic syndrome, cancer, arthritis and disability, gallbladder disease, acute pancreatitis, nonalcoholic fatty liver disease, pulmonary complications, and

depression.⁴ One of the goals of *Healthy People 2020* is to promote good health through nutrition and maintenance of a healthy body weight.

There has been a dramatic increase in the prevalence of obesity in the United States over the last two decades. Prevalence estimates of obesity in 2014 by state ranged from 20 to 35%⁵ (Figure 5.1). The total excess cost related to the current prevalence of overweight and obesity among adolescents is estimated to be \$254 billion.⁶ This number includes \$208 billion in lost productivity secondary to premature morbidity and mortality and \$46 billion in direct medical costs.⁶ If current trends in the development of overweight and obesity continue, the total health-care costs related to obesity could reach \$861–\$957 billion by 2030; this would account for 16–18% of U.S. health expenditures.⁶

The first section in each chapter is **Chapter Overview and Case Studies**. Here the authors introduce the topic, explain the concepts related to each topic, and present the case studies that will be threaded throughout the chapter.

Check Your Progress: Section 5.1

1. How does the World Health Organization define the term *obesity*?
2. What are some of the major health problems associated with obesity?
3. What are the current trends in physical activity among U.S. adults and adolescents?

The main sections are double-numbered with a matching learning outcome. At the end of each section, there is a **Check Your Progress** box that features two or three open-ended questions about the content just presented.

Carrilyn Proust: Introduction



Carrilyn Proust, age 43, presents to her primary care provider's office complaining of a chronic, nonproductive cough and shortness of breath with even minor physical activities, such as climbing stairs. Ms. Proust was recently diagnosed with a viral upper respiratory tract infection, which was treated symptomatically. She suspects that her shortness of breath is secondary to her viral respiratory infection. She states that her primary concern is her chronic cough, which is preventing her from sleeping at night. She has been taking an over-the-counter cough suppressant, but she reports that this treatment is not effectively reducing her cough. She is afebrile and denies any recent history fever or chills. She reports that she has been "coughing so hard that sometimes blood comes up." Ms. Proust has a 20 pack-year history of cigarette smoking. She began smoking at age 21 and quit smoking at age 41. She denies allergies to any medications or foods. Her vital signs are within normal limits.

Carrilyn Proust: Application



Ms. Proust's primary care provider orders a chest x-ray, which reveals a mass in the lower lobe of Ms. Proust's right lung. For further evaluation, the primary care provider schedules Ms. Proust for a pulmonary computed tomography (CT) scan. In addition, a sputum sample is collected for analysis. Ms. Proust's sputum sample contains a moderate amount of blood. Ms. Proust's CT reveals an abnormal mass approximately 1 centimeter in diameter in the lower lobe of her right lung. Cytology of her sputum sample reveals suspected malignant cells. Ms. Proust is referred to an oncologist for further evaluation and treatment.

- On the basis of her gender, what type of lung cancer does Ms. Proust most likely have?
- What finding in Ms. Proust's history and physical examination suggests that Ms. Proust does not have small cell carcinoma?

Carrilyn Proust: Outcome



Ms. Proust's oncologist diagnoses her with stage 0 NSCLC—specifically, adenocarcinoma. Clinical staging reveals that the malignancy appears to be confined to the 1-cm mass in her right lower lung field. No lymph node involvement or metastasis is identified. Ms. Proust undergoes uncomplicated surgical excision of the tumor. Postoperative pathologic staging reveals no apparent lymph node involvement or cancer metastasis. However, because of Ms. Proust's smoking history and subsequent increased risk for cancer recurrence, radiation and chemotherapy are added to her treatment plan to help reduce her risk for cancer recurrence.

- Discuss the rationale for pathologic staging in Ms. Proust's treatment.
- Although Ms. Proust has a small tumor with no lymph node involvement or metastasis, explain the rationale for adding chemotherapy and radiation therapy to her surgical treatment.

Each **Case Study** appears multiple times in the chapter with an **Introduction**, one or more **Applications**, and an **Outcome** section. The patients featured in the case studies reflect the diversity of the population of the United States across all age groups.

Etiology and Pathogenesis

The primary cause of lung cancer is cigarette smoking, the result of the carcinogenic character of multiple chemicals in cigarette smoke. The chemicals bind and mutate DNA (see the feature on Genetics and Genomics for Clinical Practice).¹² There is a linear relationship between the intensity of smoking and the risk of lung cancer, as well as other cancers,

Clinical Manifestations

Most patients with lung cancer do not seek medical care until they are symptomatic. The most common symptom is a persistent cough with or without sputum production. Cough is not a specific symptom for lung cancer, and initially it is typically attributed to cigarette

Linking Pathophysiology to Diagnosis and Treatment

Diagnostic tests for lung cancer include chest x-ray, computed tomography (CT), sputum cytology, and directly sampling cells from the tumor or pleural fluid. An abnormal chest x-ray often triggers the diagnostic workup for lung cancer.

- CT scan of the thorax is done to identify tumors larger than 1 cm in diameter and to better visualize tumors

Each disorder that is covered has been chosen for its prevalence, i.e., the authors focused on the disorders that healthcare providers will see most often in clinical practice. For every disorder, the content is broken into three sections: **Etiology and Pathogenesis**, **Clinical Manifestations**, and **Linking Pathophysiology to Diagnosis and Treatment**.

Lifespan Considerations are highlighted with icons for children, pregnant women, and older adults.



Obesity in childhood and adolescence is a major public health problem associated with long-term complications. Obese children are likely to have risk factors for cardiovascular disease, such as hypertension, insulin resistance, and type 2 diabetes. Additionally, obese children are at risk for musculoskeletal problems.



Obesity during pregnancy is associated with increased maternal and fetal risks. Maternal complications include pregnancy-induced hypertension, gestational diabetes, respiratory complications, thromboembolism, preterm delivery, cesarean delivery, and preeclampsia. Fetal complications include congenital anomalies, macrosomia, and stillbirth.



In older adults, overweight and obesity are associated with higher levels of functional disability when compared with normal-weight individuals. Although obesity in older adults is associated with adverse outcomes described in this chapter, there is evidence that the risk of adverse outcomes

CHAPTER SUMMARY

19.1 Chapter Overview and Case Studies

Describe the primary considerations and concepts related to pulmonary vascular, neoplastic, and infectious respiratory disorders.

- Pulmonary disorders include alterations caused by neoplastic growths, infectious diseases, abscesses, and vascular disorders.
- Neoplastic growths may be malignant or benign.
- Malignant growths are composed of cancerous cells that are capable of metastasizing (spreading) from the site of origin to other body sites or invading local body sites and causing tissue destruction.
- Benign growths contain cells that are nonmalignant (noncancerous). Infectious diseases that serve as sources of pulmonary disorders include a variety of alterations that may affect either the upper respiratory tract, the lower respiratory tract, or both.
- Pulmonary vascular disorders include alterations of blood flow within the lungs or to or from the pulmonary circuit.

19.2 Malignant Lung Cancer

Differentiate the causes, classification, underlying pathogenesis, and clinical manifestations of malignant lung cancers and approaches to diagnosis and treatment of these conditions across the lifespan.

- Cigarette smoking is the primary risk factor for lung cancer. There is a 15- to 20-year delay between starting smoking and development of lung cancer.
- Other smoke exposures (cigars, pipes, passive exposure) and exposures to environmental and occupational carcinogens (radon or asbestos) also increase the risk for lung cancer.
- Genetic susceptibility, benign chronic lung disorders, and diet contribute to lung cancer risk.
- Histologically, carcinomas are classified as adenocarcinoma, squamous cell carcinoma, and large cell carcinomas (all three of which are considered non-small cell carcinomas) and small cell carcinoma.
- Adenocarcinoma and squamous carcinoma are classified as differentiated (well-differentiated) and undifferentiated (poorly differentiated) based on their histological features, but cell division is faster and more frequent in undifferentiated carcinomas.
- Adenocarcinomas are glandular in origin. They grow and metastasize early because of invasion of lymphatics.

