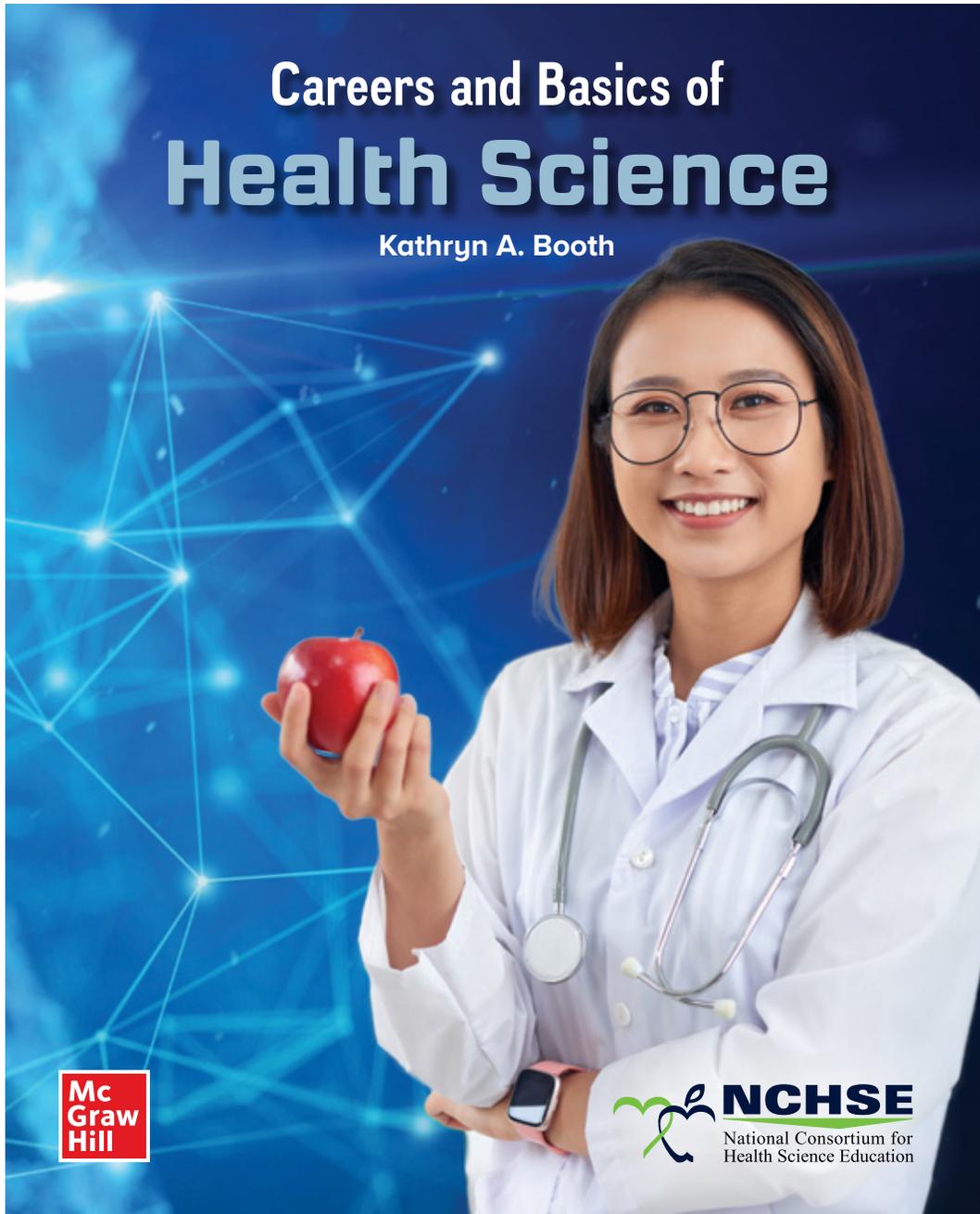


Careers and Basics of Health Science

Kathryn A. Booth



Kathryn A. Booth, RN-BSN, RMA (AMT), RPT, CPhT, MS

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UNIT

1

Chapter 1

Healthcare Career Clusters

Chapter 2

Healthcare Systems

Chapter 3

Safety and Infection Control Practices

Chapter 4

Emergency Preparedness

Chapter 5

Medical Terminology

Chapter 6

Human Structure and Function

Chapter 7

Diseases and Disorders

Chapter 8

Human Growth and Development

Chapter 9

Nutrition

Chapter 10

Vital Signs

Chapter 11

Pharmacology and Medical Mathematics

Chapter 12

Legal and Ethical Responsibilities

Chapter 13

Communication and Employability Skills

Healthcare Foundations



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Chapter 1

Healthcare Career Cluster



Essential Question

As you read this chapter, keep this question in mind:

How will you determine which area of healthcare to pursue in your career?

Welcome! You are about to embark on an exciting adventure into the healthcare profession. The chapters of this book will introduce you to a variety of health careers. Some health careers are stepping stones to other careers in healthcare. Because the healthcare field is growing so rapidly, there may even be health careers in your future that do not currently exist! Health career opportunities are many. There are more than 300 career possibilities waiting for you! This course can help you decide whether the healthcare field is right for you. It can also help you choose the right health career.



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Reading Guide

Objectives

After completing this chapter, you will be able to:

- **Discuss** the importance of the National Healthcare Skill Standards.
- **Identify** two reasons for maintaining standards for the healthcare industry.
- **Explain** the five career pathways in healthcare employment.
- **Identify** opportunities for employment and entrepreneurship in the healthcare field.
- **Carry** out a career assessment.
- **Summarize** the importance of professional students organizations and outline how meetings should be conducted.



Before you Read

Connect: Do you know what career options you have in the healthcare industry?

Main Idea

The five career pathways in healthcare are therapeutic services, diagnostic services, health informatics, support services, and biotechnology research and development.

Note-Taking Activity

Draw this table. Write key terms and phrase under Cues. Write main ideas under Note Taking. Summarize the section under Summary.

Cues ◦ ◦	Note Taking ◦ ◦
Summary	

Graphic Organizer

Before you read the chapter, draw a diagram like the one below. As you read, write the main opportunities covered in the chapter into the diagram.



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National Healthcare Skill Standards

How do I enter the field of healthcare?

The **National Consortium for Health Science Education** has set forth National Standards that identify the knowledge and skills that a healthcare worker needs if they are to deliver quality healthcare. This framework of **standards** guides educators as they work to produce quality entry-level healthcare professionals. In Table 1.1, you will see a list of the healthcare skill **foundation** standards. This table shows the basic knowledge and skills you must attain in order to enter the field of healthcare. If you know the standards, you will be better prepared for the job, and your chances for advancement will increase. When you and your coworkers are familiar with the standards, you will have clear goals and will become more valuable as healthcare employees.

All members of a healthcare system need to be in agreement regarding the quality of patient care. When each member of the healthcare team follows a set of high standards, the care given to the patient is of the highest quality. We will look at each of the standards, their importance, and what they mean to your employment in the field of healthcare.

Academic Foundation

A strong academic foundation is vital to any type of career. As a healthcare professional, you will need to know about human structure, body systems and functions, diseases and disorders, and medical mathematics. Basic knowledge of these topics will help you learn to perform healthcare tasks.

Communication

Communication, whether it is reading, writing, speaking, or listening, is a part of life as well as a part of patient care. As a healthcare professional, you must be able to interact with, and relate to, the patient and other healthcare team members. For example, you may need to read a patient's chart, record information, educate a patient, or listen to your supervisor's instructions. Or you may need to spend time listening to your patients and determining their needs.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- National Consortium for Health Science Education
- standards
- therapeutic services
- diagnostic services
- health informatics
- support services
- biotechnology

Academic Vocabulary

You will see these words in your reading and on your tests. Find their meanings in the Glossary in the back of the book.

- foundation
- communication
- ethics
- technology

Table 1.1 Healthcare Skill Standards

National Healthcare Skill Standard	Interpretation
Academic foundation	Healthcare professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. These include: human structure and function, diseases and disorders, and medical mathematics.
Communication	Healthcare professionals will know the various methods of giving and obtaining information. They will communicate effectively, both orally and in writing, and have knowledge of medical terminology.
Systems	Healthcare professionals will understand how their roles fit into their departments, their organizations, and the overall healthcare environment. They will be able to identify how healthcare delivery systems affect the services they perform and quality of care they provide.
Employability skills	Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate personal traits and behaviors, such as decision-making abilities and preparation, that enhance their employability.
Legal responsibilities	Healthcare professionals will understand the legal responsibilities, limitations, and implications of their actions within the healthcare delivery setting. They will perform their duties according to regulations, policies, laws, and the legislated rights of patients.
Ethics	Healthcare professionals will understand accepted ethical practices with respect to cultural, social, and ethnic differences within the healthcare environment. They will perform quality healthcare delivery.
Safety practices	Healthcare professionals will understand the existing and potential hazards to patients, coworkers, and themselves. They will prevent injury or illness through safe work practices and will follow health and safety policies and procedures.
Teamwork	Healthcare professionals will understand the roles and responsibilities of individual members as part of a healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.
Health maintenance practices	Healthcare professionals will understand the fundamentals of wellness and the process of preventing disease. They will practice preventive health behaviors among the patients.
Technical skills	Healthcare professionals will apply technical skills required for all career specialties. They will demonstrate skills and knowledge as appropriate.
Information technology skills	Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate the use of information technology as appropriate to healthcare applications.

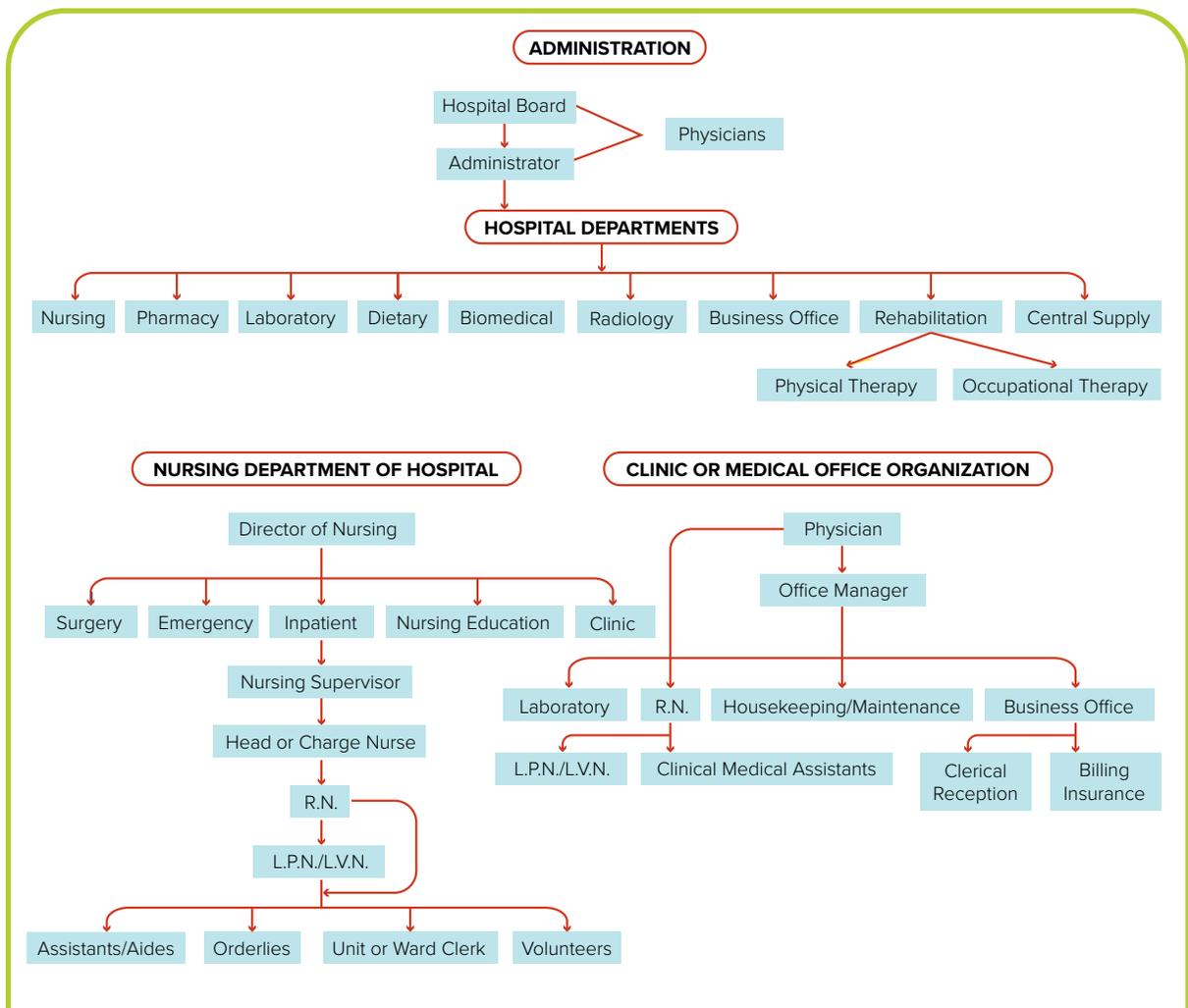


Fig. 1.1 Lines of Authority Organizational structures help define responsibilities. *Can you determine the lines of authority in these organisations?*

Systems

As a healthcare professional, you must learn how all the systems in a healthcare facility work together to provide patient care. You should also be aware of how your facility fits into the overall healthcare environment and relates to other facilities. In addition, you should know what services each department within the facility provides for patient care. For example, a physician sees a patient in his or her office or in a hospital, depending upon the patient's needs. A laboratory must draw blood, and an X-ray department may do an X-ray before surgery. A coordinated effort is required for ideal care.

Employability Skills

To be employable, which means to be able to get and keep a job, you must develop certain traits and behaviors. For example, you should arrive on time and complete each task with attention to detail. Otherwise, you may lose your job.

21ST CENTURY SKILLS

Teamwork and the Organizational Structure

All facilities have an organizational structure that contribute to the efficient operation of the facility. It identifies the relationships among departments or individuals and the line of authority. It also defines areas of responsibility. **Figure 1.1** shows sample structures. Healthcare professionals must know the organizational structure of their place of employment. You should know and follow the line of authority leading from you upward through the levels of supervision.

Legal Responsibilities

Knowing what you are and are not allowed to do according to law is a requirement for healthcare employees. You must follow the rules and regulations of the career field you choose. For example, a nursing assistant may give a patient a bath but is not allowed to give an injection.

Ethics

Ethics is defined as a set of principles that determines what is morally right or wrong. Healthcare professional organizations define the ethics by which their field is governed. Professionals are expected to know these ethical standards, and they are expected to practice according to those principles. Ethical dilemmas often arise in the field of healthcare.

Safety Practices

The patient and the healthcare professional must stay safe throughout the patient care process. Safety practices include fire safety training, electrical safety training, infection control, prevention of injury, and emergency preparedness. You should know how to clean up spills, handle blood and other bodily fluids, and lift and move patients in a safe manner so as not to cause injury or spread disease.

Teamwork

Teams are groups of people working together for a common goal. Teamwork is crucial to quality healthcare. As a healthcare professional, you must understand your role and know how to interact effectively with others. For example, as a medical assistant, you may work side by side with a physician who is sewing up a wound or contact the laboratory for test results.

Health Maintenance Practices

Prevention of disease means engaging in behaviors that help you maintain an optimal state of health, which is known as wellness. Have you ever been told to “eat right, exercise, and get plenty of rest”? These are examples of health practices that you should engage in—and should encourage your patients to practice.

