SIMMERS
DHO
HEALTH SCIENCE

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Karen Simmers-Nartker
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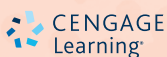
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UPDATED EIGHTH EDITION

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HEALTH SCIENCE

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CENGAGE
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Notice to the Reader

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Preface

Health Science, updated eighth edition, was written to provide the beginning student in health science education (HSE) with the basic entry-level knowledge and skills required for a variety of health care careers. Although each specific health care career requires specialized knowledge and skills, some knowledge and skills are applicable to many different health careers. In short, this book was developed to provide some of the core knowledge and skills that can be used in many different fields.

Health care is in a state of constant change. This change is reflected in the title of this textbook. Previously called *Diversified Health Occupations*, the title has been changed to reflect the fact that health care careers are based on science, or the knowledge and skills related to the natural or physical world. The scientific foundation presented in this textbook is required in over 200 different health care careers.

Organization of Text

Health Science, updated eighth edition, is divided into two main parts. Part 1 provides the student with the basic knowledge and skills required for many different health care careers. Part 2 introduces the student to basic entry-level skills required for some specific health care careers. Each part is subdivided into chapters.

Chapter Organization

Each chapter has a list of objectives and a list of key terms (with pronunciations for more difficult words). For each skill included in the text, both the knowledge necessary for the skill and the procedure to perform the skill are provided. By understanding the principles and the procedure, the student will develop a deeper understanding of why certain things are done and will be able to perform more competently. Procedures may vary slightly depending on the type of agency and on the kind of equipment and supplies used. By understanding the underlying principles, however, the student can adapt the procedure as necessary and still observe correct technique.

Information Sections (Textbook): The initial numbered sections for each topic in this text are information sections which provide the basic knowledge the student must acquire. These sections explain why the knowledge is important, the basic facts regarding the particular topic, and how this information is applied in various health care careers. Most information sections refer the student to the assignment sheets found in the student workbook.

Assignment Sheets (Workbook): After students have read the information in the initial section of a topic, they are instructed to go to the corresponding assignment sheet. The assignment sheets allow them to test their comprehension and to return to the information section to check their answers. This enables them to reinforce their understanding of the information presented prior to moving on to another information section.

Procedure Sections (Textbook): The procedure sections provide step-by-step instructions on how to perform specific procedures. The student follows the steps while practicing the procedures. Each procedure begins with a list of the necessary equipment and supplies. The terms *Note*, *Caution*, and *Checkpoint* may appear within the procedure. **Note** urges careful reading of the comments that follow. These comments usually stress points of knowledge or explain why certain techniques are used. **Caution** indicates that a safety factor is involved and that students should proceed carefully while doing the step in order to avoid injuring themselves or a patient. **Checkpoint** alerts students to ask the instructor to check their work at that point in the procedure. Checkpoints are usually located at a critical stage. Each procedure section refers the student to a specific evaluation sheet in the workbook.

Evaluation Sheets (Workbook): Each evaluation sheet contains a list of criteria on which the student's performance will be tested after they have mastered a particular

procedure. When a student feels he or she has mastered a particular procedure, he or she signs the evaluation sheet and gives it to the instructor. The instructor can grade the students' performance by using the listed criteria and checking each step against actual performance.

Because regulations vary from state to state regarding which procedures can be performed by a student in health science education, it is important to check the specific regulations for your state. A health care worker should never perform any procedure without checking legal responsibilities. In addition, a student should not perform a procedure unless the student has been properly taught the procedure and has been authorized to perform it.

Special Features

- The text material covers the *National Health Care Foundation Standards*, helping instructors implement the curriculum elements of this important document. An appendix provides a table showing the correlation of chapters in the book to the *National Health Care Foundation Standards*.

- Mandates of the Health Insurance Portability and Accountability Act (HIPAA) have been incorporated throughout the textbook to emphasize the student's responsibilities in regard to this act.

- Chapter objectives, included in every chapter, help focus the student on content discussed in the chapter.

- Internet search topics are at the end of each chapter to encourage the student to explore the Internet to obtain current information on the many aspects of health care.

- Review questions are at the end of each chapter to enable the student to test his or her knowledge of information provided in the chapter.

- Career information has been updated and is stressed throughout the textbook to provide current information on a wide variety of health care careers. Careers have been organized according to the National Health Science Career Clusters. Several new careers have been added.

- Additional emphasis has been placed on cultural diversity, technological advances, legal responsibilities, new federal legislation pertaining to health care providers, infection control standards, and safety.

- Various icons have been included throughout the textbook. These icons denote the integration of academics, such as math, science, and communication; occupational safety issues, such as standard precautions; federal requirements such as HIPAA, electronic health records (EHRs), and OBRA; and workplace readiness

issues such as career, legal, and technology information. The icons and their meaning are as follows:

- Observe Standard Precautions
- Instructor's Check—Call Instructor at This Point
- Safety—Proceed with Caution
- OBRA Requirement—Based on Federal Law for Nurse Assistants
- Math Skill
- Legal Responsibility
- Science Skill
- Career Information
- Communications Skill
- Technology
- Health Insurance Portability and Accountability Act
- Electronic Health Records

Enhanced Content New to the Updated Eighth Edition

- Vital, updated information on standard precautions, OBRA requirements, and transmission-based precautions have been included.

- Information on the Patient Protection and Affordable Care Act has been added.

- The information on viruses has been expanded to include new viruses that can become potential sources of epidemics and pandemics. New emphasis is placed on infection control methods to prevent epidemics and/or pandemics.

- A new section on biotechnologies discusses many of the sciences emerging in this field.

- The section on cardiopulmonary resuscitation has been revised to meet the American Heart Association's new 2015 standards for CPR for health care professionals.

- New nutritional guidelines from the U.S. Department of Agriculture have been incorporated into the nutrition chapter. Instructions are provided for using *My Plate* to plan a healthy diet.

- The chapter on computers and technology has been revised to reflect all of the technological changes occurring in health sciences.

Extensive Teaching and Learning Package

Health Science, updated eighth edition, has a complete and specially designed supplement package to enhance student learning and workplace preparation. It is also designed to assist instructors in planning and implementing their instructional programs for the most efficient use of time and resources. The package contains the following instructor and student support materials.

Health Science Teacher's Resource Kit

ISBN-13: 978-1-3055-0968-9
A complete guide to implementing a *Health Science* course. The kit explains how to apply content to applied academics and the *National Health Care Foundation Standards*. This kit is provided as a three-ring binder with convenient tabs to easily locate the resources needed for specific classroom support. It is also provided online via the instructor companion website that accompanies this textbook. It provides:

- Classroom Management Activities
- Lesson Plans
- Ready-to-Use Tests and Quizzes
- Classroom Activities
- Internet Activities
- Leadership Development Activities
- Applied Academics
- Clinical Rotations
- Resources
- Visual aids to reinforce learning in a visual format

Health Science, Updated Eighth Edition, Instructor's Manual

ISBN-13: 978-1-3055-0967-2
Provides easy-to-find answers to questions found in the *Student Workbook*. New to this edition, the *Instructor's Manual* now includes answers to the end-of-chapter review questions found in the textbook.