- Squamous cell carcinomas usually originate in medial bronchial mucosa at bronchial bifurcations and metastasize to adjacent lymph nodes and lung tissue.
- Large cell carcinomas often present as big, bulky solitary tumors in the lung periphery.
- Small cell carcinomas are aggressive, highly malignant, and fast-growing tumors that metastasize early and widely.
- Symptoms initiating a diagnostic workup include obstructive pneumonia, dyspnea with a pleural effusion, hemoptysis, pain, hoarseness, or a paraneoplastic disorder.
- Initial lung cancer symptoms are often nonspecific with a persistent cough that is attributed to another cause.
- Diagnostic tools include sputum cytologic analysis, CT scan of the thorax, bronchoscopy, fine needle aspiration, thoracentesis, and mediastinoscopy.

19.3 Benign Lung Lesions

Differentiate the causes, classification, underlying pathogenesis, and clinical manifestations of benign lung lesions and approaches to diagnosis and treatment of these conditions across the lifespan.

- Pulmonary granulomas are formed to control an inhaled antigen that cannot be digested or in response to an autoimmune inflammatory process.
- Macrophages engulf the antigen, and helper T cells surround the macrophages, preventing a chronic inflammatory response.
- As macrophages die, the exposed antigen stimulates a further granulomatous inflammatory response.
- Tuberculosis is caused by the rod-shaped aerobic *M. tuberculosis* bacillus, which is protected by a waxy capsule. Transmission is primarily through inhalation of infected droplets by a susceptible person.
- *M. tuberculosis* can remain latent and in a state of dormancy for years; individuals with latent TB are not infectious.
- Active TB is symptomatic and communicable to other individuals.
- Reactivation of latent TB (secondary TB) occurs when

Chapters end with a **Chapter Summary** that gives a bulleted list of highlights for each numbered section/learning outcome.

Review Questions are NCLEX-style to give the students practice with the format.

Answers to Review Questions can be found in Appendix A. Answers to Check Your Progress and Case Study questions will be found online for the print book and will be pop-ups in the eText.

Recommended Websites and References round out the offerings.

20 Chapter 5 Health Risks of Obesity and Physical Inactivity

6. You are placed in charge of an intervention for the students of a local elementary school. You know that a key factor for change in children's association with food is to address:
 - a. the parents because they are all making incorrect food choices.
 - b. the food insecurity that these children experience because it affects their food choices.
 - c. the city parks and rec department because there are not enough state-of-the-art activities at the local YMCA.
 - d. None of the above, since you are just one person.
7. Mr. Xi is scheduled to undergo a Roux-en-Y gastric bypass. He wants to know what he should expect from the procedure. You explain that:
 - a. he will not be restricted in his diet post procedure.
 - b. he will be monitored for increased hepatic glucose production.

- c. he will have improved insulin sensitivity and thus improved beta-cell function.
 - d. he will need to use more diabetic medication because of the surgery.
8. A new nurse is teaching a class at the local YMCA. The students are older adults from the community. The nurse's topic is the importance of weight management as the individuals age. Understanding of this material is noted by a student who says:
 - a. "Weight gain will not affect my ability to care for myself."
 - b. "Weight loss will not help if I have joint pain."
 - c. "Weight gain will affect my ability to do simple tasks, such as turning in bed, by itself."
 - d. "Weight loss can increase my change of diabetes and its complications."

ANSWERS

Answers to Review Questions can be found in Appendix A. Answers to Case Study and Check Your Progress questions are available on the faculty resources site. Please consult with your instructor.

RECOMMENDED WEBSITES

Centers for Disease Control and Prevention: Childhood Overweight and Obesity
<https://www.cdc.gov/obesity/childhood/index.html>

Physical Activity Guidelines for Americans
<https://health.gov/paguidelines/guidelines>

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GLOSSARY

Acute bronchitis A very common, self-limited lower respiratory tract inflammation, often referred to as a "chest cold."

Bacillus Calmette-Guérin (BCG) Tuberculosis vaccine that is one of the most widely used vaccines throughout the world.

Benign In reference to a tumor, one that does not spread to, invade, and destroy surrounding tissue.

Blastomycosis A fungal infection caused by *Blastomyces dermatitidis*, an uncommon fungus that is found in Ohio, the Great Lakes region, and the Mississippi River valley; it is common in dogs in endemic areas but also occurs in horses, cows, and bats, and infections in animals can serve as an indicator of human disease.

Bronchiolitis A condition characterized by inflammation of the bronchioles.

Coccidioidomycosis A fungal infection caused by *Coccidioides immitis*, which is endemic in the soil in the southwestern United States but can also be found throughout the world; it grows best in bird feces, also known as San Joaquin Valley fever.

Hospital-acquired pneumonia (HAP) A classification of pneumonia in which the infection was not incubating at the time of hospital admission and develops 48 hours or more after hospital admission.

Influenza A highly contagious viral infection that sweeps through a geographic region as an epidemic that lasts 6–8 weeks during the winter months.

Pertussis A highly contagious respiratory infection usually caused by *Bordetella pertussis* that has been controlled in children through pertussis vaccination; also known as whooping cough.

Pneumonia An inflammation of the lung parenchyma that is typically characterized by lung consolidation with alveoli filled with exudate.

Pulmonary arterial hypertension (PAH) A primary disorder of increased blood pressure in the pulmonary arteries, characterized by an increased pulmonary arterial resistance in the absence of left ventricular failure or chronic thromboembolism.

Pulmonary embolism (PE) Occurs when a substance or object (e.g., blood clot, fat globule, air bubble, bone fragment, or foreign matter) is pumped from the right heart into progressively smaller pulmonary arteries until it wedges in a vessel that is too small for

At the end of the book, students will find a complete **Glossary**.

Chapter Features

To enhance the content offered within the usual structure, we have feature boxes throughout:

Healthy People 2020 features highlight the role of the Healthy People initiative and the topics and objectives for healthcare that it contains.

Healthy People 2020

Nutrition and Weight Status

The overall goal of the Nutrition and Weight Status objectives for *Healthy People 2020* is to promote health and reduce the risk of chronic disease through healthful diets and the achievement and maintenance of healthy body weights. In addition, these objectives emphasize that efforts to modify diet and weight should address individual behaviors along with the policies and environments that support these behaviors. Those objectives are broadly divided into the following categories: Health/Care and Worksite Settings, Weight Status, Food Insecurity, Food and Nutrient Consumption, and Iron Deficiency.¹ The primary objectives are as follows:

- Increase the number of states with nutrition standards for foods and beverages provided to preschool-aged children in child care.
- Increase the proportion of schools that offer nutritious foods and beverages outside of school meals.
- Increase the number of states that have state-level policies that incentivize food retail outlets to provide foods that are encouraged by the Dietary Guidelines for Americans.
- Increase the proportion of Americans who have access to a food retail outlet that sells a variety of foods that are encouraged by the Dietary Guidelines for Americans.

Healthcare and Worksite Settings

- Increase the proportion of primary care physicians who regularly measure the body mass index of their patients.
- Increase the proportion of physician office visits that include counseling or education related to nutrition or weight.
- Increase the proportion of worksites that offer nutrition or weight management classes or counseling.

Weight Status

- Increase the proportion of adults who are at a healthy weight.
- Reduce the proportion of adults who are obese.
- Reduce the proportion of children and adolescents who are considered obese.
- Prevent inappropriate weight gain in youth and adults.

Food Insecurity

Food insecurity is the inability to access sufficient safe, nutritious food that is needed to maintain a healthy and active life.²

- Eliminate very low food security among children.
- Reduce household food insecurity and in doing so reduce hunger.

Food and Nutrient Consumption

- Increase the contribution of fruits to the diets of the population aged 2 years and older.
- Increase the variety and contribution of vegetables to the diets of the population aged 2 years and older.
- Increase the contribution of whole grains to the diets of the population aged 2 years and older.
- Reduce consumption of calories from solid fats and added sugars in the population aged 2 years and older.
- Reduce consumption of saturated fat in the population aged 2 years and older.
- Reduce consumption of sodium in the population aged 2 years and older.
- Increase consumption of calcium in the population aged 2 years and older.

Iron Deficiency

- Reduce iron deficiency among young children and females of childbearing age.
- Reduce iron deficiency among pregnant females.