Technical Skills

Healthcare professionals should learn the skills related to their career field. For example, a laboratory technician needs the skills to draw blood safely and efficiently.

Information Technology Skills

Today you may learn how to use one machine to take blood pressure. Tomorrow you may need to learn how to use a more technical or advanced machine to take blood pressure. Systems of computers connect departments within one facility.



Ethics in Action

Cloning

A stem cell is a primitive type of cell that can be made to develop into most of the 220 types of cells found in the human body, such as blood cells, heart cells, and brain cells. Some researchers regard stem cells as offering the greatest potential for the lessening of human suffering since the development of antibiotics. More than 100 million Americans suffer from diseases that may eventually be treated more effectively, or may even be cured, with stem cells. Duplicating stem cells is called cloning. When this is done with the objective of finding cures for diseases, it is called therapeutic cloning.

Wireless connections provide high-speed communication between facilities and with patients. **Technology** change is constant in healthcare. The challenge for you is to stay informed.

Reading Check

Identify three parts of the academic foundations for healthcare professionals.

Healthcare Career Pathways

Which career pathway do you think is the best fit for you?

The National Healthcare Skill Standards were created for the benefit of all students in the field of healthcare. No matter what healthcare career you choose, these standards apply.

Healthcare careers are divided into five career pathways. Learning about the pathways will help you make an educated decision about which healthcare career to enter. The five pathways are:

- Therapeutic Service Careers
- Diagnostic Service Careers
- Health Informatics Careers
- Support Services Careers
- Biotechnology Research and Development Careers

Table 1.2, which was developed by the National Consortium for Health Science Education, lists sample career specialties and occupations in each of the five pathways. Note that each pathway includes a wide variety of careers. This book will focus on the most common careers. It will include more detailed information about the types of careers, the education needed, and the procedures employed.

Therapeutic Service Careers

Healthcare professionals in a career in **therapeutic services** provide a service to the patient over time. Some career options in this pathway are in the areas of clinical medical assisting, nursing, home healthcare, respiratory care, rehabilitation, and pharmacy. The amount of education required within this pathway depends on the level of achievement the student chooses within his or her career. Skills needed in this pathway include data collection, treatment planning, implementing procedures, and patient status evaluation. **Figure 1.2** shows a nursing assistant, one of the careers in therapeutic services.



Fig. 1.2 Career Pathways A nursing assistant is one career in therapeutic services. *Why is the position of nursing assistant included in the therapeutic career pathway?*

Table 1.2 Healthcare Career Pathways

Pathways	Therapeutic Services	Diagnostics Services	Health Informatics	Support Services	Biotechnology Research and Development
Sample Career Specialties/Occupations	Acupuncturist	Audiologist	Admitting Clerk	Animal Behaviorist	Biochemist
	Anesthesiologist/Assistant	Blood Bank Technology Specialist	Applied Researcher	Biomedical/Clinical Engineer	Bioinformatics Scientist
	Anesthesia Technologist/Technician	Cardiovascular Technologist	Compliance Technician	Biomedical/Clinical Technician	Biomedical Chemist
	Art/Music/Dance Therapist(s)	Clinical Lab Technician	Clinical Account Manager	Biomedical/Clinical Technician	Biomedical Manufacturing Technician
	Athletic Trainer	Clinical Laboratory/Technologist	Clinical Account Technician	Clinical Simulator Technician	Biostatistician
	Audiologist	Computer Tomography (CT) Technologist	Clinical Data Specialist	Central Service Manager	Cancer Registrar
	Certified Nursing Assistant	Cytogenetic Technologist	Community Services Specialists	Central Service Technician	Cell Biologist
	Chiropractor	Cytotechnologist	Data Quality Manager	Community Health Worker	Clinical Data Management Specialist
	Chiropractic Assistant	Dentist	Epidemiologist	Community Health Worker	Clinical Pharmacologist
	Dental Assistant/Hygienist	Diagnostic Medical Sonographer	Ethicist	Dietary Manager	Clinical Trials Monitor
	Dental Lab Technician	Electrocardiographic (ECG) Technician	Health Educator	Dietetic Technician	Clinical Trials Research Coordinator
	Dietitian/Nutritionist	Electroneurodiagnostic Technologist	Health Information Mgmt. Administrator	Environmental Health Advocate	Crime Scene Investigator
	Dosimetrist	Electronic Diagnostic (EEG) Technologist	Health Information Mgmt. Technician	Environmental Health Practitioner	Diagnostic Molecular Scientist
	EMT/Paramedic	Exercise Physiologist	Healthcare Access Manager	Environmental Health Specialist	Forensic Biologist
	Endodontist	Geneticist	Healthcare Administrator	Facilities Manager	Forensic Chemist
	Exercise Physiologist	Geriatrician	Healthcare Finance Informatician	Food Safety Specialist	Forensic Odontologist
	Home Health Aide	Histotechnician	Information Privacy Officer	Health Advocate	Forensic Pathologist
	Kinesiotherapist	Histotechnologist	Managed Care Contract Analyst	Hospital Maintenance Engineer	Genetic Counselor
	Licensed Practical Nurse	Magnetic Resonance Technologist	Medical Coder	Industrial Hygienist	Geneticist-Lab Assistant
	Massage Therapist	Mammographer	Medical Historian	Interpreter/Translator	Lab Technician
	Medical Assistant	Medical Technologist/Clinical Laboratory Scientist	Medical Illustrator	Marital, Couple, Family Counselor/Therapist	Medical Editor/Writer
	Mental Health Counselor	Nuclear Medicine Technologist	Medical Information Technologist	Materials Manager	Microbiologist
	Naturopathic Doctor	Ophthalmologist	Medical Librarian	Medical Health Counselor	Molecular Biologist
	Nurse Anesthetist	Ophthalmic Assistant/Technologist	Medical Transcriptionist	Mortician/ Funeral Director	Nurse Researcher
	Nurse Midwife	Optician	Patient Account Manager	Nurse Educator	Packaging Technician
	Nurse Practitioner	Ophthalmologist	Patient Account Technician	Occupational Health Nurse	Patent Lawyer
	Occupational Therapist/Assistant	Optometrist	Patient Advocate	Occupational Health & Safety Expert	Pharmaceutical/Clinical Project Manager
	Oral Surgeon	Optometrist	Patient Information Coordinator	Social Worker	Pharmaceutical Sales Representative
	Orientation/Mobility Specialist	Pathologist	Project Manager	Transport Technician	Pharmaceutical Scientist
	Orthodontist	Pathologists' Assistant	Public Health Educator		Pharmacokineticist
	Orthoptist	Phlebotomist	Quality Management Specialist		Pharmacologist
	Orthotist/Prosthetist/Technician	Polysomnographic Technologist	Quality Data Analyst		Product Safety Scientist
	Pedorthist	Positron Emission Tomography (PET) Technologist	Research and Decision Support Specialist		Process Development Scientist
	Perfusionist	Radiologic Technologist	Reimbursement Specialist		Processing Technician
	Pharmacist	Radiologist	Risk Manager		Quality Assurance Technician
	Pharmacy Technician	Speech-Language Pathologist	Unit Coordinator		Quality Control Technician
	Physical Therapist/Assistant		Utilization Manager		Regulatory Affairs Specialist
	Physician (MD/DO)		Utilization Review Manager		Research Assistant
	Physician Assistant				Research Scientist
	Podiatrist				Toxicologist
	Psychologist				
	Psychiatrist				
	Radiation Therapist				
	Recreation Therapist				
	Registered Nurse				
Rehabilitation Counselor					
Respiratory Therapist					
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Wellness Coach					

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Cluster K & S
 Cluster Knowledge and Skills
 • Academic Foundation • Communications • Systems • Employability Skills • Legal Responsibilities • Ethics • Safety Practices
 • Teamwork • Health Maintenance Practices • Technical Skills • Information Technology Applications

Diagnostic Service Careers

People in **diagnostic service** careers create a “picture” of the health status of a patient at one point in time. For example, if a patient has blood drawn, the results reported are only for the point in time at which the blood was drawn. If the patient were in an accident the next day, the results might be different. Skills needed within this pathway include planning, preparation, procedure, evaluation, and reporting. Some careers in this pathway are in the areas of cardiology, imaging, and radiology. The technician shown in **Figure 1.3** has a career in diagnostic services.



Fig. 1.3 Diagnostic Services Careers in this field create a “picture” of a client’s health status. *What is the basic function of diagnostic services?*

Health Informatics Careers

People employed in **health informatics** careers record the patient’s valuable healthcare information. Skills needed are analysis, abstracting and coding, informatics systems, documentation, and operations. Some career options in informatics services are in medical records and unit coordination. **Figure 1.4** shows a health informatics technician at work.

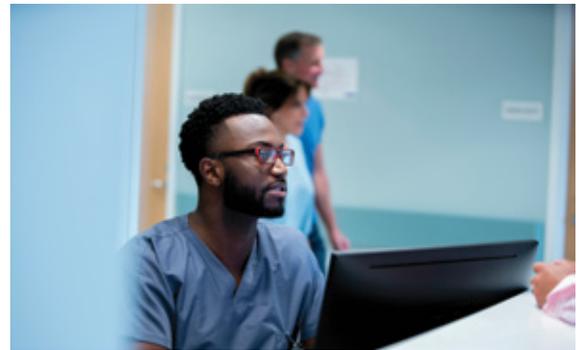


Fig. 1.4 Health Informatics Careers in this field record a client’s healthcare information. *Why is a career in computerized medical records considered to be in the health informatics career category?*

Support Services Careers

People in careers in **support services** create a safe and healthful environment for the patient and other healthcare professionals. In support services, knowledge of aseptic procedures and an understanding of the importance of an esthetically appealing environment are important. Examples of careers in this field are biomedical engineer and central supply technician. The central supply technician shown in **Figure 1.5** has a career in support services.



Fig. 1.5 Support Services Biomedical engineer and central supply technician are careers in support services. *Why is a central supply technician in the support services career category?*

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Sample Review - Not for Classroom Use

Biotechnology Research and Development Careers

The fifth pathway for health careers is **biotechnology** research and development. These careers are highly scientific. Biotechnology is a field of applied biology that involves living organisms and bioprocesses such as engineering, technology, and medicine. In general, people in these careers work in laboratories. However, they may also travel to various locations to study and explore elements in the environment. They are biologists and chemists. A strong background in and enjoyment of science is necessary. Your high school course work for a career of this kind should include biology, chemistry, physics, computer science, and mathematics. Working in a summer research program at a local college will be good experience if you have an interest in this field.

It is exciting to choose a career in healthcare because you have so many careers from which to choose. Choosing a career means matching your needs and interests with a career. Your choice will depend on many things, such as the education necessary and the jobs available.

Reading Check

List the five career pathways in healthcare.

1.1 Careers in Healthcare Review

After You Read

- 1. Illustrate** why the National Healthcare Skill Standards are important in pursuing a career in the healthcare industry.
- 2. Examine** one of the National Healthcare Skill Standards and explain why it is important. Give an example of how the standard is used in a healthcare profession.
- 3. Identify** a job opportunity in each of the healthcare career pathways.
- 4. Classify** each of the following professional careers by pathway: physician assistant, biomedical engineer, veterinary technician, electrocardiographic technician, geneticist, and unit coordinator.
- 5. Select** five courses you should take in high school as a foundation for a career in biotechnology.

Online Explorations

Career Information

Choose a health career that interests you and find out about it by accessing the Occupational Outlook Handbook at www.bls.gov. This is a U.S. Department of Labor website, and it will give you valuable information regarding all types of careers. Print out the information on your chosen career and share the information with your class.

1.2

Opportunities in Healthcare

Education

How much time do you plan to spend on career education?

Opportunities in healthcare are increasing. According to the Bureau of Labor Statistics, healthcare occupations are expected to grow 13 percent from 2021 to 2031, which is much faster than average. This industry includes public and private hospitals, nursing and residential care facilities, and individual and family services. 2 million new jobs and 1.9 million replacement jobs will be added. This growth is driven by an aging population and longer life expectancies.

Some high schools offer programs in the health sciences and certificates for completion of the programs. After high school, you might receive on-the-job training, or you might attend a career or technical school, a community college, or a university. The levels of education and the jobs for which they will prepare you are quite varied. These educational paths include:

- **High school health science or health occupations courses.** These programs can prepare you for entry-level employment.
- **On-the-job training.** During or after high school, you may receive training to advance your career while working. This training provides experience and education. However, advancement in most health career fields comes through formal education.
- **Technical or career schools.** These institutions provide training for specific health careers during and beyond high school.
- **Community college.** Community colleges and some technical and career schools offer two-year **associate's degrees.**
- **University or four-year college.** Students spend four or more years to earn a **bachelor's degree.** Afterwards, they may spend one or more years to earn a **master's degree.** Some high-level positions require a **doctorate,** which takes two to six more years.
- **Continuing education.** Once you have achieved a career goal, your education will continue in the workplace. This is called continuing education. In many health careers, continuing education is required to maintain professional status. The amount of education required varies by state and career. **Continuing education** can be obtained at your place of employment, at a school or college, online, or through reading professional publications. You are responsible for knowing the requirements regarding continuing education in your field.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- associate's degree
- bachelor's degree
- master's degree
- doctorate
- continuing education
- entrepreneurs
- career
- career assessment
- parliamentary procedure

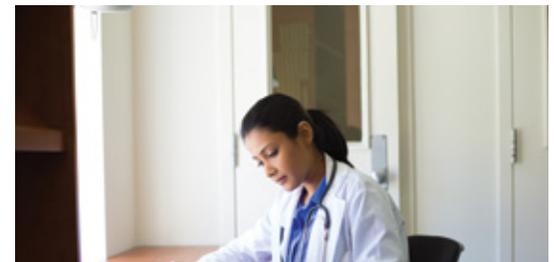


Fig. 1.6 Continuing Education Most healthcare careers require continuing education. *How might that study take place?*

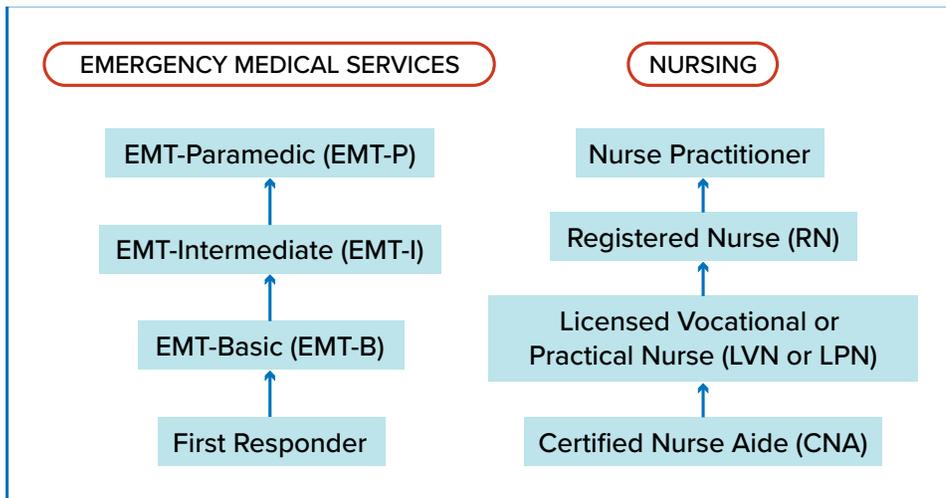


Fig. 17 Career Ladders These are career ladders for emergency medical services and nursing. What is the highest level in the Nursing career ladder?