Health Science, Updated Eighth Edition, Student Workbook

ISBN-13: 978-1-3055-0965-8
This workbook, updated to reflect the *Health Science* updated eighth edition text, contains perforated,

performance-based assignment and evaluation sheets. The assignment sheets help students review what they have learned. The evaluation sheets provide criteria or standards for judging student performance for each procedure in the text.

Instructor Companion Website to Accompany *Health Science*, Updated Eighth Edition

A digital package for teachers provides a wealth of tools to support and manage the course. To access go to *login.cengage.com*. Register for a Faculty Account and search using the 13-digit ISBN for the core textbook to locate and access these resources.

Components include:

- Customizable Computerized Test Bank powered by Cognero® platform providing over 1,800 questions and answers directly tied to the textbook in multiple choice, true/false, matching, and short answer format. New to this edition, each question in the computerized test bank now includes correlation mapping information to the *National Healthcare Foundation and Skills Standards*.
- Teacher support slides created in PowerPoint® with over 900 slides supporting the text for use in classroom lectures.
- Electronic Instructor's Manual in PDF format providing electronic access to the printed *Health Science Instructor's Manual*.
- Multimedia animations narrating difficult-to-visualize anatomical and physiological processes, including "The Anatomy of a Cell," "The Process of Hearing," "Blood Flow Through the Heart," and much more.
- Electronic Teacher's Resource Kit in PDF format providing electronic access to the printed *Health Science Teacher's Resource Kit*.
- A comprehensive guide maps the textbook content to the *National Consortium for Health Science Education's National Healthcare Foundation Standards and Accountability Criteria*.

MindTap to accompany *Health Science*, Eighth Edition

ISBN-13: 978-1-3055-0954-2
The DHO MindTap engages diverse types of learners by elevating learning through interactivity and simulations, and allows navigation to program-specific content for an introductory survey course.

- The learning path allows flexibility to meet diverse classroom needs and learning styles.
- Chapter level simulations help students apply knowledge and elevate their level of learning.
- MindTap allows instructors to adapt the Table of Contents to their course, while a customizable Learning Path allows instructors to select desired chapter sections and activities.

DHO MindTap provides a unique learning path that combines trusted content with an elevated learning experience that cannot be found elsewhere.

Additional Student Resources

Audio podcasts of medical terminology and animations are available for download at *www.cengagebrain.com*. Search by author last name, book title, or 13-digit ISBN to access these bonus resources available with the textbook. Look for the Free Materials tab.

Video Resources Also Available
HEALTH CARE CAREER EXPLORATION
Learning Lab for Health Care Career Exploration

Instant Access Code, Institutional Purchase, for Your Learning Management System, for 1 year: ISBN-13: 978-1-13360-910-0

Instant Access Code for Your Learning Management System, for 1 year: ISBN-13: 978-1-13360-919-3

Printed Access Card for 1 Year: ISBN-13: 978-1-13360-856-1

Instant Access Code Student Purchase for 1 Year: ISBN-13: 978-1-13360-926-1

Instant Access Code Institutional Purchase for 1 Year: ISBN-13: 978-1-13360-927-8

The *Learning Lab for Health Care Career Exploration* is an online homework solution. The module-based, interactive learning environment provides teachers with a way to introduce health science students to the variety of health care career paths available to them. Using video simulations that follow a young, seriously injured patient from an accident scene through all aspects of required health care to home care, the student is exposed to 31 primary careers and various additional related careers. From the patient's point of view, the student watches video segments of each primary professional that offer a glimpse of the health care professional's role in the care of the young patient. Students are introduced to career paths that require various levels of education and training and offer a variety of salary ranges—careers that range from phlebotomist to occupational therapist to psychiatrist. Accompanying career profile screens offer interview

videos for each primary career and provide basic information such as duties and responsibilities, career attributes, and educational and certification requirements.

Health Care Career Exploration Interactive Classroom DVD

ISBN-13: 978-1-13376-560-8
The *Health Care Career Exploration Interactive Classroom DVD* contains similar content as the Learning Lab but is designed to help teachers facilitate in-class discussions and group work using a whiteboard or other computer technology.

Activity Manual to Accompany Health Care Career Exploration Interactive Classroom DVD

Written by Lara Skaggs, M.A.
ISBN-13: 978-1-28516-788-6
Available to support the DVD, this activity manual offers additional classroom tools to support each video segment, including:

- In-class worksheets help students follow along by answering questions based on the video content. The worksheets can be submitted to the instructor for grading or review.
- Assignment sheets can be used as homework assignments and require students to use their knowledge of health care and other resources, such as their textbook and/or Internet resources, to answer the questions.
- Capstone activities for each video segment provide more in-depth application-based activities such as essay writing, class presentations, and research projects.
- A related careers worksheet provides additional careers that relate to each video segment. The worksheets prompt students to identify and research a related career they are interested in learning more about.

Instructor Support Materials

Additional instructor support materials offer teaching tips and strategies for incorporating this material into the curriculum. Log onto *login.cengage.com* to access these resources.

CRITICAL THINKING FOR HEALTH CARE PROFESSIONALS
Critical Thinking for Health Care Professionals Interactive Classroom DVD

ISBN-13: 978-1-13328-333-1
Fifteen video-based interactive modules direct students to make decisions related to real-world dilemmas they may encounter on the job and to explore the positive and

negative outcomes of their selections. Beginning, intermediate, and advanced scenarios address safety, infection control, HIPAA, communication, ethics, and other topics common to all health care disciplines. Designed for instructor-led in-class discussions and group work using a whiteboard or other computer technology, this DVD allows the instructor to spark in-class discussions that prompt students to think critically about real world and potentially life-threatening health care issues in a safe learning environment.

Activity Manual to Accompany Critical Thinking for Health Care Professionals Interactive Classroom DVD

Written by Grant Iannelli, DC
ISBN-13: 978-1-28516-785-5
Available to support the DVD, the accompanying activity manual includes the following materials for each module:

- Pre-assessment questions
- Learning objectives
- Decision Point Actions: Students identify which action they chose and discuss why they made that choice. Each decision point has its own worksheet, so there may be 1 to 3 of these worksheets, depending on the level of the module.

- Module Discussion: Students answer two discussion questions about the module topic.
- What if?: Students create an alternate scenario using different information.
- Post-assessment questions

In addition, each module contains background resource material to augment students' knowledge of the topics.

Available Instructor Support Materials

Instructor support materials include the following resources for each module:

- Answer keys for the pre- and post-assessment questions
- A synopsis of each video module
- Instructional goals and teaching strategies
- Answer keys for all action questions and/or flow charts to illustrate the various learning paths a student may take based on decisions made at each action point.
- Impact summaries that illustrate the potential result of a decision made by the student when navigating through the video modules.

Log onto *login.cengage.com* to access these resources.

About the Authors

Louise Simmers received a Bachelor of Science degree in nursing from the University of Maryland and an MEd from Kent State University. She has worked as a public health nurse, medical-surgical nurse, charge nurse in a coronary intensive care unit, instructor of practical nursing, and health science education teacher and school-to-work coordinator at the Madison Comprehensive High School in Mansfield, Ohio. She is a member of the University of Maryland Nursing Alumni Association, Sigma Theta Tau, Phi Kappa Phi, National Education Association, and Association for Career and Technical Education (ACTE), and is a volunteer worker for the Red Cross. Mrs. Simmers received the Vocational Educator of the Year Award for Health Occupations in the State of Ohio and the Diversified Health Occupations Instructor of the Year Award for the State of Ohio. Mrs. Simmers is retired and lives with her husband in Venice, Florida. The author is pleased that her twin daughters are now assisting with the revisions of this textbook.