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2. World Health Organization. (2014). *Trade, foreign policy, diplomacy and health*. Available at <http://www.who.int/trade/glossary/story028/en>

Impact of Current Research on Clinical Practice

Treatment of Fatigue with a Central Nervous System Stimulant

Description: Fatigue and depression are common near the end of life and have a negative effect on the person's quality of life. In a double-blind investigation in which neither clinicians nor patients knew whether the patient received the investigational medication or placebo, 30 hospice patients in either inpatient or outpatient settings were randomized to receive treatment with either methylphenidate (Metadate, Ritalin), a mild central nervous system stimulant that increases the levels of norepinephrine and dopamine in the brain, or a placebo. The placebo was a tablet that looked identical to methylphenidate but contained starch instead of the medication. The research study nurse conducted the physical assessments and administered the symptom assessment scales. While all patients reported fatigue, no differences in severity scores were observed between the treatment and placebo groups at the beginning of the study.

Clinical Practice: A statistically significant decrease in the severity of fatigue was observed by day 14 in the group treated with methylphenidate. No improvement in fatigue was experienced by patients in the placebo group. Patients treated with methylphenidate who had clinically significant depression at the beginning of the study experienced improvement in depression based on three depression self-report scales; less improvement was noted in the placebo group. These results support the use of the central nervous system stimulant methylphenidate to improve the quality of life of patients experiencing fatigue or depression associated with terminal illness.

Research Study: Kerr, C., Drake, J., Milch, R., et al. (2012). Effects of methylphenidate on fatigue and depression: A randomized, double-blind, placebo-controlled trial. *Journal of Pain and Symptom Management*, 43(1), 68–77.

Impact of Current Research on Clinical Practice features show students how research is used clinically to highlight the importance of evidence-based practice.

Impact of Nutrition in Clinical Practice features highlight the importance of nutrition in health promotion, disease prevention, and nursing management of patients.

Impact of Nutrition in Clinical Practice

Nutrition at the End of Life

Joanne Kouba

At the end of life, the goal is for the patient to eat for pleasure and satisfaction. Dietary restrictions are eliminated, and patients are encouraged to eat and drink whatever foods and fluids appeal to them. Patients and family members must receive information about anorexia and cachexia as an expected consequence of end-stage disease. They should be informed that better care or increased effort to feed the patient will not reverse cachexia because the process of muscle protein degradation is not due just to decreased caloric intake and therefore does not respond to interventions such as supplemental nutrition or high-calorie foods. Enteral feedings via

gastrostomy or nasogastric tubes are limited to patients who state that they are hungry but do not have the mechanical ability to eat.

Artificial hydration and nutrition at the end of life is a subject of considerable controversy. The benefits must be weighed against the burdens of such treatment, including the associated risks of fluid overload, peripheral and pulmonary edema, electrolyte imbalances, infection, and aspiration into the lungs. A decrease in food and fluid intake is part of the normal process of dying; as death approaches, parenteral and enteral feeding does not improve symptoms or prolong life.

Genetics and Genomics for Clinical Practice

DNA Mutation in Lung Cancer

A variety of oncogenes (e.g., *MYC*, *KRAS*, *EGFR*, *c-MET*, and *ckIT*), deleted or mutated tumor suppressor genes such as *p53*, fusion genes such as *EML4-ALK*,¹² and activated signal transduction molecules have been associated with lung cancer. The pattern for specific genetic alterations varies with the type or subtype of lung cancer. For example, *KRAS* is most common genetic mutation in adenocarcinomas in women who smoke, while epidermal growth factor receptor gene (*EGFR*) occurs more commonly in adenocarcinomas in women who do not smoke and Asians; *p53* mutations occur most commonly in squamous cell carcinomas but also are present in small cell carcinomas.¹³ The *EML4-ALK* fusion gene in non-small cell lung cancer does not exist with *EGFR* or *KRAS* mutations, and its presence identifies a subset of individuals with non-small cell lung cancer that will respond to ALK-targeted agents but not

EGFR tyrosine kinase inhibitors.¹² The importance of this genetic research is that it will allow targeting of the specific sensitivities of a tumor with oncology medications that will interfere with tumor growth.^{12,13}

CLINICAL POINT: Cigarette smoking has been directly linked to DNA mutations by a specific metabolite of benzo(a)pyrene in cigarette smoke that damages three specific loci on the *p53* tumor suppressor gene. The *p53* tumor suppressor gene mutations are present in approximately 60% of all lung cancers. Cigarette smoke contains over 200 carcinogens that act as initiators (polycyclic aromatic hydrocarbons), promoters (phenol derivatives), and contaminants such as radioactive elements, arsenic, nickel, molds, and additives.■

Genetics and Genomics for Clinical Practice features demonstrate the foundational importance of genetics and genomics in the study of pathophysiology.

Visuals

All of the artwork in **Pathophysiology: Concepts of Human Disease** has been specifically created for this text. It is attractive, realistic, and accurate. Visual learners in particular will be delighted to see the detailed illustrations.

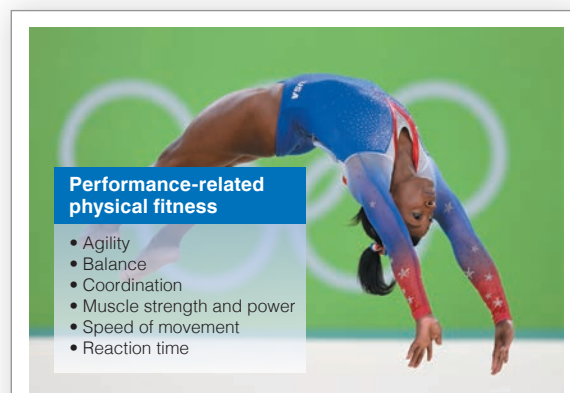
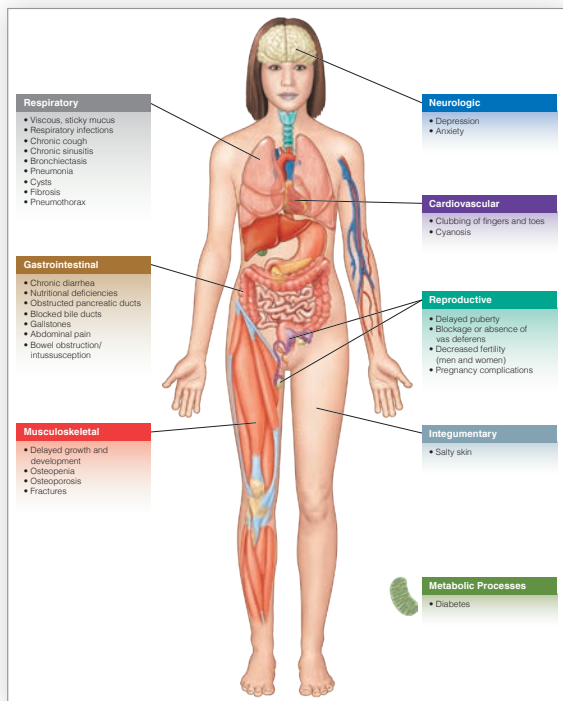
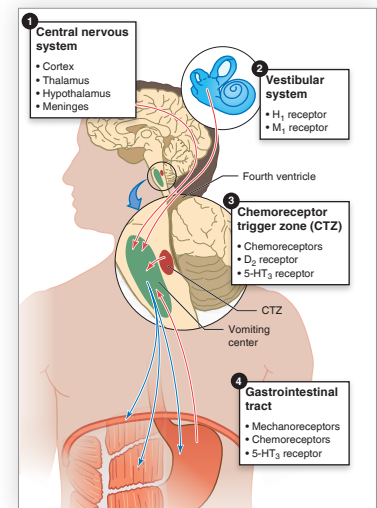
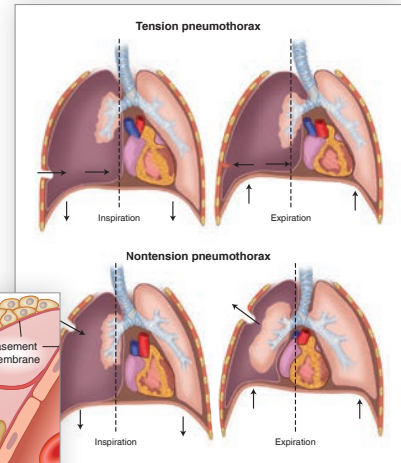
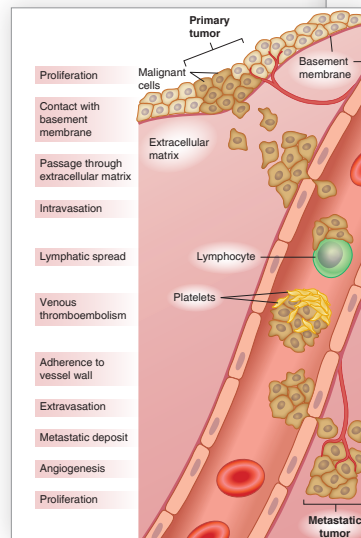
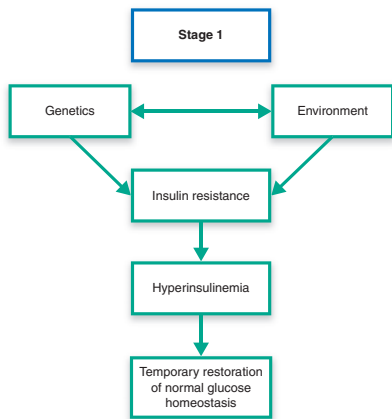
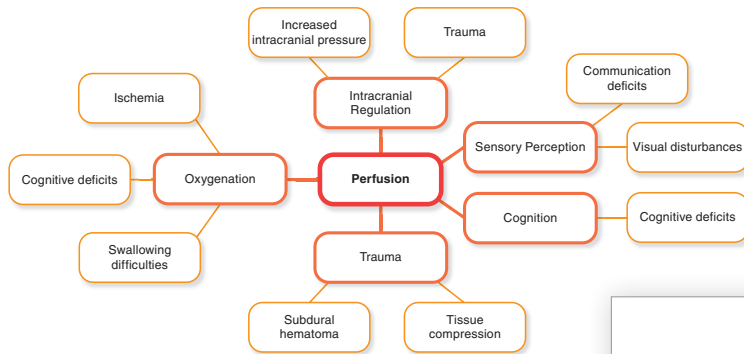