Reading Check

Explain when a healthcare professional is finished with their education.

Levels of Employment

Have you ever considered continuing education as a way to develop your career?

The learning process should never stop. Many students receive a two-year degree and return to school later for a four-year degree.

You can enter the healthcare field at various levels, depending upon your education, experience, and training. You might enter as an aide and move to assistant, technician, or technologist. The idea of climbing a career ladder applies to all these positions. See **Figure 1.7** for examples of career ladders for nursing and emergency medical services. **Table 1.3** shows healthcare career levels with an example at each level.

Reading Check

Describe career ladder steps for emergency medical services.

Table 1.3 Levels of Employment

Level	Educational Requirements	Career Example
Professional	Four-year degree, advanced degree, and clinical training	Pathologist
Technologist	Three to four years of college and work experience	Laboratory technologist
Technician	Usually two years of training	Laboratory technician
Assistant	Up to one year of classroom and clinical preparation	Laboratory assistant
Aide	High school diploma; on-the-job training	Laboratory aide

Entrepreneurs

Does an entrepreneurial career in healthcare appeal to you?

Entrepreneurs organize, manage, and take on the responsibilities and risks of a business or enterprise. They work independently. They may be associated with a facility, but they are usually their own bosses.

Many healthcare professionals become entrepreneurs. Some of these entrepreneurs can be massage therapists, veterinarians, physicians, dentists, and medical transcriptionists. A massage therapist may start a business traveling to clients' homes. Veterinarians, physicians, and dentists may open offices to practice their skills.

Reading Check

List three careers in healthcare that are especially suitable for entrepreneurs.

Recalling Healthcare Career Standards

All members of the healthcare team must adhere to high standards. These standards ensure that high quality care is provided to patients. Knowing these standards will prepare you for a career in healthcare.

Identifying Healthcare Career Cluster Pathways

Healthcare careers are divided into five pathways. Learning about the pathways will help you make an educated decision about which healthcare career to enter.

Choosing a Career

Do you think the job that appeals most to you today will change in the future?

Before you choose a **career** path, think about what you might like to do in one, five, or ten years. Learn your needs and interests. Identify careers that best fit your personality and aptitudes.

In addition to a **career assessment**, get help from resources such as teachers, counselors, professionals, or websites. Talk with friends and family. Take it seriously, but remember that many people change professions several times in a lifetime. Your goal is to find a place to start.

Reading Check

Describe how to make an informed career choice.



Medical Math

STEM CONNECTION

Whether you are an entrepreneur or employee, you will need enough income to meet your expenses. Developing a budget can help. To stay on budget, you must determine what your monthly or weekly expenses will be and compare them to your income for that period. Use the steps in this activity to determine your monthly or weekly expenses and the amount of money you will make to meet the expenses.

Professional Organizations

Does your school have a chapter of a healthcare student organization?

A professional student organization gives you a link to others who share your interests. As a member, you will gain knowledge of health careers. Student organizations will help you

- develop leadership abilities, citizenship skills, social competencies, and a wholesome attitude.
- strengthen creativity, thinking skills, decision-making abilities, and self-confidence.
- enhance the quality and relevance of your education by developing the knowledge, skills, and attitudes that lead to successful employment and encourage the pursuit of continuing education.
- promote quality of work and pride in occupational excellence through competitive activities.

Reading Check

Describe the benefits of participation in professional student organizations.

Parliamentary Procedure

Have you ever been to a meeting that uses parliamentary procedure?

As part of your responsibility to a professional organization, you will attend or conduct meetings. **Parliamentary procedure** is a set of rules to follow in order to conduct a meeting in an efficient manner. General Henry M. Robert wrote the book *Robert's Rules of Order* in 1876 to help protect democratic procedures in organizations.



Reflect on Your Health

As you enter the field of healthcare, you should consider your own health. Healthcare professionals should be good role models. Do you eat well? Did you have breakfast this morning? How about exercise? How many times a week do you exercise? When did you go to bed last night? Are you getting enough sleep? Proper nutrition, enough sleep, and exercising most days of the week are part of a healthy lifestyle that will help prevent illness and improve your state of wellness..

The book's basic principles are:

1. Take up business one item at a time.
2. The majority rules.
3. Protect the rights of the minority to speak and to vote.

Robert's Rules of Order, Newly Revised, still serves as a guideline for conducting meetings. Organizations using these rules usually follow a fixed order of business. Here are examples:

1. Call to order
2. Roll call of members present
3. Reading and approval of minutes of last meeting
4. Officers' reports
5. Unfinished business
6. New business
7. Announcements
8. Adjournment

Procedures for Motions

Issues that membership is to discuss are presented as "motions." A motion is a proposal for action. The membership considers the motion and votes on it. See Appendix A for detailed procedures for motions.

1. Obtain the floor.
2. Make your motion.
3. Another member will second your motion, or the Chairman will call for a second.
4. If there is no second to your motion, it is lost.
5. If your motion is seconded, the Chairman states your motion.
6. Expand on your motion.
7. The question of whether or not to vote is put to the membership.

Voting on a motion will depend upon the organization or the motion requiring a vote. There are five methods most often used to vote:

1. By Voice—The Chairman asks those in favor to say "aye" and those opposed to say "no." Any member may move for an exact count.
2. By Roll Call—Each member answers "aye" or "no" as his or her name is called. This method is used when a record of each person's vote is required.
3. By General Consent—When a motion is not likely to be opposed, the Chairman says, "If there is no objection..." The membership shows agreement by silence. However, if one member says, "I object," the item must be put to a vote.
4. By Division—This is a slight variation of a voice vote. It does not require a count unless the Chairman so desires. Members raise their hands or stand.
5. By Ballot—Members write their vote on a slip of paper. This method is used when secrecy is desired.

Relating to Others in a Meeting

Have you ever been in a meeting in which someone constantly interrupts when things are not going their way? Do you know someone in charge who believes they have complete control over all things? These situations can occur even when parliamentary procedure is being used. Some suggestions for conducting a successful meeting include:

1. Always have a purpose for the meeting. Ask yourself: “What do we want to accomplish?” Write it down. If you have several things that you want to get done, list them in order of importance.
2. Put these items in the form of an agenda. Stick to the agenda and the topic under discussion. If someone wants to stray off the subject, remind the member to stick to the topic.
3. Do not allow everyone to speak at once. The person conducting the meeting should state who is to speak. For example, the presiding officer states, “It is Amber’s turn to speak.”
4. If members keep rehashing the same points, ask, “Is there anything new someone wants to add?” If not, restate the points, take a vote, and get on with the next subject on the agenda.

Reading Check

Identify the three basic principles of Robert’s Rule of Order.

1.2 Opportunities in Healthcare Review

After You Read

1. Choose what kind of school you would most likely attend to obtain an associate’s degree. To obtain a bachelor’s degree?
2. Indicate the level of education you would need to become a technician.
3. Examine the three factors that determine your entry point into a career.
4. Explain why it is important to do continuing education.
5. Define the word “entrepreneur” and give one example of an entrepreneur.
6. Describe a professional student organization.
7. Identify a professional student organization at your school.
8. Explain why parliamentary procedure was developed.

Online Explorations

Career Inventory

Obtain a copy of a career assessment from your teacher or search the Internet using terms such as “career assessment” or “career inventory.” Some websites charge a fee, but free assessments are also available at sites such as careeronestop.org. Follow the directions carefully and answer each question honestly. Once you have completed the assessment, evaluate your career match. Do you think that it is correct? Why or why not?

Chapter 1 Review

Chapter Summary

Section 1.1

- The entry-level healthcare professional should be proficient in each of the following eleven National Healthcare Skill Standards: academic foundation, communications, systems, employability skills, legal responsibilities, ethics, safety practices, teamwork, health maintenance practices, technical skills, and information technology skills.
- National Healthcare Skill Standards were established to communicate the importance of the knowledge and skills needed by all healthcare professionals.
- The five career pathways identified within the National Healthcare Skill Standards are therapeutic, diagnostic, health informatics, support, and biotechnology research and development.

Section 1.2

- Entry into a healthcare profession requires varying amounts of education, experience, and clinical training. Continuing education is necessary for career advancement.
- Entrepreneurship involves working independently when practicing healthcare skills such as massage therapy or medical transcription.
- Choosing a career takes time and requires an understanding of your interests and aptitudes. A career assessment is a good starting point to help you determine your career.
- Professional student organizations assist with career advancement and the development of character and leadership qualities.
- The book Robert's Rules of Order explains parliamentary procedure, which provides for organized and efficient meetings.

Chapter 1 Assessment

Critical Thinking/Problem Solving

1. A nurse practitioner works daily with a plastic surgeon. He is expected to be at the hospital for scheduled surgeries at 7 a.m. After assisting the physician in the operating room, he performs follow-up visits to all of their clients who are still in the hospital. He is back at the office by 2 p.m. At the office, he sees clients until 5:30 p.m. Review the National Healthcare Skill Standards and explain in detail how this nurse practitioner uses each of these skills in his professional work.
2. During a meeting of your professional student organization, one student keeps interrupting and repeating information. If you were conducting the meeting, how would you handle this student?

21ST CENTURY SKILLS

3. **Teamwork** Your teacher will divide the class into groups of five or more students, with each student in a group representing a different healthcare career. The groups should stand in a circle. Then each student reaches into the center of the circle and grasps one hand of two other students. Students should not grasp the hand of the person next to them or grasp both hands of the same person. Now, without letting go of hands, the group unwinds to form a full circle. Ask each student which health career they represent. Then each class member should find out how his or her career and the careers of the two other students might work together in real life.
4. **Problem Solving** In a small group, practice parliamentary procedures using this textbook, Robert's Rules of Order, Newly Revised, or another source. Choose a chairman and other officers and then role-play a meeting. During your meeting, practice obtaining the floor to make a motion, phrasing a motion correctly, and voting on a motion. Role-play different situations that may occur to disrupt a meeting, and then discuss how they can be corrected.
5. **Information Literacy** Search the Internet for professional healthcare organizations. Find an organization that matches your health career interest and review the information given on the website. Obtain the following information: name of the organization, web address, physical address, phone number, and title of current newsletter or other informational publication (if available).
6. **Information Literacy** Search the Internet for the website of a local healthcare facility of your choice. Visit the healthcare facility's careers or help wanted page to see the kinds of jobs that are currently available there. Write a paragraph explaining how those careers do or do not match up with what you expect to learn in this course.

Chapter 4

Emergency Preparedness



Essential Question

As you read this chapter, keep this question in mind:

How do you think you would respond to an emergency in a public place?

Emergencies of all types can occur when you are working in the field of healthcare. No matter where you are, people may have an acute illness or an injury. An appropriate response will be needed, and you may be the one who must respond. You could even experience a disaster—anything from a simple fire to a bomb threat, active shooter, or bioterrorism. As a healthcare professional, you should be prepared to determine the urgency of such a situation and respond properly. No matter what type of emergency occurs, remember to stay calm and think through each situation in order to create the best outcome.



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Reading Guide

Objectives

After completing this chapter, you will be able to:

- **Identify** causes of emergencies.
- **Distinguish** safety and emergency signs, codes, and symbols.
- **Summarize** how to respond to various disasters.
- **Summarize** fire prevention and fire safety practices.
- **Demonstrate** the appropriate response to an emergency fire situation.
- **Assess** what is wrong with an injured or sick patient.
- **Apply** knowledge to an initial assessment and a focused exam.
- **Demonstrate** cardiopulmonary resuscitation (CPR) for the one-rescuer adult, child, and infant and the two-rescuer adult.
- **Practice** responsive and unresponsive foreign body airway obstruction (FBAO) for adult, child, and infant.
- **Demonstrate** first-aid and CPR procedures.



Before you Read

Connect What is the first thing you should do in a medical emergency?

Main Idea

Healthcare professionals must learn how to recognize medical emergencies, analyze them correctly, and act accordingly.

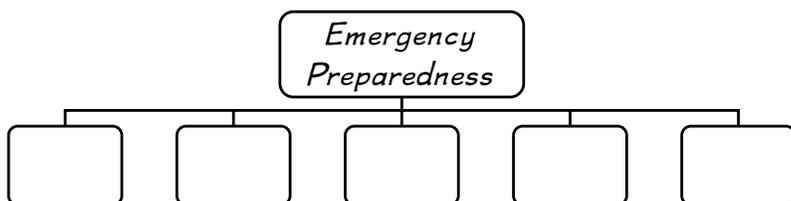
Note-Taking Activity

Draw this table. Write key terms and phrases under **Cues**. Write main ideas under **Note Taking**. Summarize the section under **Summary**.

Cues ◦ ◦	Note Taking ◦ ◦
Summary	

Graphic Organizer

Before you read the chapter, draw a diagram like the one below. As you read, write the main points covered in the chapter into the diagram.



Sample Review - Not for Classroom Use

4.1

Emergency Readiness

Medical Emergencies

What are some medical emergencies?

A medical emergency is any situation in which a person suddenly becomes ill or sustains an injury that requires immediate help by a healthcare professional. Some emergencies are not life threatening.

First Aid

Do you know any of the basics of first aid?

First aid is the quick assistance you offer to someone injured or unwell. First aid might lead to calling 911 for help or even performing **cardiopulmonary resuscitation** (CPR), is a life-saving technique for those whose breathing and/or heartbeat has stopped. It involves applying firm chest compressions to maintain blood flow, followed by rescue breaths. But, if giving breaths is not an option or you are unsure how to do it, stick to chest compressions. First aid aims to provide crucial support until professional medical help arrives.

Reading Check

Describe the goal of first aid.

Contacting EMS

When should EMS be contacted?

Contacting the Emergency Medical Services (EMS) system is the first step during an emergency. When you call 911, which activates the EMS system for medical assistance and transport, speak clearly and calmly to the dispatcher. Provide all important information, including the location. Do not hang up until the dispatcher gives you permission.

Vocabulary

Content Vocabulary

You will learn these content vocabulary words in this section.

- first aid
- cardiopulmonary resuscitation (CPR)
- shelter-in-place

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- community

Safety and Emergency Signs

Which organizations work with safety sign standards?

To maintain safety and be prepared for an emergency, it is essential to recognize safety insignia. These labels, signs, and symbols are required by the Occupational Safety and Health Administration (OSHA). The International Standards Organization (ISO), the National Fire Protection Association (NFPA), and the American National Standards Institute (ANSI) are involved in safety sign standardization and compliance. Common signs and labels are shown in **Table 4.1**. Most healthcare facilities also use emergency codes that are defined by color. **Table 4.2** shows these colors and emergency codes.

Reading Check

Explain the meaning of “code yellow” in a healthcare facility.