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Sharon Simmers-Kobelak graduated from Miami University, Ohio, with a Bachelor of Business Administration degree. She is currently employed in the educational publishing industry as an Integrated Solutions Specialist. In this position, she assists instructors at private career schools to find appropriate print and digital materials for classroom instruction. Sharon also provides in-service training for instructors on how to utilize digital assets and the instructor and student resources in the most productive manner. She achieved President's Club status for 2 years, number one representative status 1 year, and has repeatedly achieved quota in her 20 years in the educational publishing market.

How to Use This Textbook

Chapter Objectives

Review these goals before you begin reading a chapter to help you focus your study. Then, when you have completed the chapter, go back and review these goals to see if you have grasped the key points of the chapter.

16   **Vital Signs**

CHAPTER OBJECTIVES

After completing this chapter, you should be able to:

- List the five main vital signs.
- Convert Fahrenheit to Celsius, or vice versa.
- Read a clinical thermometer to the nearest two-tenths of a degree.
- Measure and record oral temperature accurately.
- Measure and record rectal temperature accurately.
- Measure and record axillary temperature accurately.
- Measure and record tympanic (aural) temperature accurately.
- Measure and record temporal temperature accurately.
- Measure and record radial pulse to an accuracy within ±2 beats per minute.
- Count and record respirations to an accuracy within ±1 respiration per minute.
- Measure and record apical pulse to an accuracy within ±2 beats per minute.
- Measure and record blood pressure to an accuracy within ±2 mm of actual reading.
- State the normal range for oral, axillary, and rectal temperature; pulse; respirations; and systolic and diastolic pressure.
- Define, pronounce, and spell all key terms.

Icons

Icons are used throughout the text to highlight specific pieces of information. An icon key is presented at the beginning of each part to reinforce the meaning of the icons.

The icons and their meanings are:

- Observe Standard Precautions
- Instructor's Check—Call Instructor at This Point
- Safety—Proceed with Caution
- OBRA Requirement—Based on Federal Law for Nurse Assistant
- Math Skill
- Legal Responsibility
- Science Skill
- Career Information
- Communications Skill
- Technology
- Health Insurance Portability and Accountability Act
- Electronic Health Records

Key Terms

KEY TERMS

apical pulse *(ape′ -ih-kal)*
apnea *(ap′ -nee″ -ah)*
arrhythmia *(ah-rith′ -me-ah)*
aural temperature
axillary temperature
blood pressure
bradycardia *(bray′ -dee-car′ -dee-ah)*
bradypnea *(brad″ -ip-nee′ -ah)*

character
Cheyne-Stokes *(chain′ -stokes″)*
clinical thermometers
cyanosis
diastolic *(die″ -ah-stall′ -ik)*
dyspnea *(dis(p)′ -nee″ -ah)*
electronic thermometers
fever

homeostasis *(home″ -ee-oh-stay′ -sis)*
hypertension
hyperthermia *(high-pur-therm′ -ee-ah)*
hypotension
hypothermia *(high-po-therm′ -ee-ah)*
oral temperature

Key terms highlight the critical vocabulary words you will need to learn. Pronunciations are also included for the harder-to-pronounce words. These terms are highlighted within the text where they are defined. You will also find most of these terms listed in the Glossary section. Use this listing as part of your study and review of critical terms.

TODAY'S RESEARCH TOMORROW'S HEALTH CARE | Memories Restored by Flipping a Switch?

Do you wish that you could forget the time you dropped a plate of spaghetti in your lap at a restaurant or that you could always remember the names of people you have met before? Wouldn't it be nice to be able to turn memories on and off with the flip of a switch? You could eliminate all of your bad memories and improve your good ones. Some day this may be possible.

Theodore Berger, a biomedical engineer at the University of Southern California, has figured out how to manipulate brain cells in rats so that they can be activated or suppressed. The study involved an area of the brain called the hippocampus, a region crucial for memory formation. The team inserted electrical probes in the hippocampus. They then taught rats to learn which of several levers had to be pressed to receive a reward. During the learning process, the researchers recorded changes in the brain activity of the rats between two major internal divisions of the hippocampus, sub-regions known as CA3 and CA1. Through research, they learned these sub-regions interact to convert short-term memory into long-term memory. They were also able to pinpoint the pattern of nerve-cell activity involved in creating a solid memory. The scientists then used the electrical probes to stimulate the nerves in the same pattern and found that the rats' performance improved and the rats could remember the correct lever for a longer period of time. In order to evaluate if memory could be suppressed, the researchers gave the rats a drug that blocked the nerve-cell activity and caused the rats to forget the task. A prosthetics (artificial devices) team then created an artificial system that duplicated the pattern of interaction between CA3 and CA1 in the hippocampus. When this system was inserted into the animals, and the brain cells were stimulated with the correct pattern, long-term memory returned. A final discovery was that when the prosthetic hippocampus with its electrodes was implanted in animals with normal function, the device strengthened the memory being created. Additional research is now being conducted with primates and more advanced tasks.

If research is successful, it might be possible to create a prosthetic that can be implanted in humans. This could help victims of Alzheimer's disease, stroke, or brain injury recover memory that has been lost and could improve mental function. In addition, if the prosthetic can be used to suppress memories, the device might be a method for treating individuals with post-traumatic stress disorder or other psychiatric conditions such as fears caused by a previous memory. Even though this research will require many more years of study due to the complex nature of memory in humans, if it is successful it will be a major breakthrough for many individuals.

Today's Research: Tomorrow's Health Care

Today's Research: Tomorrow's Health Care boxes are located in each chapter. These commentaries help you learn about the many different types of research occurring today. If the research is successful, it may lead to possible cures and/or better methods of treatment in the future for a wide range of diseases and disorders. These boxes of information also highlight the fact that health care changes constantly because of new ideas and technology.

Career Highlights

Career Highlights appear in the Special Health Care Skills chapters. By reading and understanding the material presented in these boxes, you will learn the educational requirements of each profession, potential places of employment, and additional tasks you may have to perform that are not specifically discussed within the chapter.

career highlights

Career

Medical, or clinical, laboratory personnel work under the supervision of doctors, usually pathologists. They are important members of the health care team. They perform laboratory tests on body tissues, fluids, and cells to aid in the detection, diagnosis, and treatment of disease. Levels of personnel are the technologist, technician, laboratory assistant, and phlebotomist. Clinical laboratory scientists (CLS) or medical technologists (MT) perform more complex tests and have a bachelor's or master's degree. Clinical laboratory technicians (CLT) or medical laboratory technicians (MLT) perform less complex tests and usually have an associate's degree. Medical laboratory assistants perform basic laboratory tests and usually have specialized health science education (HSE) training. Phlebotomists, or venipuncture technicians, collect blood and prepare it for testing. They usually have 1–2 years of on the job experience or specialized health science education (HSE) training. Some states require laboratory personnel to be licensed or registered. Certification can be obtained from the National Credentialing Agency for Laboratory Personnel (NCA), the American Society for Clinical Pathology (ASCP), or the American Medical Technologists Association (AMT), each of which has specific requirements.