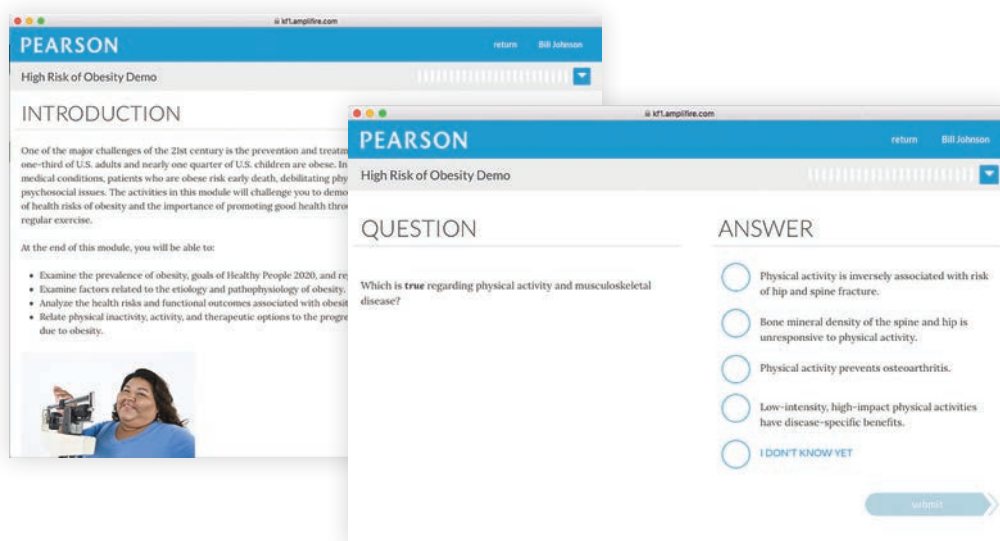
Figure 5.11 ■ The primary skill-related components of performance-related physical fitness are demonstrated by Simone Biles, who won four gold medals and one bronze medal in gymnastics in the 2016 Olympic Games in Rio de Janeiro.

MyLab Nursing

MyLab Nursing is an online learning and practice environment that works with the text to help students master key concepts, prepare for the NCLEX-RN exam, and develop clinical reasoning skills. Through a new mobile experience, students can study *Pathophysiology: Concepts of Human Disease* anytime, anywhere. New adaptive technology with remediation personalizes learning, moving students beyond memorization to true understanding and application of the content. MyLab Nursing contains the following features:

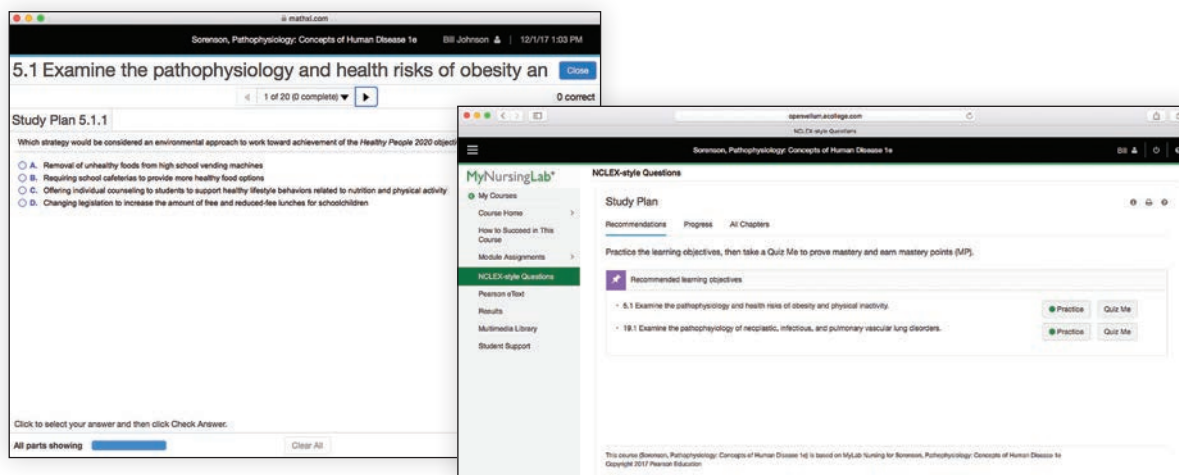
Dynamic Study Modules

New adaptive learning modules with remediation that personalize the learning experience by allowing students to increase both their confidence and their performance while being assessed in real time.



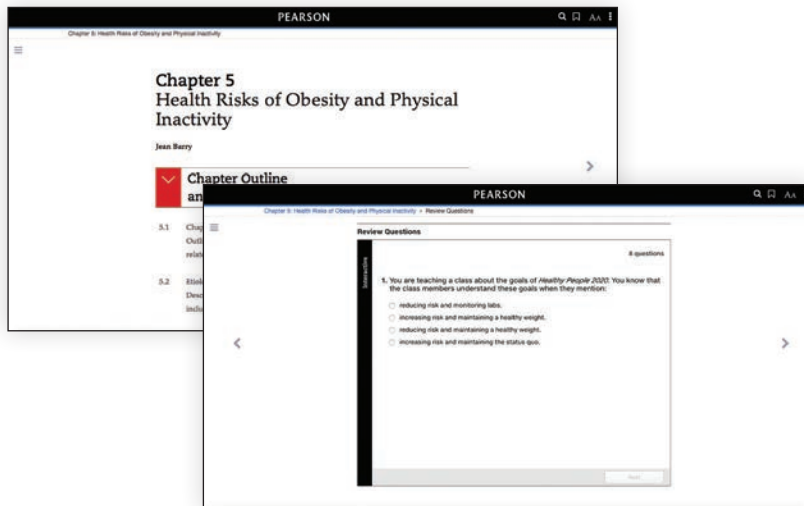
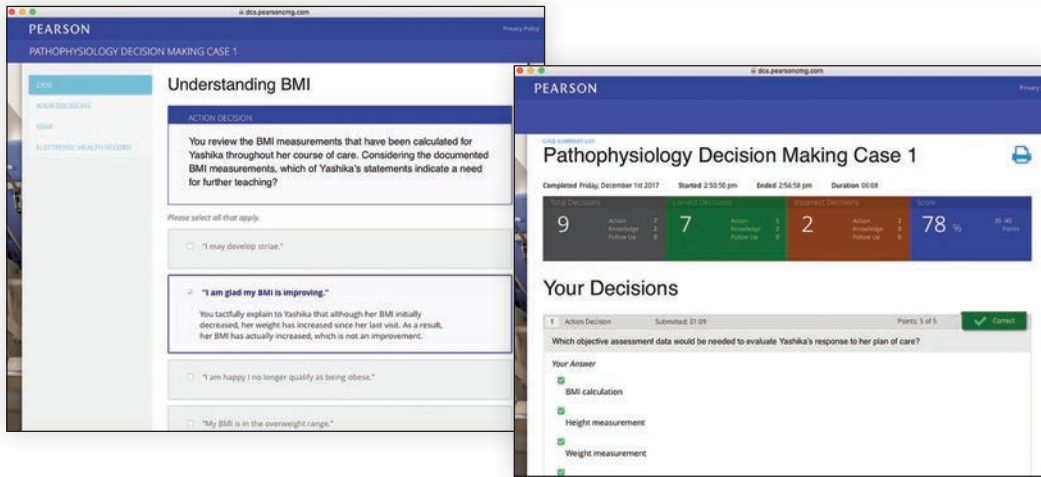
NCLEX-Style Questions