Table 4.1 Safety and Emergency Signs Symbols and Labels

Title, Sign, Symbol, Or Label	Meaning
<p>Biohazard</p> 	<p>Indicates the actual or potential presence of a biohazard, including equipment, containers, rooms, and materials that present a risk or potential risk.</p> <p>The biohazard symbol is usually black. The background is typically fluorescent orange, orange-red or other contrasting color.</p>
<p>Fire Safety</p> 	<p>A fire extinguisher sign is placed at the location of the extinguisher. An exit sign like this one indicates the appropriate method of exit in case of a fire. Elevators and escalators are not typically in use during an emergency.</p>
<p>First Aid and Automated External Defibrillator (AED)</p> 	<p>The sign would indicate that a first aid kit and an automated external defibrillator is available for use. These are placed at the location of the equipment.</p>
<p>Wash Your Hands</p> 	<p>Hands should be washed frequently. This is a reminder placed in locations where contamination to hands can occur and available handwashing equipment is nearby.</p>
<p>Handicap</p> 	<p>This symbol indicates the route a handicapped person should take. Consider this for patients who are unable to walk or need to avoid steps for any reason.</p>
<p>General Safety Signs</p> 	<p>Provide notices of general practice and rules relating to health, first aid, medical equipment, sanitation, housekeeping, and suggestions relative to general safety measures. For example, an eye wash station is used when chemicals, blood, or other foreign items get in the eye.</p>

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Table 4.2 Emergency Codes

Codes	Emergency code definitions
Fire	RED—Follow procedures to protect patients, staff, visitors, self, and property from a confirmed or suspected fire.
Medical emergency	BLUE—Facilitate the arrival of equipment and specialized personnel to the location of an adult medical emergency. Provide life support and emergency care.
Infant/Child abduction	PINK—Activate response to protect infants and children from removal by unauthorized persons, and describe someone attempting to take an infant from the facility.
Combative assault person	GRAY—Activate response when staff members are confronted by an assaultive person.
Bomb threat	GREEN—Activate response to a bomb threat or discovery of a suspicious package.
Person with weapons or hostage	SILVER—Activate facility and staff response to event in which staff members are confronted by persons with weapons or who have taken hostages in the facility.
Hazardous material spill	YELLOW—Identify conditions, evacuate an area, and protect others from exposure due to a hazardous materials spill. Perform procedures for a minor or major spill.
Internal disaster	TRIAGE INTERNAL—Activate response to incidents that require or may require significant support from several departments in order to continue patient care.
External disaster	TRIAGE EXTERNAL—Activate response to external emergencies that may require significant support from several departments in order to continue patient care.
Power black out	CODE EDISON—Activate response to a rolling power failure.

Note: emergency codes vary per state.

Bioterrorism and Disasters

Have you participated in any community disaster drills?

Bioterrorism is the intentional release of a biologic agent with the intent to cause harm. Bioterrorism requires public health readiness.

A healthcare professional's skills are of great value to the community. You must also be familiar with the steps for responding to disasters, as shown in **Table 4.3**. Participating in **community** fire drills or other disaster drills is an excellent way to be prepared.

Evacuation and Shelter-in-Place Plans

A healthcare facility should have evacuation and shelter-in-place plans. **Shelter-in-place** refers to a room in the facility with few or no windows, in which to take refuge when evacuation is too dangerous.

Evacuation plans should include means of communication to employees during and after the emergency. Maps of the facility with escape routes clearly marked should be posted.

Reading Check

Describe shelter-in-place and its purpose in a healthcare facility.

Table 4.3 Assisting in Disasters

Type of Disaster	Action to Take
Weather disaster, such as a flood or hurricane	<ul style="list-style-type: none"> • Report to the community command post; have your credentials with you. • Receive an identifying tag or vest; accept only an appropriate assignment. • Document what medical care each victim receives on each person's disaster tag.
Indoor fire	<ul style="list-style-type: none"> • Activate the alarm system. • Use a fire extinguisher if the fire is confined to a small container. • Turn off oxygen and shut windows and doors; seal doors with wet cloths. • If evacuation is necessary, proceed quietly and calmly. Direct ambulatory patients and family members to the exit. Assist patients who need help leaving.
Bioterrorist attack	<ul style="list-style-type: none"> • Be alert for a rapidly increasing incidence of disease in a healthy population. • Take appropriate isolation precautions. • Use standard precautions when decontaminating rooms and equipment. • Inform local health departments of suspected bioterrorism agent.
Chemical emergency	<ul style="list-style-type: none"> • Don appropriate personal protective equipment to avoid secondary contamination. • Identify the chemical and report to the local authorities. • Assist with patient decontamination. • Monitor patient's CABs (compressions, airway, breathing) of CPR and vital signs if indicated. (See section 4.4.) • Document what medical care each victim receives. • Arrange for patient transport if possible.
Mass casualties	<ul style="list-style-type: none"> • Assess the situation for safety. • If there is an explosion, do not move toward the explosion. • Report to the community command post. • Triage victims as necessary and render first aid as required. • Document what medical care each victim receives.
Active Shooter	<ul style="list-style-type: none"> • If you can safely escape, run out of the building immediately, leaving your belongings behind. • If you cannot run, find a secure hiding place, lock the door, and stay quiet. • As a last resort, if you are directly confronted, use anything available to defend yourself.

4.1 Emergency Readiness Review

After You Read

1. **Indicate** at least five types of emergencies.
2. **Differentiate** between first aid and CPR.
3. **Describe** a shelter-in-place.
4. **Create** a bulletin board, collage, or poster of emergency signs, labels, symbols and codes and their meanings.

Online Explorations

The CDC and Bioterrorism

The CDC maintains an Internet site with information about identified biological agents. Create a list of the newest biological agent and five other biological agents used for bioterrorism.

4.2 Fire Safety

The Fire Tetrahedron

Can you recognize situations that present a fire risk?

Fire is one of the dangers faced by healthcare providers. Healthcare professionals must recognize and respond to fire risk situations. Caution and a clear head are needed to protect the patient, healthcare professionals, and yourself. If healthcare professionals do not know the steps to take for safety during a fire risk situation, the loss of life in a large healthcare facility could be great. All healthcare professionals should be trained in fire prevention and first response to a fire hazard.

Fire can occur in any setting when four elements are present. A **fire tetrahedron** is a model that represents the four components needed for a fire to start and continue burning. These components are:

- fuel (something to burn)
- oxygen (to sustain combustion)
- heat (to reach ignition temperature)
- a chemical chain reaction (to sustain the fire)

All four elements, as seen on **Figure 4.1**, must be present for a fire to occur, and removing any one of them will extinguish the fire.

Reading Check

Identify the four elements that are needed for a fire to occur.

Types of Extinguishers

Have you ever used a fire extinguisher?

Fire extinguishers are divided into five categories based on different types of fires (see **Table 4.4**). The most common type is the ABC fire extinguisher. This type is capable of putting out all types of fires except combustible metal fires and cooking-oil fires.

When a Fire Emergency Occurs

What would you do in a fire emergency?

If a fire occurs, you should use the acronym RACE to help keep patients and coworkers safe and to stop the fire from spreading. (An acronym is an abbreviation formed from the first letter of each word in a term or phrase.) The acronym RACE stands for

Vocabulary

Content Vocabulary

You will learn this content vocabulary word in this section.

- fire tetrahedron

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- appropriate

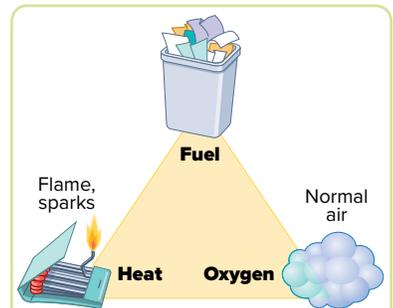


Fig. 4.1 Fire Tetrahedron Shown are the factors needed for fire. How can you stop a fire once it has started?

R = Rescue. Once a fire is seen everyone not involved in the fire extinguishing process must leave the scene.

A = Alarm. Assign someone to pull an alarm or pull the alarm yourself. If an alarm is not close by, call a facility phone operator or 911.

C = Contain. Close windows and doors. You can also contain a fire with blankets, pillows, or other things that will help smother it.

E = Evacuate. When fire and smoke are a threat, move everyone, including yourself, out of immediate danger. Smoke and heat can cause great damage to the mucous membranes of the respiratory system. Once damaged, the membranes swell and close off the airway passages. This can be fatal!

You can also think of the E in RACE as standing for “Extinguish.” You should only attempt to extinguish a fire that is small and confined. In this case, you may be able to put the fire out with a nearby fire extinguisher. Determine the cause of the fire and check your extinguisher to be sure that it can handle the fire type.

Reading Check

Identify the meaning of the letters in the acronym RACE.

Emergency Fire Rules

Do you know what you would do if there were a fire at your workplace?

Preparation: Understand what to do during a fire.

Evacuation: Learn your exit paths (see **Figure 4.2** for a route).

Fire Alarms: Know their locations and how to use them.

Fire Extinguishers: Store visibly and ensure easy access.

Area Maintenance: Keep spaces tidy and free from clutter.

Table 4.4 Fire Types

Classes, types of fires	Picture symbol
A Wood, paper, cloth, trash, and other ordinary materials	
B Gasoline, oil, paint, and other flammable liquids	
C May be used on fires involving live electrical equipment without danger to the operator	
D Combustible metals and combustible metal alloys	
K Cooking media (vegetable or animal oils and fats)	

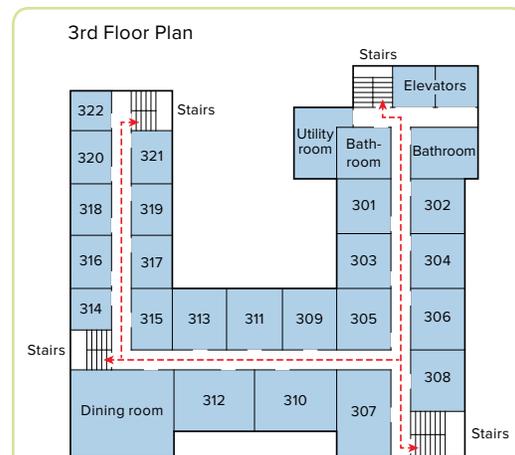


Fig. 4.2 Evacuation Route Diagram Know the evacuation route at the facility where you are employed. *In what order should clients be evacuated?*

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Sample Review - Not for Classroom Use

Evacuation Order:

1. Walkers first.
2. Wheelchair users next.
3. Bed-bound individuals last.
 - Patients' Safety: Stay with patients when safe.
 - Elevator Warning: Never use during fires.
 - Windows: Keep them closed during fires.
 - Doors: Touch before opening. If hot, do not open!

Reading Check

Explain what you would do if you came to a closed door as you were escaping a workplace fire.

21ST CENTURY SKILLS

Problem Solving

No matter the emergency, you must be able to respond calmly. Knowing your responsibilities and emergency procedures will help you be prepared. Act quickly and efficiently. When giving directions, use short sentences. Pay attention to details. Be prepared to do whatever is **appropriate**.

In addition to smoke, panic kills more people than fire itself. Healthcare facilities have a plan in place for fire emergencies. Yearly training and review are provided to employees to remind them of fire and other emergency procedures. Some facilities conduct periodic fire drills for all shifts and in all areas. Everyone must know how to respond to a fire. The safety committee reviews employees' response to the fire drill. The safety committee also makes recommendations. Practice will prevent deaths if a fire occurs.

4.2 Fire Safety Review

After You Read

1. **Assess** how, in a fire emergency, you would decide whether you should enter a room. For example, if a door were hot, would you enter?
2. **Choose** the order in which you would evacuate the following:
 - a. Patient A, who uses a walker.
 - b. Patient B, who is in a wheelchair.
 - c. A visitor of patient A, who is ambulatory.
 - d. Patient C, who is in a coma.
3. **Indicate** the four elements of the fire triangle.
4. **Explain** why each element of the fire triangle is necessary to produce a fire.
5. **Define** the acronyms PASS and RACE.

Online Explorations

Fire Prevention

Research online to determine the most common cause of fires as well as ways to prevent fires. Create a list of the causes and a set of rules to prevent fires.

4.3 Basics of First Aid

Consent

What must you do before administering first aid?

Providers of first aid must be able to recognize medical emergencies. They must then seek professional medical help and offer basic emergency care. When properly given, first aid can be the difference between temporary and permanent disability. It can even mean the difference between life and death.

Before giving first aid, you must have the patient's permission, or consent. Obtain verbal consent from all **conscious** adults of legal age capable of making a sound decision. Consent for the **unconscious** or unresponsive patient is implied. This means that it is assumed that consent to emergency assistance would be given. When possible, a child's parent or guardian gives consent for a child to receive first aid. Never withhold first aid from a child by spending unnecessary time obtaining parental or guardian permission. Keep in mind that a conscious, competent adult patient has the right to refuse your help. However, if, in your opinion, a patient really needs help, call 911 regardless of what the patient says.

Reading Check

Describe the concept of implied consent.

Responsibilities of First Aid Providers

Have you ever needed to provide first aid to a stranger?

First aid providers are a vital link between an injured or sick patient and the activation of Emergency Medical Services (EMS). It is essential for the person providing first aid to do the following:

- Recognize that an emergency exists based upon the patient's appearance, behavior, or surroundings.
- Make a decision to help. The decision to help someone is important. This decision must take into account your own personal safety if you provide first aid.
- Call EMS if the situation requires you to do so.
- Safely gain access to the patient and determine what is wrong.
- Provide first aid.
- Stay with the patient until EMS arrives.

Vocabulary

Content Vocabulary

You will learn these content vocabulary words in this section.

- conscious
- unconscious
- primary assessment
- abdominal thrusts
- secondary assessment

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- aware



Safety

Protection from Bloodborne Pathogens

When giving first aid, you might come into contact with blood or other body fluids. To stay safe:

- **Always use Barriers:** Whenever possible, wear disposable gloves.
- **Improvising Protection:** If you do not have gloves, use what is available, like plastic bags or wrap.
- **Face Protection:** Keep your eyes, nose, and mouth covered.
- **Aftercare:** Once you are done, wash your hands thoroughly, even if you wore gloves.

Assessing the Scene for First Aid

Before jumping in to help, always take a moment to evaluate what is going on around you:

- **Look for Dangers:** Whether you are in a car crash or a situation at home, first, ensure it is safe to step in. Look for hazards like fallen power lines, leaking fuel, broken glass, or even aggressive people.
- **Stay Smart, Stay Safe:** If you think the situation is too risky, do not put yourself in danger. Call 911 and wait for professionals to arrive. Your safety comes first.
- **Identify the Problem:** Determine what is wrong with the person needing help. Is it a medical issue or an injury caused by the accident?
- **Count Heads:** Know how many people are hurt or sick. This will be important when you call for emergency medical services (EMS). Report what you see so they can be best prepared to help.

The Primary Assessment

If you find yourself in an emergency, the first thing to do is assess the situation and the person in need. Here is how to conduct a **primary assessment**:

- **Introduce Yourself:** If the person is conscious, let them know you are trained in first aid and ask if you can assist them. Their response will give you vital clues about their airway, breathing, circulatory status, and whether they want to accept your help.
- **Check for Responsiveness:** Being responsive means they can talk, blink, and breathe. Listen carefully to what the person says. Can they tell you their name and what happened? If so, they are responsive and **aware**. Note how they talk. Short, uneven phrases or an inability to speak may indicate breathing issues.
- **Visual Check:** Take a quick scan of their appearance. Are they in distress or pain? Is there any visible bleeding? What is their skin color? Pale or bluish skin color can be a red flag for severe breathing or circulatory issues.
- **Immediate Actions:** Act fast if you notice critical problems, like trouble breathing or severe bleeding. For a blocked airway, perform **abdominal thrusts** above the belly button; for breathing issues, start rescue breathing; for bleeding, apply direct pressure to the wound.

By conducting a primary assessment, you will better understand how to proceed until medical professionals arrive. First aid for foreign body airway obstruction and bleeding, rescue breathing, and other skills are discussed later in this chapter.