Legal

Any medical laboratory or physician office laboratory (POL) that performs tests on human specimens is regulated by a federal amendment, the Clinical Laboratory Improvement Amendment (CLIA) of 1988. CLIA established standards, regulations, and performance requirements based on the complexity of a test and the risk factors associated with incorrect results. The purpose is to ensure quality laboratory testing. Levels of complexity include waived tests, moderately complex tests including provider performed microscopic procedures (PPMP), and highly complex tests. Each of these levels has different requirements for personnel and quality control. Laboratories are certified by the U.S. Department of Health and Human Services (USDHHS) based on these levels. In addition, only Food and Drug Administration (FDA)–approved equipment or self-contained kits may be used to perform waived tests. The FDA maintains an up-to-date listing of approved equipment and self-contained kits for waived tests at *www.fda.gov* in the search for *waived analytes* (substances whose chemical components are being identified and measured). Therefore, *medical laboratory assistants/medical assistants must follow all legal requirements before performing any laboratory test*. Some examples of waived tests, or tests that can be performed by assistants if the agency where they are working has a CLIA waiver certificate and if the equipment or self-contained test kits are FDA approved, include:

- Most urinary reagent strip (dipstick) or reagent tablet tests
- Hematocrit and spun microhematocrit
- Erythrocyte sedimentation rate (nonautomated)
- Hemoglobin: automated by single analyte instruments with self-contained components to perform specimen/reagent interaction and provide direct measurement and readout
- Blood glucose
- Ovulation and pregnancy tests by visual color comparison
- Fecal occult blood
- Cholesterol monitoring
- Rapid streptococcal identification
- Gastric occult blood
- Specific drug screening
- Specified automated blood chemistry analysis
- Triglyceride test

Related Health Careers

Note: A basic knowledge of human anatomy and physiology is essential for almost every health care provider. However, some health careers are related to specific body systems. As each body system is discussed, examples of related health careers are listed. The following health career categories require knowledge of the structure and function of the entire human body and will not be listed in specific body system units.

- Athletic Trainer
- Emergency Medical Careers
- Medical Laboratory Careers
- Medical Assistant
- Medical Illustrator
- Nursing Careers
- Pharmacy Careers
- Physician
- Physician Assistant
- Surgical Technologist

Specific careers for cells and components of body tissues include:

- Biochemist
- Biologist
- Cytologist
- Forensic Scientist
- Genetic Engineer

Related Health Careers

Related Health Careers appear in Chapter 7, *Anatomy and Physiology*, and in other chapters that contain information related to specific careers. By reviewing the information presented in these boxes, you will relate specific health careers to specific body systems or chapter content.

Information Sections

The initial numbered sections for each topic in this text are information sections which explain the basic facts of the topic, why you would need this information, and how the information is applied to various health care fields.

The information sections are designated using a numbering system that correlates to the chapter number.

11:1 Fundamentals of Nutrition

People enjoy food and like to discuss it. Most people know that there is an important relationship between food and good health. However, many people do not know which nutrients are needed or why they are necessary. They are not able to select proper foods in their daily diets in order to promote optimum health. Therefore, it is important for every health care worker to have a solid understanding of basic nutrition. With this understanding, the health care worker can both practice and promote good nutrition.

- **Osteoporosis**: condition in which bones become porous (full of tiny openings) and break easily; one cause is long-term deficiencies of calcium, magnesium, and vitamin D
- **Diabetes mellitus**: metabolic disease caused by an insufficient secretion or use of insulin, leading to an increased level of glucose (sugar) in the blood; heredity, obesity, lack of exercise, and diets high in carbohydrates and sugars contribute to individuals developing this disease

PROCEDURE 20:2C

Streaking an Agar Plate

Equipment and Supplies

Agar plate with correct medium, specimen for direct smear, label, pen or marker and or computer, incubator, disposable gloves, infectious-waste bag

Procedure

1. Assemble equipment.
2. Wash hands. Put on gloves.

   CAUTION: Observe standard precautions while handling any culture specimen.

   Precaution

3. Remove the applicator containing the culture specimen from its container. Hold it by the nonapplicator end. Take care to avoid contaminating the applicator tip. Look at the tip to be sure it is still moist.

   NOTE: If the specimen is dry, the organisms have probably died, and the results will not be accurate.

4. The agar plate is made up of two parts: the lower disk, which contains the agar, and the upper lid. Open the agar plate. Take care not to touch the inside of the plate. Invert the lid; that is, place the lid with the top against the counter. In this way, the inside of the lid faces up and stays clean.

   NOTE: The agar plate can also be placed upside down, with the agar on top. The agar plate should then be lifted. The lid will remain on the table, with the inside facing up.

5. Hold the plate firmly in one hand (Figure 20–11A) or place it on a flat surface.

6. Starting at the top of the agar, gently place the applicator tip in one corner. Using a rotary motion, turning the top of the tip so that all sides of the tip touch the agar, go from side to side approximately one-quarter of the way down the plate. To cover the second quadrant of the plate, turn the plate one-quarter turn and repeat the side-to-side motion of the applicator tip, crossing the first quadrant two to three times. Turn the plate one-quarter turn and use the same motion to cover the third quadrant. To cover the fourth quadrant, turn the plate one-quarter turn, and cross into the third quadrant one or two times. Note the sample streaking pattern in Figure 20–11B. This streaking method helps isolate the colonies of organisms in the fourth quadrant (Figure 20–11C).

   NOTE: This is only one type of streaking pattern. Use the streaking pattern preferred by your employer.

FIGURE 20–11A Hold the agar plate firmly in one hand while streaking it with the specimen.
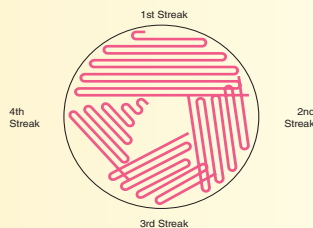
FIGURE 20–11B A sample streaking pattern.

   CAUTION: Be gentle. Do not break into the agar.

   Safety

   NOTE: An inoculating loop can also be used to streak the agar. After each quadrant is streaked, the loop is placed in a flame and cooled. Use the method the laboratory or physician prefers.

   NOTE: Cover the agar only one time in each area. Do *not* go back over areas already covered.

Procedure Sections

Procedure sections provide step-by-step instructions on how to perform the procedure outlined in the initial information section at the start of each topic. Practice these procedures until you perform them correctly and proficiently.

Full-Color Photos and Illustrations

Illustrations are presented in full color and demonstrate important health care concepts, including the inner workings of the body. Use these illustrations for review while studying.

Full-color photos are used throughout the text to illustrate important techniques you will be required to know and demonstrate when working within a health care field.
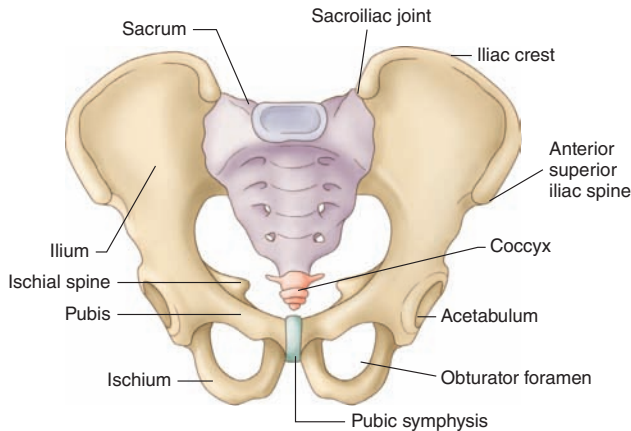
FIGURE 7–22 Anterior view of the pelvic girdle.