Practice tests with more than 1000 NCLEX-style questions of various types build student confidence and prepare them for success on the NCLEX-RN exam. Questions are organized by Chapter.



Decision Making Cases

Clinical case studies that provide opportunities for students to practice analyzing information and making important decisions at key moments in patient care scenarios. These 15 unfolding case studies are designed to help prepare students for clinical practice.



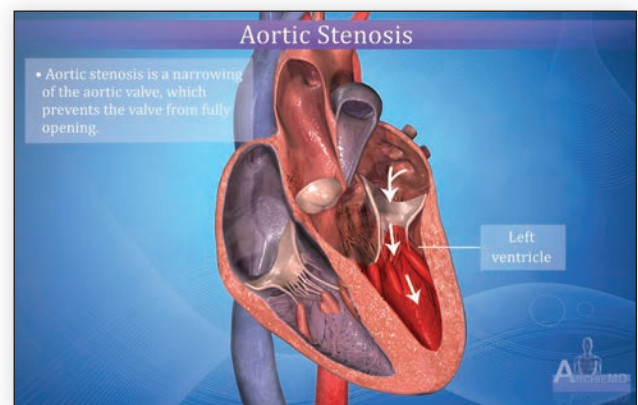
Pearson eText

Enhances student learning both in and outside the classroom. Students can take notes, highlight, and bookmark important content, or engage with interactive and rich media to achieve greater conceptual understanding of the text content. Interactive features include audio clips, pop-up definitions, figures, questions and answers, the nursing process, hotspots, and video animations. Some examples of video animations include:

- **Congenital Heart Defect Animations** illustrate the many congenital heart defects that may occur in new-borns and provide students the opportunity to see, hear, and understand how congenital heart defects impair the correct functioning of the heart and how they may be corrected.

Instructor Resources

Instructor Resource Manual
Lecture Note Power Points
Test bank



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Pathophysiology

Concepts of Human Disease

Unit I

Foundations of Pathophysiology

Chapter 1

Introduction to the Basics of Pathophysiology

Chapter 2

Genetics, Genomics, and Epigenomics

Chapter 3

Environmental Influences on Disease and Injury

Chapter 4

Stress, Adaptation, and Psychoneuroimmunology

Pathophysiology is the study of functional alterations at the molecular, cellular, tissue, and organ system levels that are involved in disease states, and also involves the study of the impact of alterations in one organ system on the function of others. Understanding these alterations is the basis for understanding the mechanisms that are responsible for clinical manifestations of disease, both those noted by the healthcare provider on physical assessment or through diagnostics, such as x-rays, and those that the patient reports to the provider.

Underneath all physiologic mechanisms, there are basic principles at play. Through understanding these basic principles, or concepts, a healthcare professional can apply that knowledge across different situations and disease states. For example, Down syndrome is a genetic disorder caused by trisomy of chromosome 21. It can result in miscarriage or in a live-born child with a combination of congenital birth defects, characteristic facial features, and variable degrees of mental impairment. The degree of impairment may be influenced by environmental variables, such as the mother's prenatal health and prenatal nutrition.^{1,2} Impairment may also be affected after birth by the family's ability to afford and access early intervention services, appropriate nutrition, and healthcare for the child. In other words, the quality of services and care available in the family's social environment will affect the child's long-term health and ability to interact with other people and function in his environment.

Stress and adaptation also play a role. The ability of the child's parents to respond to the stresses of having a child with Down syndrome will affect their own physical and mental health and that of all their children. The first and possibly the most important stressor for the family of a child with Down syndrome is the time of diagnosis, which can initiate a period of intense feelings of grief and loss.³ The degree of the child's impairment in turn affects the family environment and stress levels. In children with disabilities such as Down syndrome, co-occurring seizures, anxiety, irritability, and greater extent of disability in the affected child all have been linked to increased financial and employment strain on parents and caregivers.⁴ To close the circle, cultural variables, another aspect of social environment, also play a role. A family's understanding of why their child has Down syndrome may be culturally influenced.

Further, if a family receives poor treatment from healthcare providers who lack cultural competency, the family may be reluctant to continue return for further treatment.⁵

The chapters in this unit address key factors that inform pathophysiology and, in turn, inform the care of patients. Underlying pathophysiology of an illness can be influenced by any combination of individual and family behaviors and lifestyles (including cultural beliefs and preferences), physical and mental wellness states, genetic and epigenetic factors, environmental factors at both the individual and population levels, and the neurologic and physiologic mechanisms that regulate how—and how well—the individual reacts and adapts to stress.

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Social Environment Factors

- Financial resources
- Access to health and mental health services
- Community resources

Individual and Family Behaviors

- Substance use
- Abuse and neglect
- Parenting styles
- Communication styles
- Activity levels

Physical Environment Factors

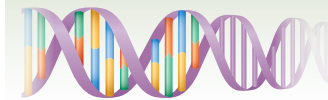
- Prenatal health of the mother
- Prenatal nutrition
- Newborn and early childhood nutrition and feeding practices
- Safe environment

Genetic and Epigenetic Factors

- Family history of physical or mental illness
- Susceptibility for genetic disorders