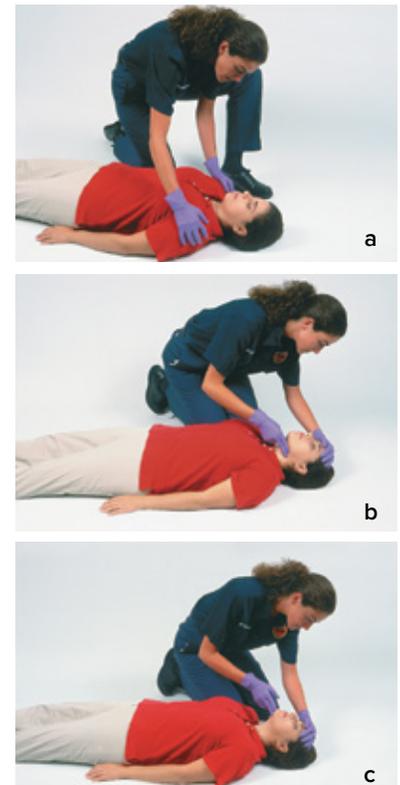


Fig 4.3 First Aid (a) Primary assessment: Unresponsive patient: check for hazards. If the scene is not safe, leave immediately. If it is safe, check the patient for responsiveness. If responsive say “My name is _____, and I know first aid. May I help you?” If you get no response, assume the patient is unresponsive. If there is no possibility of injury to the head, neck or back, position the patient on his or her back, then use the CABs. **(b) Compressions:** Check for breathing. If the patient is not breathing or breathing is not normal (i.e. gasping), quickly check the carotid pulse in the neck for no longer than 10 seconds. If the pulse is absent or you are not sure, perform 30 chest compressions. If breathing is normal, open the airway and continue with the assessment. **(c) Airway:** Open and check airway using the head tilt-chin lift method or the jaw thrust maneuver. **Breathing:** Give 2 rescue breaths that make the chest rise. Return to chest and perform continuous cycles of 30 compressions to 2 breaths. Stop about every 2 minutes, for no longer than 10 seconds, to check for a pulse and breathing.

Unresponsive Patient

For a patient who is not breathing or is gasping for breath, you will begin CABs. C = check circulation/chest compressions, A = Airway, B = Breathing. Follow these steps as illustrated in **Figure 4.3**.

1. If there is no possibility of injury to the neck or back, position the patient on his or her back.
2. Check for responsiveness by tapping the patient on the shoulder and saying “Are you okay? Can you hear me? My name is _____, and I know first aid.” If the patient is unresponsive follow the CABs as shown in steps 3, 4, and 5.
3. **C (circulation/compressions):** When assessing an individual’s condition, looking for indications of proper circulation is vital. This involves monitoring their breathing, checking for spontaneous movements or coughs, and observing the color and temperature of their skin. For unresponsive individuals, gauge their circulation by feeling the carotid artery on the side of the neck, while for those showing responsiveness, the radial pulse on the wrist is the go-to spot. A natural skin tone, regular temperature, and voluntary movements are all positive signs of normal circulation. Additionally, make sure to do a full-body scan for any significant bleeding. If found, apply direct pressure to slow the bleeding, ensuring you minimize any direct contact with the person’s blood. Should you suspect signs of shock or find no indicators of adequate circulation, promptly begin cardiopulmonary resuscitation (CPR), further detailed in Section 4.4. Always ensure an Automated External Defibrillator (AED) is called for, as it can be a life-saving tool in emergencies.
4. **A (airway):** If you suspect a neck or back injury, open the airway using the jaw thrust maneuver (see **Figure 4.4**). If you have help, direct the helper to hold the patient’s head motionless to protect the neck. If there is no possibility of a neck or back injury, open the patient’s airway using head-tilt, chin lift (see **Figure 4.5**).
5. **B (breathing):** Check for breathing. Place your ear over the patient’s mouth and watch the patient’s chest. Do this for at least 5 seconds but no longer than 10 seconds. If the patient is breathing, you should see the chest rise and fall, and you will hear and feel air exiting the mouth. If you hear snoring, wheezing, gurgling, or groaning, the patient is experiencing breathing difficulties and may require EMS services. If the patient is not breathing, provide rescue breaths to the patient.

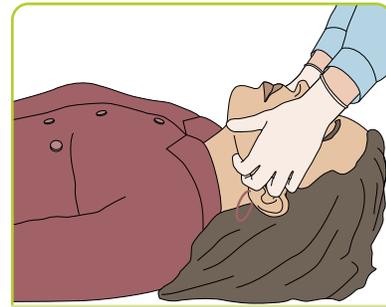


Fig. 4.4 Jaw Thrust Open the airway using the jaw thrust maneuver. *When should the jaw thrust maneuver be used?*



Fig. 4.5 Open the Airway Use the head tilt-chin lift method to open the airway. *What should you do after opening the airway?*

Secondary Assessment

If the patient’s injury or illness does not need an immediate first aid measure, conduct a **secondary assessment**. This includes checking the patient’s head, neck, chest, abdomen, pelvis, legs, arms, and portions of the back that are reachable without moving the patient. Perform this assessment on patients who are unconscious or unresponsive and on those who have sustained significant trauma. Remember, if a patient is not breathing, has no pulse, or has major bleeding, correct these before performing the secondary assessment. Never move a patient when you think that the patient has a neck or back injury.

If it is not already being done, ask someone to hold the patient's head still as you check it. Begin your secondary assessment by starting at the head and performing the following steps. **Figure 4.6** illustrates these steps.

1. Head: Begin by looking at and feeling the patient's head for deformities, bruises, open wounds, tenderness, depressions, and swelling. Check the ears and nose for blood as well as for clear fluid. Check the mouth for bleeding, loose teeth, or foreign bodies.

2. Eyes: Gently open the patient's eyes and compare the pupils. They should be the same size and should react equally to light.

3. Neck: Look and feel for deformities, bruises, depressions, open wounds, tenderness, and swelling. Check for a medical-alert necklace.

4. Chest: Look and feel for deformities, bruises, open wounds, tenderness, depressions, and swelling.

5. Abdomen: Look and feel for deformities, bruises, open wounds, tenderness, depressions, and swelling.

6. Pelvis: Look and feel for deformities, bruises, open wounds, tenderness, depressions, and swelling. Gently press downward on the pelvis to check for pain. Gently grasp the upper thighs and press inward to check for pain.

7. Legs: Look and feel for deformities, bruises, open wounds, depressions, tenderness, and swelling. Compare the skin color, temperature, condition (for example, dry or moist), and size of both legs. If the injury does not keep you from doing so, check for movement and sensation. Have the patient wiggle his or her toes. Touch the patient's toe and have him or her identify the toe. If the patient can wiggle his or her toes as well as identify which toe is being touched, assume that the nerve pathways to that extremity are intact and not damaged.

8. Arms: Look and feel for deformities, bruises, open wounds, depressions, tenderness, and swelling. Compare the skin color, temperature, and size of both arms. If the injury does not keep you from doing so, check for movement and sensation. Have the patient wiggle his or her fingers. Touch a finger and ask the patient to identify the finger you have touched. Check for a medical-alert bracelet.

9. Back: Slide your hand under the back as far as it will go without moving the patient. Look and feel for bleeding, deformities, bruises, open wounds, depressions, tenderness, and swelling.

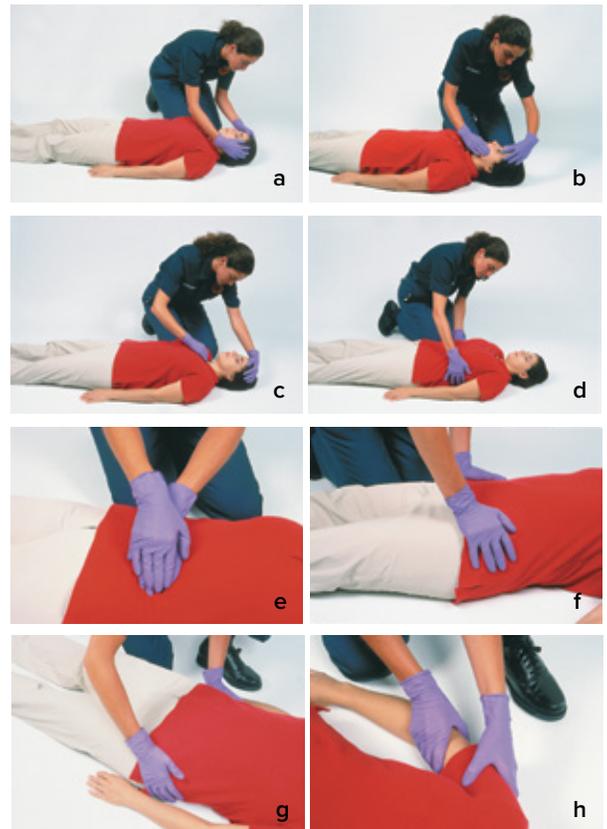


Fig. 4.6 Secondary Assessment (a) Head: Check the skull and scalp. **(b)** Gently open both eyes and compare the pupils—they should be the same size. **(c) Neck:** Check for a medical-alert necklace. **(d) Chest:** Gently squeeze the chest for rib pain. **(e) Abdomen:** Gently press the four abdominal quadrants. **(f) Pelvis:** Gently press downward on the tops of the hips for pain. **(g) Pelvis:** Gently press towards each other for pain. **(h) Extremities:** Check the full length of both arms and legs. *If a patient is not breathing, what should you do before performing a focused exam?*

Obtaining Information from a Patient

Use the memory aid SAMPLE to gather information relating to the patient's symptoms and medical history.

S = Signs and Symptoms: "What seems to be bothering you today?" or "What is wrong?"

A = Allergies: "Are you allergic to any medications?" "What are they?"

M = Medications: "What prescription or over-the-counter medications, vitamins, or herbal remedies are you taking?"

P = Pertinent Past Medical History: "Have you ever had this problem before?" "What was it?" "What other medical problems or conditions do you have?"

L = Last Oral Intake: "When was the last time you ate or drank something?" "What was it?"

E = Event preceding: "What were you doing when this happened?" "How did it happen?"

21ST CENTURY SKILLS

Communication

When providing first aid to a sick or injured patient, incorporate these communication skills:

- Identify yourself and state that you know first aid.
- Obtain the patient's name and use it when communicating.
- Speak slowly and use your normal tone of voice.
- Maintain eye contact with the patient.
- Calm and reassure the patient.

Reading Check

List the nine body parts checked in a focused examination.

4.3 Basics Of First Aid Review

After You Read

1. **Describe** first aid.
2. **Identify** the three conditions a first aid provider should evaluate during a survey of an incident.
3. **Describe** three potential hazards that might exist at the scene of an automobile accident.
4. **Explain** what you could use as a protective barrier to prevent being exposed to blood if a patient is bleeding and you do not have gloves.
5. **Illustrate** some ways in which to appraise an injured or sick patient's condition without asking questions.
6. **Describe** appropriate first aid for an unconscious or unresponsive patient without a pulse.
7. **Recall** the appropriate first aid for an unconscious and unresponsive patient with a pulse.
8. **Explain** the purpose of doing a secondary assessment on an injured patient.

Online Explorations

Primary and Secondary Assessment

Assessing a patient requires attention to detail. Visit the American Heart Association's website to review the steps of the Primary and Secondary Assessment. Create reference cards to help you perform the assessment completely and accurately.

4.4

Cardiopulmonary Resuscitation

The Chain of Survival

Do you know what the chain of survival is?

Cardiopulmonary resuscitation (CPR) is one of the initial first aid skills you should learn. It can truly save lives.

Cardiovascular disease is the leading cause of death in the United States. Nearly 1 million Americans die each year from **heart attacks** or related causes. Of these, nearly half die from sudden **cardiac arrest**. The most likely cause is an abnormal heart rhythm called **ventricular fibrillation (VF)**. This is when the heart stops beating and starts to fibrillate, or quiver. Performing CPR on a client in cardiac arrest can double the chances of survival.

Survival rates also improve dramatically if the chain of survival is started. The American Heart Association's chain of survival **guidelines** provide five major measures to deal with life-threatening emergencies such as sudden cardiac arrest, heart attack, stroke, or choking. The key features of the five links in the chain of survival are:

- **Early access to EMS.** Early access includes knowing the warning signs of sudden cardiac arrest, heart attack, **stroke**, or choking, and seeking immediate medical assistance.
- **Early CPR with an emphasis on chest compressions.** Start CPR on an unresponsive client without a pulse emphasizing chest compressions of adequate rate and depth, allowing complete chest recoil after each compression, minimizing interruptions in compressions, and avoiding excessive ventilation. Aim for a compression rate of 100-120 compressions per minute for adults, children, and infants. Compress to a depth of at least 2 inches for adults and children. For infants (aged one and under), the compression depth should be about 1.5 inches. These procedures buy clients of cardiac arrest time and improve survival chances.
- **Rapid defibrillation.** Most clients in sudden cardiac arrest are experiencing ventricular fibrillation. Treatment for this condition is **defibrillation** or the restoration of normal heart rhythm. Trained CPR and EMS providers use **automated external defibrillators (AEDs)**, devices designed to return normal rhythm to the heart. Access to an AED is crucial. When someone suffers sudden cardiac arrest, survival chances decrease 7 to 10 percent for each minute without defibrillation. Public access defibrillation (PAD) is a program to train people to use AEDs and make them available.

Vocabulary

Content Vocabulary

You will learn these content vocabulary words in this section.

- heart attacks
- cardiac arrest
- ventricular fibrillation (VF)
- stroke
- defibrillation
- automated external defibrillators (AEDs)
- barrier devices
- bag-valve mask (BVM)

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- guidelines

- **Effective Advanced Life Support.** Trained EMS providers, called paramedics, provide the necessary combinations of drugs, airway management, and defibrillation to improve the chances of survival for clients of cardiac arrest, heart attack, stroke, and choking.
- **Integrated post–cardiac arrest care.** This link emphasizes the importance of hospital based Intensive Care Unit (ICU) post-cardiac arrest care including therapeutic hypothermia in selected cases.

Reading Check

Summarize the process of defibrillation.

Using Barrier Devices and Face Masks

Can you think of some barrier devices you can use in an emergency?

First aid providers should adhere to updated infection-control measures when initiating and performing CPR. This includes using gloves and **barrier devices** to minimize the risk of transmitting infections. While the probability of contracting diseases like the human immunodeficiency virus HIV or hepatitis through mouth-to-mouth rescue breathing is extremely low, there's also the potential risk of transmitting current infectious diseases, such as COVID-19. Leading organizations like the American Heart Association and the American Red Cross now emphasize the importance of using barrier devices and bag-valve masks during resuscitation to protect the provider and the patient. If you do not have a barrier device or are uncomfortable with mouth-to-mouth, performing chest compressions alone can still be significantly beneficial.

Using a Bag-Valve Mask

Have you ever seen a bag-valve mask?

A **bag-valve mask (BVM)** consists of a self-inflating bag and a one-way valve attached to a face mask. EMS and hospital personnel prefer to use this device for giving rescue breaths in CPR. The mask works best when it is used with supplemental oxygen. The proper use of the BVM requires practice. It is most effective when used by two first aiders; however, a single first aider can also use the BVM.

Reading Check

Explain why groups such as the American Heart Association and the American Red Cross recommend using barrier devices and bag-valve masks for rescue breathing.



Preventive Care & Wellness

Healthy Arteries

The arteries of your brain and heart need your help to stay healthy. Habits such as smoking, a diet high in fat and cholesterol, overeating to obesity, and lack of exercise can damage arteries. When this happens, blood clots may cause a stroke, a heart attack, or death. You can reverse the effects of these habits by not smoking, having your blood cholesterol checked periodically, exercising regularly, eating a healthy diet, and monitoring your blood pressure.