FIGURE 16–14B While taking a temperature, hold the probe of the electronic thermometer in place.

INTERNET SEARCHES

Use the search engines suggested in Chapter 12:9 in this text to search the Internet for additional information about the following topics:

1. **Cultural diversity:** Search words such as culture, ethnicity, and race to obtain additional information on characteristics and examples for each.
2. **Ethnic groups:** Search countries of origin for information on different ethic groups or on your own ethnic group; for example, if you are German–Irish, search for information on both Germany and Ireland.
3. **Cultural assimilation and acculturation:** Search for additional information on these two topics.
4. **Bias, prejudice, and stereotyping:** Use these key words to search for more detailed information.
5. **Family structure:** Search words such as extended or nuclear family, patriarchal, and/or matriarchal.
6. **Health care beliefs:** Search by country of origin for health care beliefs, or search words such as yin and yang or shaman.
7. **Alternative health care:** Search for additional information on chiropractor, homeopath, naturopath, hypnotist, hypnotherapy, meditation, biofeedback, acupuncture, acupressure, therapeutic touch, yoga, tai chi, and/or faith healing. (Refer to Table 1–8 in Chapter 1.)
8. **Spirituality and religion:** Search for additional information on spirituality; use the name of a religion to obtain more information about the beliefs and practices of the religion.

Internet Searches

Internet Searches can enhance your comprehension of the chapter information by offering you the chance to research information on the chapter topics.

Review Questions

Review Questions enhance your comprehension of chapter content. After you have completed the chapter reading, try to answer the review questions at the end of the chapter. If you find yourself unable to answer the questions, go back and review the chapter again.

REVIEW QUESTIONS

1. Differentiate between culture, ethnicity, and race.
2. Name five (5) common ethnic groups and at least two (2) countries of origin for each group.
3. Create examples of how a bias, prejudice, and stereotype may interfere with providing quality health care.
4. Describe your family structure. Is it a nuclear or extended family? Is it patriarchal or matriarchal or neither? Why?
5. Do you feel acculturation occurs in the United States? Why or why not?
6. Describe at least three (3) different health care practices that you have seen or heard about. Do you feel they are beneficial or harmful? Why?
7. Differentiate between spirituality and religion.
8. Why is it important for a health care worker to have an awareness of a patient's religious beliefs while caring for a patient who is dying?
9. You are preparing a patient for a surgical procedure and know that all jewelry must be removed. The patient is wearing a bracelet and states she is not allowed to remove it. What do you do?
10. List six (6) specific ways to respect cultural diversity.

Note: The cultural assessment questions presented in this unit were adapted from Joan Luckmann's *Transcultural Communication in Health Care* (2000), which adapted them from Fong's CONFHER model and Rosenbaum.

Supplements at a Glance

Supplement	What It Is	What's In It
Teacher's Resource Kit ISBN-13: 978-1-3055-0968-9	Three-Ring Binder Also available on Instructor Resources CD-ROM or Instructor Companion Website	Classroom Management Activities Lesson Plans Ready-to-Use Tests and Quizzes Classroom Activities Internet Activities Leadership Development Activities Applied Academics Clinical Rotations Resources Visual Aids
Instructor's Manual ISBN-13: 978-1-3055-0967-2	Print product Also available on Instructor Resources CD-ROM or Instructor Companion Website	Answers to Student Workbook Assignment Sheets New! Answers to end-of-chapter review questions
Workbook ISBN-13: 978-1-3055-0965-8	Print product	Assignment Sheets for student review Evaluation Sheets for judging student performance for each procedure in the textbook
Instructor Companion Website	Online instructor resources; Web access via *login.cengage.com*	Computerized test banks powered by Cognero® software Slide presentations in PowerPoint® Image Library Animations Standards mapping grid Electronic Instructor's Manual, and Teacher's Resource Kit
MindTap to Accompany DHO ISBN-13: 978-1-3055-0954-2	Accessed via a web code.	The learning path allows flexibility to meet diverse classroom needs and learning styles. Chapter level simulations help students apply knowledge and elevates their level of learning. MindTap allows instructors to adapt the Table of Contents to their course, while a customizable Learning Path allows instructors to select desired chapter sections and activities.
Student Online Companion	Free online student resources; Web access via *www.cengagebrain.com*. Look for the Free Materials tab.	Audio podcasts of medical terminology Animations of anatomical and physiological processes

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Hu-Friedy Manufacturing Company

Integra Miltex

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Iris Sample Processing Company

i-Stock

J.T. Posey Company

Kardex Systems

Kerr Corporation

McKesson Automation Solutions

Medical Indicators, Inc.

Medline Industries

Midmark Corporation

Miltex Instrument Company

National Archives, Brady Collection

National Cancer Institute

National Consortium for Health Science Education

National Eye Institute

National Hospice and Palliative Care Organization

National Institutes of Health

National Library of Medicine

National Multiple Sclerosis Society

National Pressure Ulcer Advisory Panel

National Uniform Claim Committee

NexTemp

Nonin Medical, Inc.

NPS Corporation

Omron Healthcare

Pfizer

Physicians' Record Company

Polara Studios

Poly-Medco

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Quinton Cardiology, Inc.

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SkillsUSA

Smead Manufacturing

Spacelabs Medical, Inc.

SPS Medical

Statlab Medical Products

STERIS Corporation

Ron Stram, MD

Sunrise Medical

Larry Torrey

Unico

UPI/Newscom

U.S. Administration on Aging

U.S. Army

U.S. Department of Agriculture

U.S. Postal Systems

Vertex-42

Victorian Adult Burns Service, Melbourne, Australia

W. A. Baum Company, Inc.

Wake Forest Institute for Regenerative Medicine, Dr. Atala

Winco

Zuma Press/Newscom

PART 1

Basic Health Care Concepts and Skills

Welcome to the world of health science education. You have chosen a career in a field that offers endless opportunities. If you learn and master the knowledge and skills required, you can find employment in any number of rewarding careers.

There will always be a need for workers in health care careers because such workers provide services that cannot be performed by a machine. Thus, although the future will bring changes, you will always be an important part of providing needed care or services.

The material that follows will give you a good start toward your career goal. As you learn to use the information presented in the following pages, always be willing to continue to learn and to grow. All material is presented in a manner to make learning as easy as possible. However, you must still make the effort to achieve the standards set and to perform to the best of your ability.

You will find this text different from previous texts that you have used. If you read the pages that begin each part, you will understand how to use this text. You will likely enjoy working with it because it will allow you to constantly see how much progress you are making. In addition, it is probably the only text you will have used that allows you to practice tests or evaluations before you actually take them.

One final word. You are entering a field that provides one of the greatest rewards: that of working to assist others. Although the work is hard at times, you will always have the satisfaction of knowing that you are helping other people. So be proud of yourself. When you learn the concepts and skills well, you will provide services that are appreciated by all.