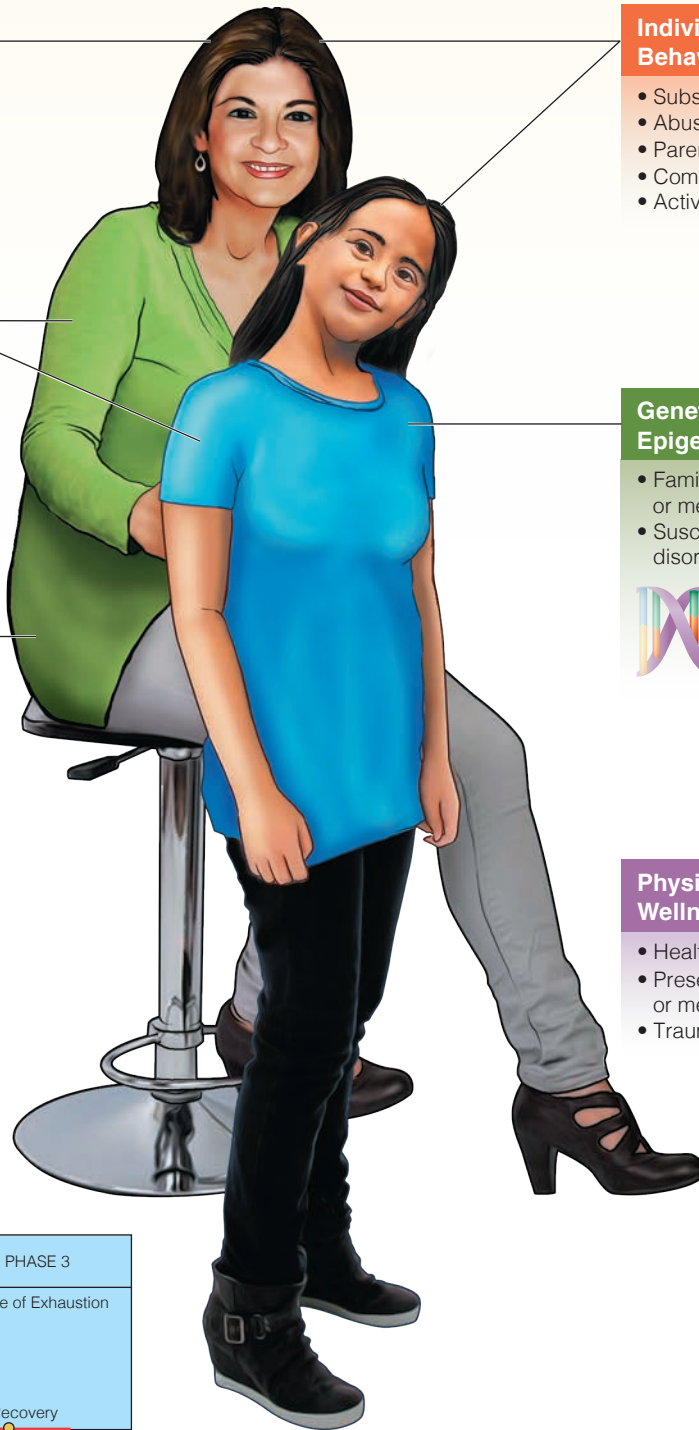
Stress and Adaptation

- Number and nature of stressors
- Response and adaptation
- Coping mechanisms and resources

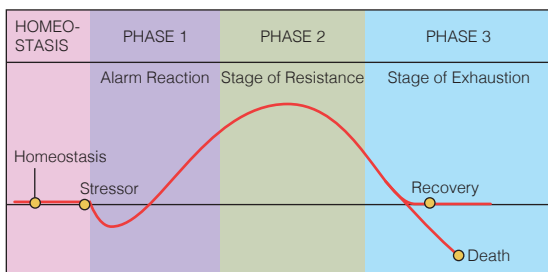


Physical and Mental Wellness

- Healthy behaviors
- Presence of chronic physical or mental illness in the home
- Trauma history



Stress Response Curve





Chapter 1

Introduction to the Basics of Pathophysiology

Matthew Sorenson, Laurie Quinn, and Diane Klein



Chapter Outline and Learning Outcomes

1.1 The Language of Pathophysiology

Define the conceptual basis for and the language used in the study of pathophysiology.

1.2 Overview of Health and Illness

Describe characteristics of risk factors associated with health and illness.

1.3 The Structure of Pathophysiology: Concepts of Human Disease

Outline the structure of this book/eText, including the pathogenesis and etiology of disease; the clinical

manifestations of disorders; how pathophysiology is linked to diagnosis and treatment; and the impact of genetics, nutrition, and lifespan on health and illness.

1.4 Leading Indicators of Morbidity and Mortality

Describe the study of epidemiology, and outline the leading indicators of morbidity and mortality in the United States.

1.5 The Importance of Evidence-based Practice

Explain the importance of evidence-based practice.

KEY TERMS

Clinical manifestations, 10

Disease, 8

Disorder, 8

Epidemiology, 14

Epigenomics, 11

Etiology, 10

Evidence-based practice (EBP), 17

Exacerbation, 11

Genetics, 11

Genomics, 11

Health, 8

Iatrogenic, 10

Idiopathic, 10

Illness, 8

Incidence, 14

Injury, 8

Ischemia, 7

Hypertension, 8

Modifiable risk factor, 9

Morbidity, 15

Mortality, 15

Nonmodifiable risk factor, 9

Pathogenesis, 10

Pathology, 5

Pathophysiology, 5

Prevalence, 14

Public health, 14

Remission, 11

Risk factor, 9

Sign, 10

Symptom, 10

Syndrome, 9

ABBREVIATIONS

CDC—Centers for Disease Control and Prevention

DALY—disability-adjusted life-year

EBP—evidence-based practice

IOM—Institute of Medicine

NIH—National Institutes of Health

WHO—World Health Organization

1.1 The Language of Pathophysiology

Essential Terminology

Pathophysiology is the study of functional alterations at the molecular, cellular, tissue, and organ system levels that are involved in disease states. Because many organ systems are interrelated, pathophysiology also involves the study of how alterations in one organ system can affect the function of others. Understanding these alterations is the basis for understanding the mechanisms responsible for clinical manifestations of disease noted on physical assessment or reported by the patient. In other words, pathophysiology is important in order to understand *why* alterations happen rather than just *what* happens.

Understanding pathophysiology requires knowledge of the principles of normal anatomy and physiology. These principles are briefly reviewed at the beginning of each relevant chapter. By understanding the normal physiology of the renal system, for example, it is possible to reason out at least some of the expected alterations in the individual as a result of impaired renal function, such as acute or chronic renal failure. The focus in this book is the concepts underlying the physiologic and pathophysiologic changes seen in association with disease.

Pathology is a medical discipline that focuses on structural alterations in tissues and organs and is closely related

to pathophysiology. This discipline involves the analysis of specimens, such as tissue, blood, urine, and sputum removed from patients for the purpose of aiding in the diagnosis of certain diseases and assessing their progression. Other scientific disciplines contribute to the process of understanding the pathogenic process of disease. Histology is a subdivision of pathology that studies the microscopic anatomy of cells and tissues either in the form of samples from a patient or grown outside the body in tissue culture. Specialized stains are used in histologic studies to identify various cell types, the organization of the cells, and intracellular contents as viewed with the aid of light or electron microscopy. These interrelated disciplines of pathophysiology, pathology, and histology are all important in understanding disease processes.

The Conceptual Basis of Pathophysiology

Underneath all physiologic mechanisms, there are basic principles at play. Through understanding these basic principles, or concepts, a healthcare professional can apply that knowledge across different situations and disease states.

For a listing of concepts featured in this book, see **Table 1.1**. Each primary concept has related subconcepts that reflect related biophysiologic processes. Examples of disease states that reflect the pathogenic concept are also provided.

Pharmacologic therapies and nursing interventions are based on the conceptual mechanisms that underlie a pathogenic process. For example, in the treatment of

Table 1.1 Biophysiologic Concepts

Biophysiologic Concepts	Subconcept	Examples of Diseases/Conditions Related to the Concept
Acid–base balance	Excretion	Metabolic acidosis/alkalosis Respiratory acidosis/alkalosis
Addiction	Dependence Loss of control Tolerance Withdrawal	Alcohol abuse or dependence Behavioral addiction (e.g., gambling, gaming, shopping) Opiate abuse or dependence
Cellular regulation	Cell differentiation Cell growth	Cellular aging Cellular injury Neoplasia Tissue and wound healing
Cognition	Behavior Judgment Memory	Dementia Delirium Depression and anxiety Thought disorders
Comfort	Acute pain Chronic pain	Headache Neuropathy
Elimination	Bowel and bladder function Hydration Nutrition	Acute kidney injury Bowel obstruction Ulcerative colitis Urinary incontinence
Energy balance	Environment Metabolism Nutrition Thermoregulation	Cachexia Fatigue Obesity Wasting syndrome
Environment	Culture Hydration Nutrition Society	Air pollution Lead poisoning Mercury poisoning Food-borne infections Lifestyle risk factors

(Continued)