21ST CENTURY SKILLS

Problem Solving

Cardiac arrest is when your heart stops beating. Not all people who experience this condition are older. Based on data from the National Institute of Health, over 20,000 children experience cardiac arrest in the U.S. each year. The incidence of sudden cardiac arrest in high school athletes in the U.S. is from .63 per 100,000 high school students annually. Everyone should know what to do when a cardiac arrest occurs.

Cardiopulmonary Resuscitation

Have you ever performed CPR?

If sudden cardiac arrest occurs, blood flow stops and the heart, brain, and other vital organs are deprived of oxygen. There are three “red flags” for victims of sudden cardiac arrest:

- No response
- No signs of circulation
- No breathing or inadequate breathing

If there is no response, no sign of circulation, and no breathing or inadequate breathing, begin CPR. Follow CAB guidelines when performing One-Rescuer Cardiopulmonary Resuscitation (see **Figure 4.7**).

Foreign Body Airway Obstruction

What could you do if you saw someone choking in a restaurant?

Foreign body airway obstruction (FBAO), or choking, can occur in patients of all ages. In adults, an FBAO is common in situations involving a combination of alcohol and food. Often, a patient chokes on a piece of food while eating and talking at the same time. Infants and children more frequently choke on small objects such as toys.

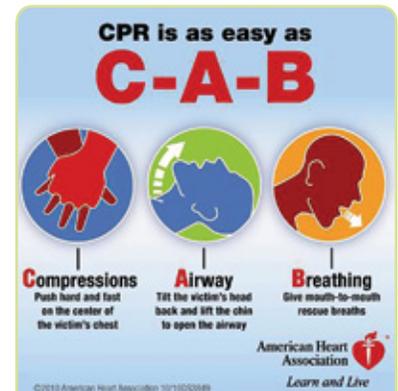


Fig. 4.7 CAB This CPR poster from the American Heart Association promotes the three main elements of CPR. *What do the initials CAB stand for?*



Fig. 4.8 Choking Aid *When would you perform a chest thrust rather than an abdominal thrust?*

4.4 Cardiopulmonary Resuscitation Review

After You Read

1. **Assess** what you should do if you discover a patient lying unresponsive on the floor.
2. **Indicate** what you should do if a woman sitting next to you during lunch begins coughing, clutches her throat, and becomes silent.
3. **Analyze** what you should look for to determine whether rescue breaths are effective.
4. **Describe** the signs of circulation.
5. **Name** your first action if you enter a room to find a middle-aged man collapsed on the floor.
6. **Explain** what you should do if an infant has choked on a grape and becomes unresponsive after you are unable to dislodge the grape.
7. **Arrange** the steps to take if a 3-year-old child near you suddenly becomes limp.
8. **Explain** what to do if a pregnant woman clutches her throat and cannot cough or speak.

Online Explorations

CPR Reference

Using items found on the Internet, develop a visual tool to help assist someone in providing CPR. Make the bulletin board or presentation as visual as possible with graphics, pictures, and photos.

Medical Emergencies

What kinds of medical emergencies have you encountered?

As a first aid provider, you will need to respond to a variety of emergency situations. This section explains how to deal with the most common types of emergencies and gives guidelines that you can apply when the unexpected occurs.

Procedures covered in this section address a number of different emergencies that you may encounter. These include recognizing and administering first aid for a heart attack and a stroke, as well as minor wound care, stopping or controlling external and internal bleeding, and treatment for shock. Also covered in this section are first aid procedures for burns, ingestion of (or exposure to) poisons, heat emergencies, cold-related emergencies, muscle and bone injuries, diabetic emergencies, and seizures.

First Aid for Heart Attack

A heart attack occurs when the heart muscle is deprived of oxygen-rich blood and nutrients. The arteries that supply blood to the heart can become narrow because of an accumulation of plaque and cholesterol. The artery becomes blocked and no oxygen nourishes the cardiac muscle. Without oxygen, the heart muscle starts to die.

First Aid for Stroke

A stroke involves the brain. The cause of a stroke is similar to that of a heart attack. An artery supplying blood to the brain becomes blocked, cutting off oxygen and nutrients. A stroke can also occur when a blood vessel in the brain ruptures and bleeds into the brain. Strokes are the fifth leading cause of death in the United States.

Minor Wound Care

Wash minor wounds with soap and water to help prevent infection. Keep in mind that wound cleaning generally restarts bleeding. If the wound is shallow, continue with washing anyway. On the other hand, if the wound is deep, postpone washing and seek immediate medical assistance. A medical provider should remove matter embedded in the skin.

Vocabulary

Content Vocabulary

You will learn these content vocabulary words in this section.

- shock
- anaphylaxis
- hypoglycemia
- hyperglycemia
- heat stroke
- heat cramps
- heat exhaustion
- hypothermia

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- constant

Sample Review - Not for Classroom Use



Fig 4.9 Wound Care *What's the best way to care for a minor wound?*

Controlling External Bleeding

External bleeding occurs when an object penetrates, tears, avulses (tears away), severs, or scrapes the outer protective layer of skin. These injuries are open wounds or soft tissue injuries. Controlling bleeding is the first priority in taking care of an open wound. Left alone, significant external bleeding can lead to severe blood loss and shock. Regardless of the bleeding or wound type, the first aid for external bleeding is the same: control the bleeding.

Internal Bleeding

Internal bleeding occurs when a blunt or penetrating force is applied to the skin, resulting in trauma to one or more internal organs, such as the liver, spleen, or kidneys. Internal bleeding can also result from non-traumatic conditions such as a stomach ulcer. Internal bleeding is difficult to recognize.

Shock

Shock refers to a condition that occurs when too little oxygen and nutrients reach the body's cells, tissues, and organs. Oxygen and nutrients travel to these structures by way of the circulatory system. Because every injury and some medical conditions affect the circulatory system to some degree, providers of first aid should treat all injured or sick patients for shock even though they may not exhibit the signs of shock.

Anaphylaxis

Anaphylaxis is a type of shock that occurs quickly, even in minutes, with severe life-threatening consequences. Exposure to a substance to which the patient is severely allergic causes anaphylaxis. Exposure to this substance, called an allergen, occurs by contact, injection, or ingestion. Common allergens are bee stings, strawberries, shrimp, peanuts, aspirin, and penicillin. Epinephrine is a drug administered to treat anaphylactic reactions. Anaphylaxis is a true medical emergency, and immediate assistance from EMS is essential.

Burns

When the outer protective layer of the body, the skin, encounters thermal energy (heat), chemicals, or electricity, burns occur.

Injuries to Bones, Joints, and Muscles

Injuries to bones, joints, and muscles commonly result from motor vehicle or sporting accidents and falls. The four common injuries to bones, joints, and muscles are fractures, dislocations, sprains, and strains. Unless there is an apparent deformity, it may be impossible or even unimportant for a first aid provider to decide whether a patient has a fracture, dislocation, sprain, or strain. In general, the first aid for each is the same.



Fig 4.10 Injuries to Bones, Joints, and Muscles *What's the best way to care for an injury to a bone?*

Diabetic Emergencies

Diabetes is a condition in which the pancreas, the organ that produces insulin, no longer produces enough insulin, or the insulin it produces is ineffective. Insulin, a hormone, helps the body use carbohydrates or sugar to produce energy. Insulin moves sugar from the bloodstream to the cells. The cells use sugar to produce energy. Diabetics may suffer from two diabetic emergencies: **hypoglycemia** or **hyperglycemia**.

Seizures

A seizure or convulsion may be an unexpected, intense, unmanageable contraction of a group of muscles. In other cases a seizure may be subtle, consisting of only a brief “loss of awareness” or a few moments of what appears to be daydreaming. Seizures are caused by abnormal bursts of electrical activity in the brain. Grand mal seizures, or tonic-clonic seizures, involve the entire body.

Sample Review - Not for Classroom Use

Heat Emergencies

Our body constantly works to rid itself of the heat it produces. If the body is exposed to excessive heat, the struggle to maintain a **constant** internal temperature of 98.6°F intensifies. This can result in heat-related illnesses such as **heat stroke**, **heat cramps**, and **heat exhaustion**.

Cold-Related Emergencies

Exposure to cold can affect the entire body or the individual parts of the body. **Hypothermia** is when a patient's entire body is affected. Excessive exposure of the skin to cold can cause freezing of the skin and tissues under the skin.

Poisons

Poisons are substances that produce harmful effects after being ingested, inhaled, or absorbed through the skin. Most poisonings occur in children under the age of 5. Ingested poisons include household chemicals, medications, petroleum products, and insect and weed control products. In the U.S., there is a universal Poison Control number: 1-800-222-1222.

4.5 First Aid For Specific Emergencies Review

After You Read

1. **Recognize** the appearance and behavior of a patient who is having a heart attack.
2. **Explain** the action you should take when blood is flowing freely from a wound.
3. **Indicate** the information that should be obtained for cases of ingested poisons.
4. **Explain** how to determine whether a patient is having a low or high blood sugar episode.

Online Explorations

CPR Training

The American Health Association and National Safety Council provide courses to become certified in first aid and/or CPR. Look online to find a course being taught in your local area.

Chapter 4 Review

Chapter Summary

Section 4.1

- Emergency care may be needed for medical emergencies, fire emergencies, bioterrorism, or other disasters. First aid is the initial help and care provided to a sick or injured person.
- First aid is the essential link between the injured or sick person and the activation of EMS.
- Recognizing safety and emergency signs, labels, and codes is necessary to be prepared for an emergency.
- Healthcare professionals must be prepared to respond to any type of disaster.

Section 4.2

- Fires can occur when there is a supply of fuel, heat, and oxygen.
- Fire drills are important in the healthcare setting. Lives can be saved when the healthcare professionals know how to handle the emergency.
- When a fire occurs, use the acronym RACE to respond to the fire and the acronym PASS to use the fire extinguisher.

Section 4.3

- Before offering first aid, survey the scene of the incident to determine threats to your own safety or to the safety of the patient or bystanders, to determine the nature or cause of the illness or injury, and to determine the number of patients involved.
- Before providing first aid, identify yourself, say you know first aid, obtain the patient's name, and use the patient's name when communicating with him or her.

Section 4.4

- Always perform an primary assessment to determine whether there are problems with the patient's circulation, airway, or breathing (the CABs). Correct these problems immediately.

Section 4.5

- Cardiovascular disease is the leading cause of death in the United States. Therefore, it is important for first aid providers to recognize the signs and symptoms of heart attack and stroke and to perform CPR when required.
- Controlling bleeding is the first priority in treating an open wound. First aid providers may need to perform procedures for internal and/or external bleeding.
- To perform first aid safely and correctly, you must first recognize the signs and symptoms of shock; burns; bone, muscle, and joint injuries; poisonings; heat and cold emergencies; seizures; and diabetic emergencies.

Chapter 4 Assessment

Critical Thinking/Problem Solving

1. You are working the evening shift in the laboratory. As you approach the urinalysis department, you smell smoke. The door is closed, and smoke is coming from under it. There are two other technologists at the other end of the laboratory. Explain what you should do. Use the acronyms RACE and PASS if applicable.
2. You just witnessed an automobile accident. What must you consider before offering your assistance? What should you tell the emergency dispatcher? If you choose to assist any of the injured patients, what should you do?
3. Your neighbor has disturbed a nest of yellow jackets and has been stung numerous times. He is short of breath and complains of severe itching. You notice that his legs and face are becoming puffy. What should you do?
4. Your father is busy remodeling your basement. He accidentally drives a nail through his right hand with a nail gun. What should you do?

21ST CENTURY SKILLS

5. **Communication** Role-play various emergencies. Describe your symptoms and have a partner or the class identify your illness or injury. Take turns and find out how many emergency situations you can determine when you are told the symptoms.
6. **Teamwork** Obtain a bag-valve mask. Practice using it correctly on a mannequin.
7. **Information Literacy** Search the Internet for organizations that issue certification in first aid and CPR. Look for the American Heart Association, the American Red Cross, or the National Safety Council. Find out the requirements for enrolling in a course in first aid or CPR and the location of a course in your area.

Chapter 27

Radiology



Essential Question

As you read this chapter, keep this question in mind:

What is the role of radiology professionals in the fight against cancer and other life-threatening diseases?

Excellent career opportunities exist in radiology and radiologic technology. To qualify for a position, you will need to learn to use sophisticated diagnostic imaging or radiation therapy equipment. This equipment is used for the diagnosis and treatment of patient disease or injury. There are numerous careers available in the field of radiology or radiologic technology, including radiologist, nuclear medicine technologist, dosimetrist, and several others described in this chapter.



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Sample Review - Not for Classroom Use

Reading Guide

Objectives

After completing this chapter, you will be able to:

- **Indicate** two primary roles of the radiologist.
- **Name** three primary roles of the radiologic technologist.
- **Identify** the advanced practice roles of the radiologic technologist.
- **Illustrate** settings in which radiologists and radiologic technologists work.
- **Differentiate** between invasive and noninvasive diagnostic imaging procedures.
- **Indicate** the steps required to protect the patient and radiologic healthcare professionals from unnecessary exposure to radiation.
- **Explain** the importance of the inverse square law.
- **Demonstrate** two radiologic procedures.



Before you Read

Connect: Have you ever had a disease or injury that was diagnosed by a radiology team? What was that experience like?

Main Idea

Radiology professionals use advanced medical technology to diagnose and treat many diseases and injuries.

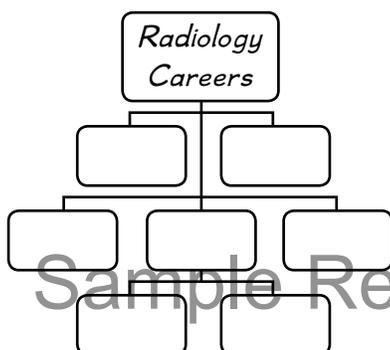
Note-Taking Activity

Draw this table. Write key terms and phrases under **Cues**. Write main ideas under **Note Taking**. Summarize the section under **Summary**.

Cues	Note Taking
◦	◦
◦	◦
Summary	

Graphic Organizer

Before you read the chapter, draw a diagram like the one below. As you read, write the main radiology careers covered in section one into the diagram.



27.1 Careers in Radiology and Radiologic Technology

Overview

What are X-rays?

Dr. Wilhelm Conrad Roentgen discovered the X-ray on November 8, 1895 and started the field of radiology. He named the ray after the symbol “X,” the mathematical symbol for “unknown.” The first recognized **radiograph** using photographic glass plates generated by Dr. Roentgen was of the hand of his wife, Bertha. It shows her hand with a ring on her finger (see **Figure 27.1**). This famous image was taken the same day as the discovery of the X-ray.