Introduction

This part is divided into 18 chapters, each covering several topics designed to provide you with the basic knowledge and skills required for many different health careers. Before starting a chapter, read the objectives so you will know exactly what is expected of you. The objectives identify the competencies you should have mastered upon completing the chapter.

Health Science, updated 8th edition, has a textbook and a workbook. Each chapter in the textbook is subdivided into information sections about specific topics. At the end of most of these sections is a statement telling you to go to the workbook to complete an assignment sheet on the information covered. Some chapters also include Procedure sections, each of

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which refers you to an evaluation sheet in the workbook. Following are brief explanations of these main components:

1. *Information Sections (Textbook):* Each topic in the text begins with an information section to provide the basic knowledge you must acquire. These sections explain why the knowledge is important, the basic facts regarding the particular topic, and how this information is applied in various health care careers. Most information sections refer you to specific assignment sheets in the workbook. Some information sections provide the basic knowledge you need to perform a given procedure. These sections explain why things are done, give necessary facts, stress key points that should be observed, and, again, refer you to specific assignment sheets in the workbook.

2. *Assignment Sheets (Workbook):* The assignment sheets provide a review of the main facts and information presented in the textbook. After you have read the information in the text, try to answer the questions on the assignment sheet. Refer back to the text to see if your answers are correct. Let your instructor grade your completed assignment sheets. Note any changes or corrections. Be sure you understand the information before moving to another topic or performing the corresponding procedure.

3. *Procedure Sections (Textbook):* The Procedure sections provide step-by-step instructions on how to perform the procedures. Follow the steps while you practice the procedures. Each procedure begins with a list of the necessary equipment and supplies. On occasion, you will see any or all of the following three words in the procedure sections: **NOTE**, **CAUTION**, and **CHECKPOINT**. **NOTE** means to carefully read the comments following, which usually stress points of knowledge or explain why certain techniques are used. **CAUTION** means that a safety factor is involved and that you should proceed carefully while doing the step in order to avoid injuring yourself or the patient. **CHECKPOINT** means to ask your instructor to check you at that point in the procedure. Checkpoints are usually located at critical points in the procedures. Each procedure section refers you to a specific evaluation sheet in the workbook.

4. *Evaluation Sheets (Workbook):* Each evaluation sheet contains a list of criteria on which you will be tested when you have mastered a particular procedure. Make sure that your performance meets the standards set. When you feel you have mastered a particular procedure, sign the evaluation sheet and give it to your instructor. Your instructor will grade you by using the listed criteria and checking each step against your performance.

In addition to these components, you will also find a References list at the end of the textbook. For additional information about the topics discussed, refer to these references.

Finally, you will notice various icons throughout the textbook. Their purpose is to accentuate particular factors or denote specific types of knowledge. The icons and their meanings are:

Observe Standard Precautions

Instructor's Check—Call Instructor at This Point

Safety—Proceed with Caution

OBRA Requirement—Based on Federal Law for Nurse Assistant

Math Skill

Legal Responsibility

Science Skill

Career Information

Communications Skill

Technology

Health Insurance Portability and Accountability Act

Electronic Health Records

1

History and Trends of Health Care

CHAPTER OBJECTIVES

After completing this chapter, you should be able to:

- Differentiate between early beliefs about the causes of disease and treatment and current beliefs about disease and treatment.
- Identify at least 10 major events in the history of health care.
- Name at least six historical individuals and explain how each one helped to improve health care.
- Create a timeline showing what you believe are the 20 most important discoveries in health care and explain why you believe they are important.
- Identify at least five current trends or changes in health care.
- Define, pronounce, and spell all key terms.

KEY TERMS

alternative therapies

biotechnology

complementary therapies

cost containment

diagnostic related groups
   (DRGs)

energy conservation

geriatric care

holistic health care

home health care

integrative (integrated)
   health care

Omnibus Budget Reconciliation
   Act (OBRA)

outpatient services

pandemic

telemedicine

wellness

Note: *To further emphasize the Key Terms, they appear in color within the chapter. You will notice beginning in Chapter 3 on page 43 that pronunciations have been provided for the more difficult key terms. The single accent mark, _'_, shows where the main stress is placed when saying the word. The double accent, _"_, shows secondary stress (if present in the word).*

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1:1 History of Health Care

Why is it important to understand the history of health care? Would you believe that some of the treatment methods in use today were also used in ancient times? In the days before drug stores, people used many herbs and plants as both food and medicine. Many of these herbs remain in use today. A common example is a medication called *morphine*. Morphine is made from the poppy plant and is used to manage pain. As you review each period of history, think about how the discoveries made in that period have helped to improve the health care you receive today.

Ancient Times

Table 1–1 lists many of the historical events of health care in ancient times. In primitive times, the common belief was that disease and illness were caused by evil spirits and demons. Treatment was directed toward eliminating the evil spirits. As civilizations developed, changes occurred as people began to study the human body and make observations about how it functions.

Religion played an important role in health care. A common belief was that illness and disease were punishments from the gods. Religious rites and ceremonies were frequently used to eliminate evil spirits and restore health. Exploring the structure of the human body was limited because most religions did not allow dissection, or cutting the body apart. For this reason, animals were frequently dissected to learn about different body parts.

The ancient Egyptians were the first people to keep health records. It is important to remember that many people could not read; therefore, knowledge was limited to an educated few. Most of the records were inscribed on stone and were created by priests, who also acted as physicians.

The ancient Chinese strongly believed in the need to cure the spirit and nourish the entire body. This form of treatment remains important today, when holistic health methods stress treating the entire patient—mind, body, and soul. Chinese herbal medicine, acupuncture, and massage (Tui na) are still commonly used.

Hippocrates (ca. 460–377 BC), called the "Father of Medicine," was one of the most important physicians in ancient Greece (see the Biography box for more information about Hippocrates). The records that he and other physicians created helped establish that disease is caused by natural causes, not by supernatural spirits and demons. The ancient Greeks were also among the first to stress that a good diet and cleanliness help to prevent disease.

BIOGRAPHY

Hippocrates

Hippocrates (ca. 460–377 BC) was a Greek physician who is called the "Father of Medicine." He is best known for authoring a code of conduct for physicians, the "Hippocratic Oath." The oath began as a swearing to the healing gods to practice medicine following a strict code of ethics. Through the years, the oath has been modernized and no longer involves swearing to the gods. Most schools of medicine still use some form of the oath, and it is a rite of passage to practicing medicine in many countries.

The ancient Greeks thought that illness and disease were caused by the disfavor of the gods or evil spirits. Hippocrates' beliefs led medicine in a more accurate direction. He believed that illness and disease had rational and physical explanations.

Hippocrates stressed the importance of observation, diagnosis, and treatment. He was the first to accurately describe symptoms of pneumonia and epilepsy in children. He encouraged the use of a good diet, fresh air, cleanliness, and exercise to help the body heal itself.

Hippocrates founded a medical school in Cos, Greece, to teach his ideas about medicine. His students were held to a strict ethical code of behavior; this oath is the basis of medical practice today.