Table 1.1 Biophysiologic Concepts *Continued*

Biophysiologic Concepts	Subconcept	Examples of Diseases/Conditions Related to the Concept
Fluid and electrolyte balance	Excretion Hydration Nutrition	Diabetes insipidus Hyponatremia/hyponatremia Hypokalemia/hyperkalemia Hypocalcemia/hypercalcemia
Hemostasis	Bleeding Coagulation	Pulmonary emboli Disseminated intravascular coagulation Thrombocytopenia
Immunity	Hypersensitivity Infection Inflammation	Autoimmune disorders HIV infection and AIDS Pneumonia Septic shock
Infection	Energy balance Hydration Infection control Nutrition Tissue integrity	Bacterial abscess Common cold Colitis Healthcare-associated infections Lower/upper respiratory infections Sepsis
Inflammation and oxidative stress	Coagulation Infection Tissue integrity	Asthma Inflammatory bowel disease Rheumatoid arthritis
Intracranial regulation	Cerebral autoregulation Fluid and electrolyte balance Trauma Ventilation	Cerebrovascular accident Hydrocephalus Seizure disorders Traumatic brain injury
Metabolism	Energy balance Hormonal regulation	Diabetes mellitus Metabolic syndrome Hypothyroidism Obesity
Mobility	Ambulation Balance	Spinal cord injury Stroke
Mood and affect	Coping Culture Emotion Social support Stress	Anxiety Depression Postpartum depression
Nutrition and digestion	Diet Malabsorption Fluid balance	Iron deficiency anemia Atherosclerosis Obesity Ulcers GI bleeding
Oxygenation	Hypoxia Ischemia Respiration Ventilation	Asthma Anemia Carbon monoxide poisoning Heart failure Acute respiratory distress syndrome Shock
Perfusion	Ischemia Vasoconstriction	Heart failure Atherosclerosis Thromboembolic disorders
Sensory perception	Hearing Smell Taste Touch Vision	Hearing loss Glaucoma Retinopathy Vision loss
Sexuality	Culture Gender Hormonal balance Sexual orientation	Erectile dysfunction Impotence Pelvic floor dysfunction
Reproduction	Sexuality	Infertility Female genitourinary issues Male genitourinary issues Sexually transmitted infections
Stress and coping	Appraisal Coping Stressor	Homeostasis/allostasis Allostatic load Acute stress disorder Posttraumatic stress disorder

Biophysiologic Concepts	Subconcept	Examples of Diseases/Conditions Related to the Concept
Tissue integrity	Thermoregulation Sensation Wounds	Pressure injury
Thermoregulation	Fever Hypothermia Hyperthermia	Fever Hypothermia Malignant hyperthermia Burns
Trauma	Consciousness Mobility Perfusion Sensation Oxygenation	Blunt trauma Penetrating trauma Burns

hypertension, one of the options is using a medication that decreases the strength with which the heart contracts. Calcium channel blockers stop the movement of calcium into cardiac tissue and thereby lessen the contractile force of the heart, lowering blood pressure.

Understanding the conceptual basis of pathogenesis then aids in understanding pharmacologic actions and nursing interventions. Turning a patient to help prevent pressure injuries is based on principles of blood flow and tissue ischemia. Developing that understanding provides the rationale for turning a patient on a schedule and highlights the importance of performing that basic nursing action. Two brief examples are provided to further demonstrate the importance of these biophysical concepts.

Example 1: Myocardial Ischemia and Infarction. Tissue integrity is a major concept explored in this text. A decrease in blood flow to tissue means that there is a decrease in the amount of oxygen and glucose to tissue. The decrease in oxygen can then result in death, or infarction, of the tissue. Decreases in glucose deprive cells of a major energy source and can disrupt cellular regulation. This decrease in oxygen and glucose is called **ischemia**. A related term is *hypoxia*, which refers to a lack of oxygen to tissue. This can occur from disruptions of the respiratory system.

The oxygen levels in the blood may stimulate constriction of blood vessels, decreasing the flow of blood. Such narrowing of blood vessels is seen in conditions of atherosclerosis, a condition in which the presence of lipids plays a major role. The immune system also plays a role in how quickly lipids accumulate and thus reduce the diameter of blood vessels.

Other illness states such as diabetes, an alteration in hormonal release with effects on metabolism, can influence the relative thickness or viscosity of blood, further slowing circulation. Therefore, pathophysiology is best viewed as a series of interrelated concepts that help to explain how a disease state affects health. In this situation, inflammation, oxygenation, perfusion, and metabolism are all involved in the pathogenesis of myocardial infarction in a patient with diabetes. See **Figure 1.1** for a diagram of the relationships between these concepts.

Example 2: Asthma. Oxygenation is the main concept associated with asthma. Asthma is a condition of reactive airway constriction. In other words, parts of the respiratory tract are sensitive to the presence of allergens. In

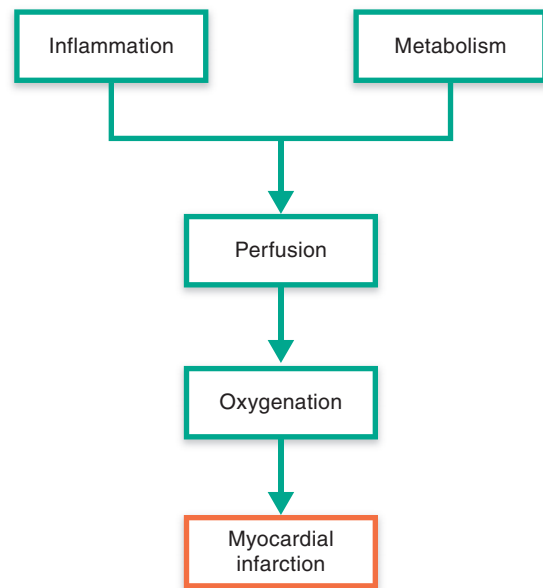


Figure 1.1 ■ Concepts related to the pathogenesis of myocardial infarction in an individual with diabetes.

the presence of an environmental allergen, such as cat hair, parts of the respiratory tract constrict, restricting the flow of air into the lung. The reduction in air flow leads to decreases in the concentration of oxygen in the bloodstream. The allergen stimulates the immune system, which releases inflammatory mediators. The resulting inflammation contributes to the reduction of airflow. Obesity, an alteration of metabolism, is a state of chronic inflammation that can worsen asthma. Obesity also can make it harder for an individual to breathe properly, owing to pressure on the lungs and the person's relative lack of fitness. There are nervous pathways that influence the constriction and dilation of the respiratory system. In this example, oxygenation reflects the concentration of oxygen but is under the influence of other concepts such as inflammation and immunity, along with other concepts such as metabolism (obesity) that can influence the degree of inflammation. See **Figure 1.2** for a diagram of the relationships between these concepts.

Case Studies

Case studies are used throughout this book/eText to help the reader apply the chapter content to clinical situations.

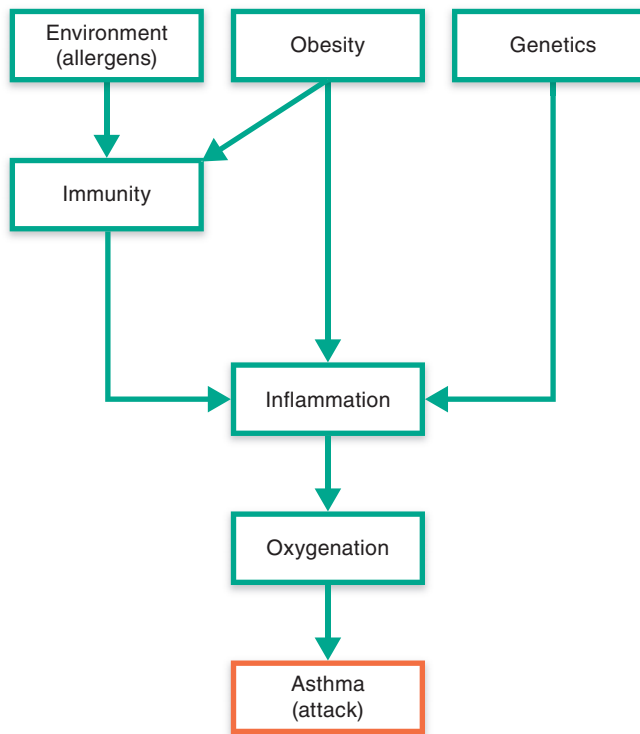


Figure 1.2 ■ Concepts related to an asthma attack.

Each case study focuses on one patient, who is followed throughout the chapter. Most chapters have two or three case studies. The following case study will be addressed throughout this chapter to introduce the reader to the format of the case studies used in the book.

Frank Smith: Introduction

Frank Smith, age 55, presents at the clinic with a chief complaint of headache with blurred vision over the past 3 hours. He describes his headache as bitemporal and throbbing. Lying down makes it worse. Mr. Smith's medical history includes hypertension, for which he was prescribed two medications. He states that he ran out of his medication 4 days ago and has not been able to afford the prescription. His blood pressure is 190/110, and he has a pulse of 68 with a strong character.