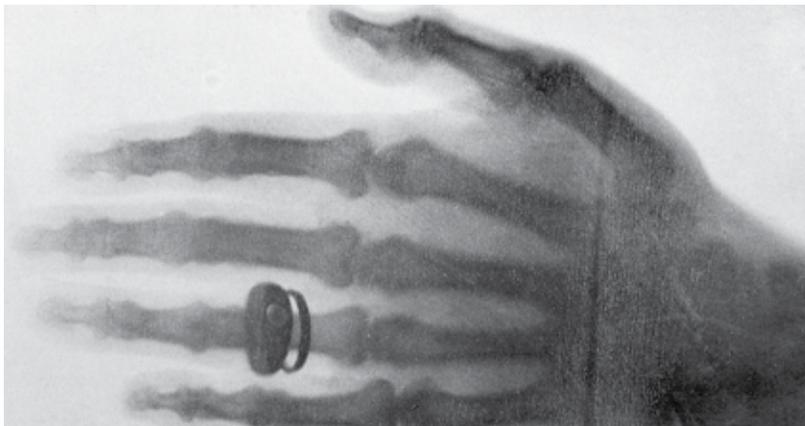


Fig. 27.1 Radiograph Image taken by Dr. Wilhelm Roentgen. *Why is this image of the hand of Dr. Roentgen’s wife, Bertha, so famous?*

Reading Check

Identify what the letter “X” in X-ray represents.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- noninvasive imaging
- invasive imaging
- contrast media
- angiogram
- arteriogram
- fluoroscopy
- atheroma
- external beam therapy
- brachytherapy
- radiograph
- X-ray
- radiopaque
- radiolucent
- As Low As Reasonably Achievable (ALARA)

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- energy

Table 27.1 Overview of Radiology and Radiologic Technology Occupations

Occupation	Educational Requirements	Certification or Licensing Agency	Job Outlook
Diagnostic Radiologist	Medical school + 4-year radiology residency.	American Board of Radiology, American Osteopathic Board of Radiology	Average growth, use of computer-aided diagnosis may reduce need.
Medical Dosimetrist	Bachelor’s degree in science + 2–4 years of on-the-job training.	Medical Dosimetrist Certification Board (some states also require a license).	Average growth.

Table 27.1 Overview of Radiology and Radiologic Technology Occupations (Continued)

Occupation	Educational Requirements	Certification or Licensing Agency	Job Outlook
Radiologic Technologist	1-4 years in an approved Joint Review Committee on Education in Radiologic Technology (JRCERT) program leading to a certificate or 2-4-year degree.	American Registry of Radiologic Technologists (some states also require a license).	Faster than average growth. Crucial for X-rays and CT scans for COVID patients.
Nuclear Medicine Technologist	1-4 years in an approved JRCERT program leading to a certificate or 2-4-year degree.	American Registry of Radiologic Technologists and/or Nuclear Medicine Technology Certification Board (NMTCB). Some states also require a license.	Little to no change expected
Radiation Therapist	1-4 years in an approved JRCERT program leading to a certificate or 2-4-year degree.	American Registry of Radiologic Technologists (most states required a license or certification).	Average growth
Computed Tomography Technologist	ARRT Certification as a registered technologist and ARRT-specified clinical experience	American Registry of Radiologic Technologists (some states also require a license).	Steady growth. Essential for CT scans, especially for COVID diagnosis.
Magnetic Resonance Technologist	ARRT Certification as a registered technologist and ARRT-specified clinical experience	American Registry of Radiologic Technologists (some states also require a license).	Faster than average growth. Used for various diagnoses, including post-COVID effects.
Sonographer	Certification as a registered technologist with ARRT and documentation of ARRT-specified clinical experience or completion of 1-4-year JRCERT approved program	American Registry of Radiologic Technologists, American Registry of Diagnostic Medical Sonographers (some states also require a license).	Much faster than average
Bone Densitometry Technologist	ARRT Certification as a registered technologist and ARRT-specified clinical experience	American Registry of Radiologic Technologists (some states also require a license).	Steady growth. Essential for bone density checks.
PACS Administrator	Education requirements vary from facility to facility, but in a majority of cases PACS administration is performed by an RT	American Board of Imaging Informatics or PACS Administrator Registry and Certification Association	Above average growth.
Registered Aide	2-4 weeks on-the-job training.	None	Average growth
Registered Radiologist Assistant	Master or doctoral degree and be certified with ARRT in radiography plus at least 1 year clinical experience	Completion of American Registry of Radiologic Technologists exam to become certified	Above average growth to assist with demand for medical imaging services.

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The Radiologist

How does radiation fight cancer?

Radiologists specialize in the use of radiant **energy** to diagnose and treat disease. Most of them work in hospitals, but they may also work in private practice and at diagnostic imaging or radiation therapy centers (see **Figure 27.2**). Doctors in this field may specialize in diagnostic radiology or radiation oncology.



Fig. 27.2 Diagnostic Radiologist Diagnostic radiology helps doctors to diagnose a patient's disease or injury. What does this kind of doctor use to diagnose disease and injury?

The Diagnostic Radiologist

What is coronary angiography?

Diagnostic radiology creates images using X-rays, magnetic fields, sonar, and radioactivity. These images allow the doctor to make a diagnosis of a patient's disease or injury. Radiologists may specialize further in areas such as angiography or nuclear medicine.

The Job of the Diagnostic Radiologist

The diagnostic radiologist conducts general and specialized imaging examinations of the human body. **Noninvasive imaging** studies are taken from outside the body and do not require the use of a contrast medium. These examinations may use radiography, magnetic resonance imaging, computed tomography, mammography, or sonography (see **Figure 27.3**). Most radiologists delegate responsibility for these images to radiologic technologists.



Fig. 27.3 Chest Radiograph Posterior-anterior (PA) chest radiograph. Is this color-enhanced posterior-anterior (PA) chest radiograph an example of a noninvasive or invasive imaging procedure?

Invasive imaging studies are taken by introducing a contrast agent into the body. Virtually every internal organ can be imaged in this way. **Contrast media** are substances that allow internal structures to be viewed. Risk to the patient is increased for these examinations, in which the diagnostic radiologist may insert catheters and inject drugs or contrast agents. Invasive examinations include angiograms, upper gastrointestinal exams, barium enemas, and nuclear medicine scans.

Diagnostic radiologists must have extensive knowledge and skill in both medicine and radiology. Invasive imaging tests like angiography require expertise.

Job Responsibilities of the Diagnostic Radiologist

The diagnostic radiologist is responsible for

- maintaining aseptic and sterile techniques, and following standard precautions when dealing with patients and coworkers.
- using various imaging modalities such as general and digital radiography, fluoroscopy, computed tomography, ultrasound, magnetic resonance, and nuclear medicine.

- administering contrast agents, such as barium, iodine-based solutions or air into the patient's digestive tract, joints, and circulatory system to enhance imaging results.
- responding to emergencies and administering drugs to counteract adverse reactions to contrast media, such as anaphylactic shock.
- using a fluoroscope to inspect internal structures of the body and guide catheters through arteries and veins.
- taking spot films that identify suspicious and routine findings.
- studying the findings for all images produced.
- generating a written report for the patient's attending physician.
- supervising a diagnostic imaging team of radiographers, nuclear medicine technologists, advanced practice specialists, and aides.

Coronary Angiography Coronary angiography is an invasive imaging procedure designed to determine where a coronary artery is narrowed or blocked. The radiologist injects contrast media into the coronary artery of the heart through a catheter inserted through the femoral artery of the groin. Sometimes the brachial artery of the arm is used to advance the catheter into the heart's coronary artery.

There is also a similar procedure called arteriography. The images from this procedure are called angiograms or arteriograms. An **angiogram** is an image showing both arteries and veins filled with contrast media. An **arteriogram** is an image that shows only arteries filled with contrast media.

Patients are sedated but conscious during both procedures. Because they are awake, they can respond to instructions from the radiologist during the procedure. These procedures must be performed under sterile conditions.

Fluoroscopy **Fluoroscopy** is an imaging process that is used to advance the catheter through the artery, into the heart, and then into the coronary artery. In fluoroscopy, the X-ray image is projected onto a fluorescent screen. This allows real-time visual examination of the anatomy. Contrast media is injected through the catheter using a pressure injector machine. A series of rapid radiographic pictures of the coronary artery and its branches are recorded digitally or on X-ray films. Depending on the type of system that is used, the images will display an outline of the heart showing white, black, or color-enhanced lines filling with contrast media and reveal the coronary artery and its branches.

The diagnostic radiologist looks for lines that are narrower than normal. This indicates the presence of plaque. The abrupt stopping of a

Provide Reassurance but Be Prudent

Patients about to undergo a radiology procedure are typically under considerable stress due to their illness or injury. Radiologic technologists must interact with them in a reassuring and confident manner. Patients will often ask the technologist for a prediction or explanation of their status. Although technologists must be sensitive to the patient's need for reassurance, they also must be prudent. It is important to explain to the patient that they are performing the procedure so that a physician can make a diagnosis and produce a treatment plan.

The Health Insurance Portability and Accountability Act (HIPAA) protects the security and privacy of patient information. Always be mindful of what patient information you discuss and where you discuss it.



Fig. 27.4 Angiography Color-enhanced coronary angiography. Why is coronary angiography considered an invasive imaging procedure?

line indicates that a branch of the main coronary artery is blocked by a blood clot or by **atheroma**, which is a fat deposit on the inside of the arterial wall (see **Figure 27.4**).

Reading Check

Recall some examples of non-invasive procedures performed by diagnostic radiologists.

The Radiation Oncologist

What types of therapy are used by radiation oncologists?

Radiation oncology deals with the use of radiation in the treatment of cancer (see **Figure 27.5**). When radiation strikes cancer cells, cell growth stops or slows down. This decreases the rate of cell division or impairs DNA synthesis.

The Job of the Radiation Oncologist

The radiation oncologist determines a tumor treatment plan for a patient. The goals of the plan are to cure a cancer, relieve pain and distress, enhance the action of drugs, or establish local tumor control (see **Figure 27.6**).

Job Responsibilities of the Radiation Oncologist

The radiation oncologist will

- use radiation treatments to destroy or inhibit the reproductive ability of cancerous cells or tumors.
- maintain aseptic and sterile techniques and follow standard precautions with patients and coworkers.
- identify the volume of the patient's body to be treated; the entry and exit points for the radiation beam; the radiation source; the amount and number of doses to be delivered; the total tumor dose; and the prescription point, or isodose.
- explain the treatment plan to the patient and obtain informed consent.
- use positioning and immobilizing devices, and normal tissue shielding.
- assess the patient's tumor response after radiation therapy treatments so that serious problems can be avoided.
- supervise a team of radiation therapists, medical dosimetrists, registered radiation assistants, and radiology aides.



Fig. 27.5 Radiation Oncologist The radiation oncologist determines the tumor treatment plan. *How does this kind of doctor use radiation in the treatment of cancer?*



Fig. 27.6 CT Scan A CT scan is used to guide radiation therapy. *What are some reasons why a patient may have radiation therapy treatment?*

Radiation Therapies Performed by the Radiation Oncologist

Two types of radiation therapies are performed by radiation oncologists.

External beam therapy External beam therapy is usually delivered in daily doses over several weeks. Cobalt 60 may be used in this treatment (see **Figure 27.7**). Treatments are given by the radiation therapist, but the prescription and treatment plans are designed by the radiation oncologist. The radiation oncologist monitors the patient's progress and informs the referring physician as needed. One version of **external beam therapy** involves the use of a linear accelerator.



Fig. 27.7 External Beam Therapy A cobalt 60 teletherapy unit. *What are the two types of radiation therapies performed by radiation oncologists?*

Linear Accelerator A linear accelerator (LINAC) uses microwave technology to accelerate electrons to incredible speeds in order to collide them into a heavy-metal target. This collision produces powerful X-rays. The radiation therapist focuses the X-rays closely on the patient's tumor, to destroy cancer cells without damaging normal surrounding tissue. External beam therapy using a LINAC is common. Depending on the patient's disease and general condition, radiation therapy treatments are administered each day for five days per week for up to eight weeks. Daily treatments take less than 15 minutes. The X-ray beam is turned on for about a minute and exposes the patient's tumor in two or more directions (see **Figure 27.8**).

Brachytherapy Another form of radiation therapy, **brachytherapy**, involves using radionuclide sources to treat tumors inside the body. For example, the radiology oncologist may insert radioactive seeds into the prostate gland to treat prostate cancer (see **Figure 27.9**). This is sometimes called targeted therapy.

Reading Check

Recall how the radiation oncologist determines the frequency and number of radiation treatments.

Medical Dosimetrist

How does a medical dosimetrist design a treatment plan for cancer patients?

The medical dosimetrist is a member of the radiation oncology team who has knowledge of the characteristics and relevance of radiation oncology treatment machines and equipment. The medical dosimetrist is familiar with brachytherapy procedures. They have the expertise necessary to generate radiation dose distributions and dose calculations in collaboration with the radiation



Fig. 27.8 LINAC A LINAC uses microwave technology. *How does a LINAC generate radiation to treat cancer?*



Fig. 27.9 Brachytherapy Radionuclide seeds are placed inside the prostate gland to treat prostate cancer. *What is this therapy sometimes called?*

oncologist. The dosimetrist will design a treatment plan that will deliver the prescribed radiation dose and specify the placement technique (see **Figure 27.10**).

Reading Check

Explain the difference between noninvasive imaging and invasive imaging.



Fig. 27.10 Dosimetrist The amount of radiation given during radiation therapy is determined by the medical dosimetrist. *Why does a patient receive radiation therapy?*

Radiologic Technologist

How do radiologic technologists support the work of radiologists?

Radiologic technologist is the preferred title for the healthcare professional who assists the radiologist. Radiologic technologists can pursue a number of occupations. Registered radiologic technologists (RT) are certified and supported by the American Registry of Radiologic Technologists (see **Figure 27.11**).

The Job of the Radiologic Technologist

Radiologic technology includes the fields of radiography, nuclear medicine technology, and radiation therapy technology. Registered radiologic technologists can also document specific clinical experience and test for advanced practice certification in areas such as cardiac-interventional technology, computed tomography, magnetic resonance imaging, mammography, sonography, bone densitometry, and quality management technology.

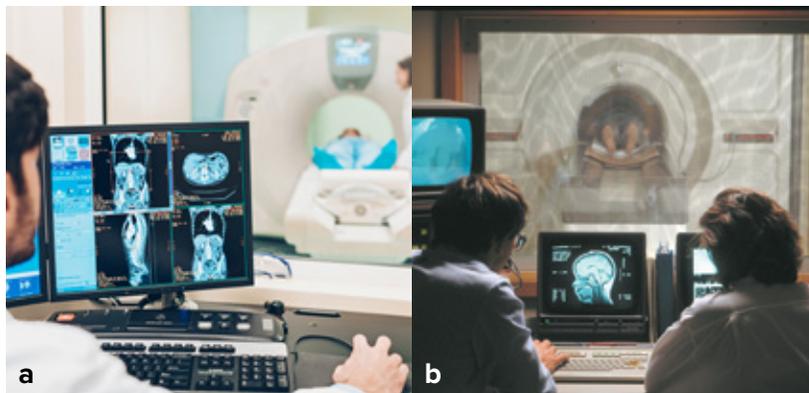


Fig. 27.11 Radiologic Technologists (a) A radiologic technologist assists the radiologist. (b) Wall for protection from radio frequency interference. *What professional organization supports radiologic technologists in the performance of their duties? What does the abbreviation MRI stand for?*

21ST CENTURY SKILLS

Leadership Skills

Radiologists and radiology managers must have excellent human relation skills. They need empathy toward others that allows them to identify with a variety of patients and situations. They need to understand the importance of body language as nonverbal communication. They must know how to listen, how to give verbal and nonverbal feedback, and how to judge the effectiveness of their communications. In leading the radiology team, radiologists and radiology managers delegate responsibilities, provide performance feedback, and monitor the outcomes of treatment. They also make sure that patient-flow in the radiology department is handled efficiently. A great sense of humor also helps.

Most radiologic technologists work in hospital radiology departments. They may also work in private physician offices, diagnostic-imaging centers, radiation treatment centers, and emergency care clinics. After receiving advanced education, some become educators in hospital- or college-based programs. Some become radiology administrators at facilities that offer diagnostic imaging or radiation treatment services. RTs may also be employed in the medical industry as sales, marketing and service representatives, product managers, or equipment application specialists. Some RTs start their own businesses, as authors, publishers, consultants, corporate trainers, providers of mobile imaging services, and owners of imaging manufacturing and supply agencies.