Image courtesy National Library of Medicine

The Rod of Asclepius (Figure 1–1A), the Greek symbol associated with medicine and healing, originated in ancient Greece. The caduceus symbol (Figure 1–1B) is often mistaken as the medical symbol, but it is actually the symbol for commerce. In Greek mythology, Asclepius was believed to be the son of Apollo and the

TABLE 1–1   History of Health Care in Ancient Times

| Historical Events of Health Care in Ancient Times	
4000 BC–3000 BC **Primitive Times**	People believed that illness and disease were caused by supernatural spirits and demons Tribal witch doctors treated illness with ceremonies to drive out evil spirits Herbs and plants were used as medicines, and some are still used today Trepanation or trephining (boring a hole in the skull) was used to treat insanity and epilepsy Average life span was 20 years
3000 BC–300 BC **Ancient Egyptians**	Earliest people known to maintain accurate health records Called on the gods to heal them when disease occurred Physicians were priests who studied medicine and surgery in temple medical schools Imhotep (2635–2595? BC) may have been the first physician Believed the body was a system of channels for air, tears, blood, urine, sperm, and feces If channels became "clogged," bloodletting or leeches were used to "open" them Used magic and medicinal plants to treat disease Average life span was 20 to 30 years
1700 BC–220 AD **Ancient Chinese**	Religious prohibitions against dissection resulted in inadequate knowledge of body structure Carefully monitored the pulse to determine the condition of the body Believed in the need to treat the whole body by curing the spirit and nourishing the body Recorded a pharmacopoeia (an official drug directory) of medications based mainly on the use of herbs Used acupuncture, or puncture of the skin by needles, to relieve pain and congestion Also used moxibustion (a treatment in which a powdered substance is placed on the skin and then burned to cause a blister) to treat disease Began the search for medical reasons for illness Average life span was 20 to 30 years
1200 BC–200 BC **Ancient Greeks**	Began modern medical science by observing the human body and effects of disease Biochemist Alcmaeon in 6th century BC identified the brain as the physiological site of the senses Hippocrates (460–377 BC), called the Father of Medicine: • Developed an organized method to observe the human body • Recorded signs and symptoms of many diseases • Created a high standard of ethics, the Oath of Hippocrates, used by physicians today Aristotle (384–322 BC) dissected animals and is called the founder of comparative anatomy Believed illness is a result of natural causes Used therapies such as massage, art therapy, and herbal treatment that are still used today Stressed diet and cleanliness as ways to prevent disease Average life span was 25 to 35 years
753 BC–410 AD **Ancient Romans**	First to organize medical care by providing care for injured soldiers Early hospitals developed when physicians cared for ill people in rooms in their homes Later hospitals were religious and charitable institutions housed in monasteries and convents Began public health and sanitation systems: • Created aqueducts to carry clean water to the cities • Built sewers to carry waste materials away from the cities • Used filtering systems in public baths to prevent disease • Drained marshes to reduce the incidence of malaria Claudius Galen (129–199? AD), a physician, established many medical beliefs: • Body regulated by four fluids or humors: blood, phlegm, black bile, and yellow bile • An imbalance in the humors resulted in illness • Described symptoms of inflammation and studied infectious diseases • Dissected animals and determined functions of muscles, kidney, and bladder Diet, exercise, and medications were used to treat disease Average life span was 25 to 35 years
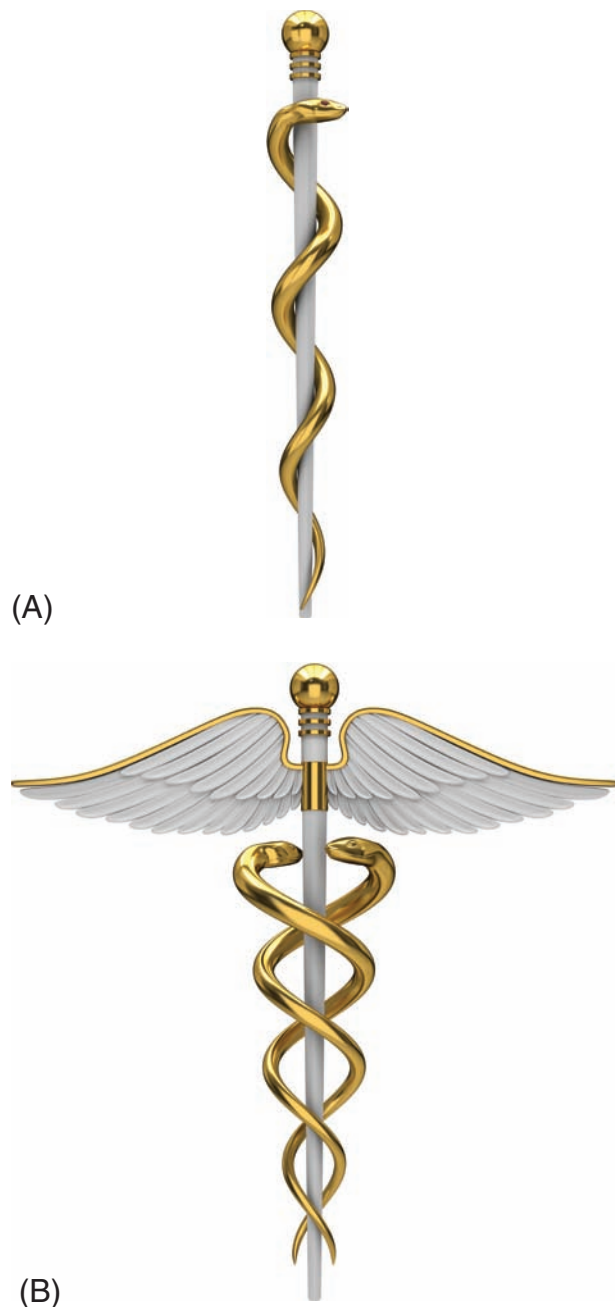
FIGURE 1–1 Symbols of medicine include (A) the Rod or Staff of Asclepius and (B) a caduceus. © Maximus256//Shutterstock.com

god of healing. The symbol consists of a staff entwined by a single serpent. There are many different schools of thought about the meaning of the symbol. Some believe that the staff is a symbol of authority and that the serpent's shedding of skin symbolizes rebirth and fertility. Others believe that the symbol comes from the ancient practice of removing parasitic worms from under the skin by slowly winding them around a stick. Different variations of both of these symbols are in use today. All contain the staff, but many have wings and either one or two serpents.

With knowledge obtained from the Greeks, the Romans realized that some diseases were connected to filth, contaminated water, and poor sanitation. They began to develop sanitary systems by building sewers to carry away waste and aqueducts (waterways) to deliver clean water. They drained swamps and marshes to reduce the incidence of malaria. They created laws to keep streets clean and eliminate garbage. The first hospitals were also established in ancient Rome when physicians began caring for injured soldiers or ill people in their homes.

Although many changes occurred in health care during ancient times, treatment was still limited. The average person had poor personal hygiene, drank contaminated water, and had unsanitary living conditions. Diseases such as typhoid, cholera, malaria, dysentery, leprosy, and smallpox infected many individuals. Because the causes of these diseases had not been discovered, the diseases were usually fatal. The average life span was 20 to 35 years. Today, individuals who die at this age are considered to be young people.