1. What characteristics of Mr. Smith's chief complaint support the idea that alterations in one system can affect the function of others?
2. What major biophysiologic concepts should the nurse focus on during the assessment of Mr. Smith?

Knowledge of pathophysiology is important for healthcare providers, including nurses, physicians, pharmacists, dietitians, and physical and occupational therapists. It provides a foundation for other courses, such as pharmacology and nutrition, as well as for clinical practice. Pathophysiology is the basis for understanding the current health status of patients and for early detection and appropriate intervention in response to changes in the clinical course. Pathophysiology is also used in teaching patients about

their conditions and about health promotion, risk reduction, and prevention of complications. One of the purposes of this chapter is to introduce the concepts of health and illness along with terminology used in describing disease progression along with the leading causes of morbidity and mortality. An additional concern that will emerge in later chapters is the concept of injury. **Injury** is damage caused to the body by an external force.

Check Your Progress: Section 1.1

1. How does the conceptual basis of pathophysiology help in the process of assessment and diagnosis?
2. What is the difference between pathophysiology and pathology?
3. How do nurses apply pathophysiology in daily practice?

1.2 Overview of Health and Illness

Characteristics of Health and Illness

Generally, the use of the word **health** refers to an absence of disease or functional changes that can result in disease. Health and illness are then terms best viewed as points along a continuum (**Figure 1.3** ■). Throughout life, the individual can be situated at different points along the continuum, moving back and forth between wellness and illness.

The terms *illness*, *disease*, and *condition* are often used almost interchangeably. Even in healthcare and nursing settings, the terms may be used as synonyms. However, there are some distinct differences to consider. The term **disease** can refer to a situation that is impairing functional ability in some way. For example, **hypertension** (a sustained elevation in blood pressure) is a disease with clear diagnostic criteria that can lead to a number of symptoms and complications.

The word **illness** is often used as a synonym for disease, but in healthcare, it is used to describe the individual experience that a person has with a disease. How each person responds to disease is different, and the subjective interpretation of the disease is influenced by the person's prior beliefs, knowledge, cultural factors, and overall state of health (**Figure 1.4** ■). For example, a healthy individual who catches a cold may feel miserable for a few days, but the disease will run its course, life will go back to normal, and the individual would not describe herself as "ill." On the other hand, if an individual with asthma catches a cold, it can exacerbate the asthma, may change the medication regimen, and could even require hospitalization. So, a patient with asthma who has a cold may feel quite ill.

If hypertension and the common cold are diseases that can result in illness, a different term is needed for the functional changes that can occur as a result of the disease. In healthcare, the term **disorder** is used to describe a disruption of physiologic or psychologic function. As an example,

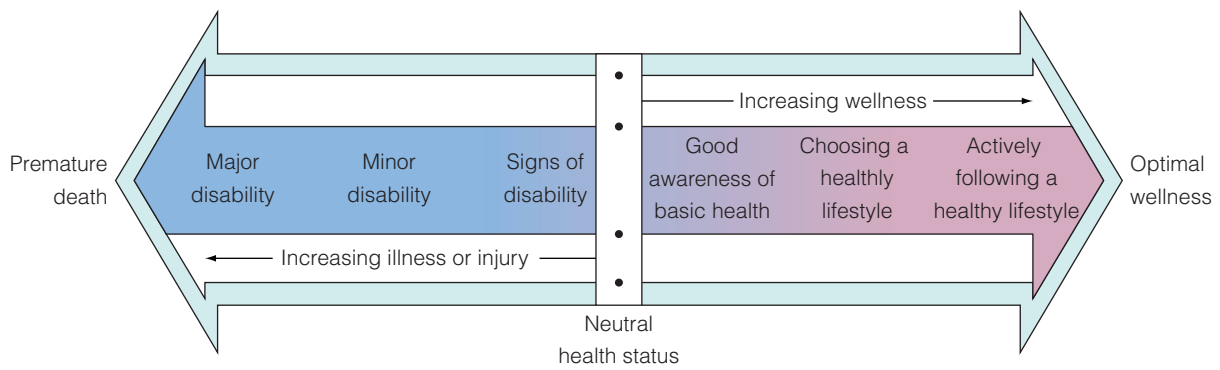


Figure 1.3 ■ An illness–wellness continuum.

several genetic variations can lead to disruptions of classes of immune cells. These disruptions can result in what is referred to as an immunoproliferative disorder. In other words, the continuing production or growth of certain cell types can lead to a loss of other cells or the release of immature cells. Leukemia is an example of such a disorder or disruption of normal cellular regulation.

The term **syndrome** usually refers to a group of signs and symptoms that emerge from a disease state. An example is acute coronary syndrome, which manifests as angina accompanied by changes in the electrophysiology of the heart resulting from a decrease in blood flow to the heart. This decrease in blood flow reduces the amount of oxygen that the heart receives, resulting in ischemia. With acute coronary syndrome, there are several potential causes, and different electrocardiogram abnormalities can be found.¹ Thus, a syndrome can have varying etiologic factors and some variation in diagnostic findings. The commonalities are in the cluster of signs and symptoms along with a shared underlying pathogenic mechanism.

Risk Factors

A **risk factor** is anything that puts a person at a greater risk for developing a particular disease. Risk factors emerge from a number of sources. One is the genetic blueprint provided to each of us at birth, and another is lifestyle factors. Lifestyle factors reflect decisions about diet, exercise, smoking and other variables that influence health. Another phrase that may be heard in healthcare courses is *social determinants of health*. Social determinants of health are factors related to where one lives, educational level, income, availability of fresh food, public transportation, and a number of other considerations that can affect health. These factors are often bound within society and are not as readily influenced as lifestyle risk factors.

Risk factors are traditionally classified as modifiable or nonmodifiable. A **modifiable risk factor** is one that the individual can change, such as diet or smoking. A **nonmodifiable risk factor** is one that cannot be altered, such as age, race, and genetic characteristics. The relationship between risk factors and disease is discussed in Section 1.3.

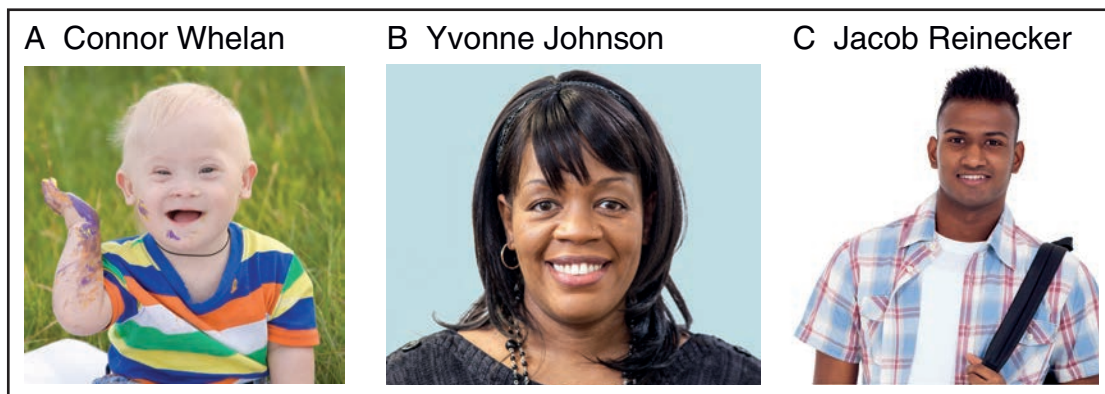


Figure 1.4 ■ **A.** Connor Whelan is an infant. He has Down syndrome and a congenital heart defect that will need to be corrected when he is 12 months old. **B.** Yvonne Johnson is a 35-year-old woman experiencing joint swelling, pain, and fatigue. The pain and fatigue are beginning to affect her ability to work. Her family physician has not been able to identify a cause. **C.** Jacob Reinecker is a 22-year-old college student who came to the emergency department after experiencing a sudden, stabbing pain in his chest with resulting shortness of breath. As you read the rest of this chapter, think about these questions: (1) Are these patients healthy or ill? (2) Are their conditions acute or chronic? (3) What risks factors does each patient have that might shed some light on the patient’s conditions?