The Dark Ages and Middle Ages

Table 1–2 lists many of the historical events of health care during the Dark Ages and the Middle Ages. During the Dark Ages, after the fall of the Roman Empire, the study of medicine stopped. Individuals again lived in unsanitary conditions with little or no personal hygiene. Epidemics of smallpox, dysentery, typhus, and the plague were rampant. Monks and priests stressed prayer to treat illness and disease.

The Middle Ages brought a renewed interest in the medical practices of the Romans and Greeks. Monks obtained and translated the writings of the Greek and Roman physicians and recorded the knowledge in hand-written books. Medical universities were created in the 9th century to train physicians how to use this knowledge to treat illness. Later, the Arabs began requiring that physicians pass examinations and obtain licenses.

In the 1300s, a major epidemic of bubonic plague killed almost 75 percent of the population of Europe and Asia. Other diseases such as smallpox, diphtheria, tuberculosis, typhoid, and malaria killed many others. The average life span of 20 to 35 years was often reduced even further by the presence of these diseases. Many infants died shortly after birth. Many children did not live into adulthood. Today, most of these diseases are almost nonexistent because they are prevented by vaccines or treated by medications.

The Renaissance

Table 1–3 lists many of the historical events of health care that occurred between 1350 and 1650 AD, a period known as the Renaissance. This period is often referred to as the

TABLE 1–2 History of Health Care in the Dark Ages and the Middle Ages

Historical Events of Health Care in the Dark Ages and the Middle Ages	
400–800 AD **Dark Ages**	Emphasis was placed on saving the soul, and the study of medicine was prohibited Prayer and divine intervention were used to treat illness and disease Monks and priests provided custodial care for sick people Medications were mainly herbal mixtures Average life span was 20 to 30 years
800–1400 AD **Middle Ages**	Renewed interest in the medical practice of Greeks and Romans Physicians began to obtain knowledge at medical universities in the 9th century A pandemic (worldwide epidemic) of the bubonic plague (black death) killed three quarters of the population of Europe and Asia Major diseases were smallpox, diphtheria, tuberculosis, typhoid, the plague, and malaria Arab physicians used their knowledge of chemistry to advance pharmacology Rhazes (al-Razi), an Arab physician, became known as the Arab Hippocrates: • Based diagnoses on observations of the signs and symptoms of disease • Developed criteria for distinguishing between smallpox and measles in 910 AD • Suggested blood was the cause of many infectious diseases • Began the use of animal gut as suture material Arabs began requiring that physicians pass examinations and obtain licenses Avenzoar, a physician, described the parasite that causes scabies in the 12th century Average life span was 20 to 35 years

TABLE 1–3 History of Health Care in the Renaissance

Historical Events of Health Care in the Renaissance	
1350–1650 AD **Renaissance**	Rebirth of the science of medicine Dissection of the body began to allow a better understanding of anatomy and physiology Artists Michelangelo (1475–1564) and Leonardo da Vinci (1452–1519) used dissection to draw the human body more realistically First chairs (positions of authority) of medicine created at Oxford and Cambridge Universities in England in 1440 Development of the printing press allowed knowledge to be more easily spread to others First anatomy book was published by Andreas Vesalius (1514–1564) First book on dietetics written by Isaac Judaeus Michael Servetus (1511–1553): • Described the circulatory system in the lungs • Explained how digestion is a source of heat for the body Roger Bacon (1214?–1292?): • Promoted chemical remedies to treat disease • Researched optics and refraction (bending of light rays) Average life span was 30 to 40 years

"rebirth of the science of medicine." New information about the human body was discovered as a result of human dissection becoming accepted and allowed. Physicians could now view body organs and see the connections between different systems in the body. Artists, such as Michelangelo and Leonardo da Vinci, were able to draw the body accurately. In addition, the development of the printing press resulted in the publication of medical books that were used by students at medical universities. Knowledge spread more rapidly. Physicians became more educated.

The life span increased to an average age of 30 to 40 years during the Renaissance, but common infections still claimed many lives. At this point in time, the actual causes of disease were still a mystery.

TABLE 1–4 History of Health Care in the 16th, 17th, and 18th Centuries

Historical Events of Health Care in the 16th, 17th, and 18th Centuries	
16th and 17th Centuries	Causes of disease were still not known, and many people still died from infections and puerperal (childbirth) fever Ambroise Paré (1510–1590), a French surgeon, known as the Father of Modern Surgery: • Established the use of ligatures to bind (use of thread or suture to tie off) arteries and stop bleeding • Eliminated the use of boiling oil to cauterize (burning to remove or close off) wounds • Improved treatment of fractures • Promoted use of artificial limbs Gabriel Fallopius (1523–1562): • Identified the fallopian tubes in the female reproductive system • Described the tympanic membrane in the ear William Harvey (1578–1657) described the circulation of blood to and from the heart in 1628 Anton van Leeuwenhoek (1632–1723) built a microscope with increased magnification in 1666 First successful blood transfusion was performed on animals in England in 1667 Bartolomeo Eustachio identified the eustachian tube leading from the ear to the throat Scientific societies, such as the Royal Society of London, were established Apothecaries (early pharmacists) made, prescribed, and sold medications Average life span was 35 to 45 years
18th Century	Gabriel Fahrenheit (1686–1736) created the first mercury thermometer in 1714 Joseph Priestley (1733–1804) discovered the element oxygen in 1774 John Hunter (1728–1793), an English surgeon: • Established scientific surgical procedures • Introduced tube feeding in 1778 Benjamin Franklin (1706–1790) invented bifocals for glasses Dr. Jesse Bennett performed the first successful Cesarean section operation to deliver an infant in 1794 James Lind prescribed lime juice containing vitamin C to prevent scurvy in 1795 Edward Jenner (1749–1823) developed a vaccination for smallpox in 1796 Average life span was 40 to 50 years

The 16th, 17th, and 18th Centuries

Table 1–4 lists many of the historical events of health care that occurred during the 16th, 17th, and 18th centuries. During this period, physicians gained an increased knowledge of the human body. William Harvey described the circulation of blood. Gabriel Fallopius described the tympanic membrane in the ear and the fallopian tubes in the female reproductive system. Bartolomeo Eustachio identified the tube between the ear and throat. These discoveries allowed other physicians to see how the body functioned.

A major development occurred after Anton van Leeuwenhoek built a microscope that increased magnification ability and produced clear and bright images (see the Biography box for more information about Anton van Leeuwenhoek). This instrument allowed physicians to see organisms that are too small to be seen by the human eye. Even though they were not aware of it at the time, physicians were looking at many of the pathogenic organisms (germs) that cause disease. The microscope continues to be a major diagnostic tool.

This period also saw the start of drug stores, or pharmacies. Apothecaries (early pharmacists) made, prescribed, and sold medications. Many of these medications were made from plants and herbs similar to those used in ancient times. At the end of the 18th century, Edward Jenner developed a vaccine to prevent smallpox, a deadly disease.

During this time, the average life span increased to 40 to 50 years. However, the causes of many diseases were still unknown, and medical care remained limited.

The 19th Century

Table 1–5 lists many of the historical events of health care that occurred during the 19th century, a period also known as the Industrial Revolution. Major progress in medical science occurred because of the development of machines and the wide availability of books.

Early in the century, René Laënnec invented the stethoscope (see the Biography box for more information about René Laënnec). This invention allowed physicians to listen to internal body sounds, which increased their knowledge of the human body.