Continuing Education for the Radiologic Technologist

To remain a registered radiologic technologist (RT) in good standing with the ARRT, RTs must receive a minimum of 24 approved continuing education units in a 24-month period. If certification expires, the RT will have to complete additional education and training. The purpose of ARRT's mandatory continuing education policy is to ensure that all RTs remain current in their areas of specialization, because rapid technological advances in equipment and procedures are constantly altering standards of patient care.

Radiographer Most radiologic technologists work as radiographers. Their main job is taking images of the inside of our bodies using X-rays. These images are crucial for doctors to diagnose and understand various health issues. Instead of old X-ray films, nowadays, we mostly use digital tools to capture and view these images. So, rather than seeing X-rays on films, we often see them on computer screens, just like the photos we take with our phones. These images are stored on digitally on hard drives, servers, or the cloud. Besides taking regular X-rays, radiographers also use special techniques, like fluoroscopy, to create live video-like images. Sometimes, they use contrast agents (special dyes) that help highlight specific parts of our body to get clearer pictures. See **Table 27.2** for a detailed list of the procedures the radiographer performs.

Note: The term “X-ray” is often incorrectly used to describe what is actually a radiograph. An **X-ray** is an electromagnetic wave that has a wavelength much shorter than that of visible light. This shorter wavelength allows X-rays

Communicating with Voice Recording

Radiologists rely on computer technology to create diagnostic and treatment reports from their dictation. The radiologist must speak precisely and use correct medical terminology. Clarity is essential so that all members of the healthcare team will understand all parts of the report. Radiologists often spell out a complex term, to make sure it is correct. They may identify exactly where they want the punctuation marks—periods, commas, colons, semicolons, and so on—to be placed.

Follow-up

Why do radiologists take the time to spell certain words and include punctuation marks when they dictate findings?



Medical Science

STEM CONNECTION

X-Ray Production

X-ray images, simple in nature and commonplace in the medical world, are the product of a complex series of mechanical and chemical processes.

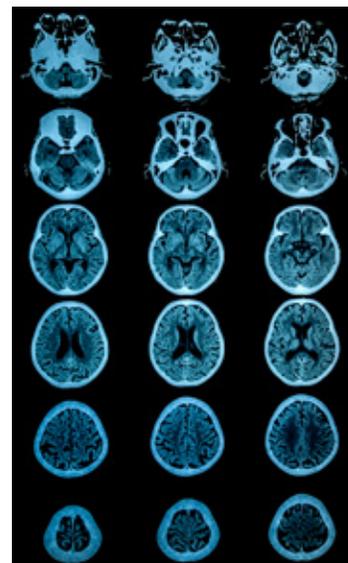


Fig. 27.12 Radiography

Radiographers are in high demand because of the use of radiography in medical diagnoses. *How is a fluoroscopic image stored?*

Table 27.2 Procedures Performed by Radiographers

Invasive Radiographic Procedures (Requiring Contrast Media)	Noninvasive Radiographic Procedures (Not Requiring Contrast Media)
Angiogram	Acromion Process
Arteriogram	Cervical Spine
Arthrogram	Chest
Barium Enema	Clavicle
Bronchogram	Facial Bones
Cholecystogram (For Gallbladder)	Lumbar Spine
Cystogram (Bladder X-ray)	Mastoids (Ear Bones)
Esophogram (For Esophagus)	Nasal Bones
Hysterosalpingogram (For Uterus and Fallopian Tubes)	Pelvis
Intravenous Cholangiogram (For Liver and Gallbladder)	Sacrum/Coccyx (Base of Spine)
Intravenous Pyelogram (For Kidneys and Bladder)	Shoulder
Lower Bowel Examination	Skull
Lymphangiogram (For Lymphatic System)	Thoracic Spine (Mid-back)
Myelogram (For Spinal Canal)	Lower Extremities: femur, knee, tibia/fibula, ankle, foot, toes
Sialogram (For Salivary Glands)	Upper Extremities: humerus, elbow, radius/ulna, wrist, hand, fingers
Upper Gastrointestinal Examination (For Stomach)	
Venogram (For Veins)	
Ventriculogram (For Heart Chambers)	

to penetrate objects and generate radiographs. Radiographs are two dimensional images on X-ray film.

Radiographers also may perform fluoroscopy. These X-ray images of a patient's anatomy are displayed on a monitor and stored electronically. Radiographic and fluoroscopic images use film emulsion or fluorescent screens to record decreasing differences of the X-rays as they pass through the various structures of human anatomy (see **Figure 27.13**).

The radiographic densities (blacks and grays) between two body parts are so similar that it is difficult to view them. Contrast media are used to make viewing easier. These are **radiopaque** or **radiolucent** substances that alter the passage of X-rays to the film emulsion or digital imaging plate. They are injected into the body to assist in imaging internal structures of the body. Iodine-based contrast media are injected into blood vessels; barium, often with air, may be swallowed or inserted into the rectum. After ingesting barium for upper gastrointestinal examinations, patients are advised to drink plenty of water since water prevents barium from hardening in the intestinal tract. (See **Figure 27.14**.)



Fig. 27.13 Fluoroscopy
Radiographers also perform fluoroscopy. What kind of output is created by this type of X-ray imaging process?

Nuclear Medicine Technologist

Nuclear medicine technologists use radioisotopes, often chemically bound to other chemicals, to obtain information about how well human anatomy functions. Radioactive drugs are used to help produce images. After drugs are injected into the body, special multi-detector cameras detect radioactivity and translate the signals into images of the anatomy on a computer. **Table 27.3** shows examples of procedures produced by nuclear medicine technologists.

Table 27.3 Procedures Performed by Nuclear Medicine Technologists

Procedure	To Diagnose
Gallium Scan	Lymphomas and metastatic tumors
Gastroesophageal Reflux Scan	Heartburn, regurgitation of stomach contents, and difficulty swallowing
Multigated Acquisition Scan	Heart disease
Positron Emission Tomography (PET) often performed in conjunction with a CT scan	Blood flow, heart metabolism, brain biochemical activity, and various cancers
Radioactive Iodine Uptake	Thyroid function
Single Photon Emission Computed Tomography (SPECT)	Blood flow and liver function
Thallium Exercise Test	Heart disease

Radiation Therapist

Radiation therapists assist radiation oncologists by administering targeted radiation doses to cancer cells in the patient's body. Radiation therapists work with other staff members to ensure comprehensive treatment of cancer patients. They must be good team players.

Advanced Practice Roles of the Radiologic Technologist With additional education, training, and experience, a radiologic technologist can perform advanced techniques and procedures in the careers listed below.

Cardiac-interventional technologists use special radiographic and fluoroscopic imaging equipment. They work with radiologists and other specialists, such as cardiologists and neurologists. The physicians guide catheters into a patient's body and inject contrast media to visualize veins and arteries. Cardiovascular-interventional technologists take sophisticated images of the circulatory systems.

Computed tomography technologists use a kind of X-ray machine called a computed axial tomography (CT or CAT) scanner. This equipment obtains transverse cross-sectional anatomical images of the body called CT or CAT scans (see **Figure 27.15**). Those images view the

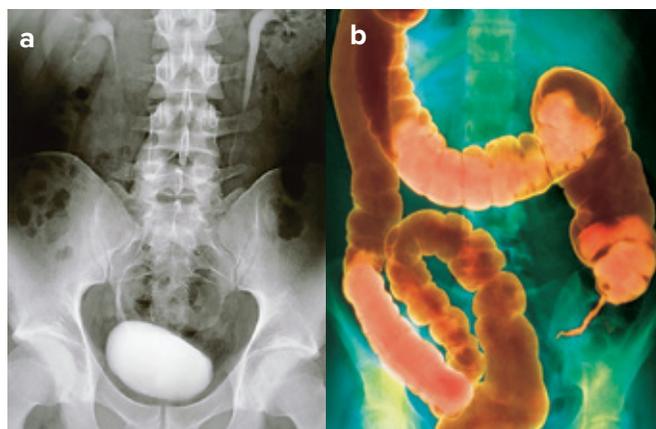


Fig. 27.14 Contrast Contrast media make viewing easier. (a) What kind of contrast medium is used to visualize kidneys, ureters, and bladders? (b) What kind of contrast medium is used to visualize a patient's colon?

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body in slices, like slices of bread in a loaf. Each image is one “slice.” Special technology uses multiple detectors and continuous (spiral) imaging, to provide more information in less time.

The images may be viewed and manipulated on a computer allowing 3D reconstruction.

Magnetic resonance technologists use a special machine to take longitudinal (vertical) and transverse (horizontal) cross-sectional anatomical images of the body. These images may be viewed on a computer monitor and transferred to film.

A magnetic resonance imaging (MRI) unit contains a large electromagnet that subjects the body to a strong magnetic field. The field aligns the hydrogen atoms in the body. When a pulse of radio waves is directed at the tissues to be imaged, the hydrogen atoms change the alignment of their nuclei. When the radio waves are turned off, the nuclei realign and give off energy that is converted to an electrical signal. The signal is clearer than most images produced by radiography or computed tomography.

Magnetic resonance technologists must question patients about the presence of metal objects in their body, such as metal plates, pins, or sutures. The strong magnetic field can cause these metal objects to move in the body or even emerge through the skin, causing injury. For this reason, the room where MRIs take place must be magnet-free. Newer open MRI units have helped patients who may be claustrophobic in older units which have a gantry or tube.

Mammographers Mammographers are specialized radiologic technologists who must be certified by the U.S. Food and Drug Administration to perform mammograms. This certification indicates that they adhere to the quality guidelines of the Mammography Quality Standards Act. Mammograms are essential tools for detecting breast cancer in its early stages, which can significantly increase the likelihood of effective treatment.

In 2023, it’s projected that 300,590 women and 2,800 men in the U.S. will be diagnosed with breast cancer. Sadly, around 43,700 individuals will lose their lives to the disease. It is crucial to understand that early detection can be lifesaving. Other diagnostic tools are used to detect breast cancer including sonography and MRI.

These diagnostic tests, especially the MRI, can sometimes be even more precise than mammograms. As a result, MRIs are becoming a more common method for screening breast cancer. Sonography may also be utilized once a growth has been found to assist with visualization when obtaining a biopsy.



Fig. 27.15 CT Scan In a CT scan, the images appear on monitors and are transferred to film. What kind of RT obtains special X-ray-generated cross-sectional images like this CAT scan of the brain?



Fig. 27.16 MRI An open MRI unit. What patient problem does this type of unit help solve?



Fig. 27.17 Mammography Breast-cancer screening. What kind of RT works with special X-ray equipment to take images of patient breast tissue?

Sonographers Sonographers use a transducer device to send safe high-frequency sound waves into the body. These sound waves bounce back from internal organs and tissues, creating echoes. These echoes are then transformed into visual images displayed on a computer screen (refer to **Figure 27.18**). With advancements in technology, ultrasounds now have the capability to produce 3D and even 4D images, giving a more detailed and dynamic view of the inside of the body. These images can be saved digitally in PACS systems or printed for radiologists to examine. The American Registry of Diagnostic Medical Sonographers (ARDMS) certifies most sonographers.



Fig. 27.18 Sound Waves Viewing an unborn child. What kind of RT works with high-frequency sound waves to produce images of a fetus?

Bone Densitometry Technologists use a special X-ray machine to measure the density of bone mineral at specific locations of the body. This test is used to check for osteoporosis and to estimate the risk of bone fracture.

Quality Management Technologists perform tests on imaging equipment and ancillary components. The purpose is to keep the equipment properly calibrated (see **Figure 27.19**).

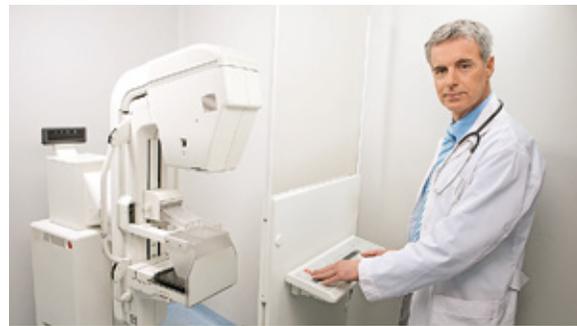


Fig. 27.19 Calibration Testing imaging equipment. What kind of RT calibrates imaging equipment using special quality management tools?

Job Responsibilities of the Radiologic Technologist

Regardless of their area of certification or advanced practice, all radiologic technologists

- follow the **As Low As Reasonably Achievable (ALARA)** guideline. It is the responsibility of all imaging technologists to practice radiation safety using all reasonable methods to minimize radiation doses.
- maintain aseptic and sterile techniques and follow standard precautions when dealing with patients and coworkers.
- identify the patient.
- transport patients from the waiting room or patient's room to the radiology department or suite.
- explain the procedure to the patient in a courteous and professional manner.
- assist patients onto and off of examination tables as necessary.
- position patients for the desired anatomy to be imaged or irradiated. Use alternative positioning methods as the patient's condition dictates. Use positioning aids and sponges to minimize patient motion and discomfort.
- use proper shielding and radiation protection to ensure the safety of patient and healthcare personnel.
- calculate and set proper imaging exposure and radiation treatment factors. The result must be high-quality

+

Safety

STEM

CONNECTION

Dangerous Allergies
Shellfish contain iodine. Patients who are allergic to shellfish may find it difficult to tolerate iodine-based contrast media used for certain procedures. Frequently, they develop an allergic reaction to the contrast media. In some cases that reaction can be life-threatening. It is important to ask the patient about any allergies to food or medications before using contrast media.

Create a Comforting Environment

The radiology environment can be intimidating to patients who are under the stress of illness or injury. Large pieces of equipment and technical personnel in lab coats can paint a cold and sterile picture in the patient's mind. This may be interpreted as dehumanizing. RTs can help prevent this by making sure that patients are treated like people and not just a number or a body part. This involves making sure that all aspects of the patient's needs are attended to during the time they spend in the radiology environment. For example, imaging and treatment tables can be hard and cold. Attentive RTs will see that the tables are covered with sheets and that patients have access to pillows, blankets, and cushions for support and warmth. They also will ensure that their patients have access to bathrooms, drinking water, and other comforts.

images or effective radiation treatments based on a proper assessment of the patient's age, body type, physical condition, and suspected pathology.

- assist the radiologist during procedures by changing films, positioning patients, and preparing contrast media and drugs.
- use aseptic and sterile technique when assisting radiologists in needle, guide wire, and catheter insertions, and tissue biopsies.
- perform image-processing procedures such as film development, reloading cassettes, radiographic film duplication and image subtraction, reloading of film bins, and cleaning cassettes and screens.
- maintain a clean and orderly work environment that is properly supplied for all diagnostic procedures. Ensure that sterile packaged supplies are on hand and are not damaged or outdated.
- use all equipment and accessories in a hygienic and efficient manner.
- perform office tasks, such as film and report filing, scheduling examinations, answering phones and relaying information, completing examination requisitions, retrieving previous films, and ensuring files and records are properly completed. Understand departmental policies and procedures, including examination routines, examination scheduling, and patient preparation. Instruct patients and nursing personnel as required.
- work after-hours "on-call" shifts.
- perform quality assurance analysis and document quality control.
- maintain employee-patient professionalism in all aspects of patient care by appearing professional and hygienic at all times.

Reading Check

List some technologies other than X-ray technology that a radiologic technologist might use.

Picture Archival and Communications Systems (PACS) Administrator

What role does image management play in the field of radiology?

The use of Picture Archival and Communications Systems (PACS) is common. Diagnostic images that are digitized can be viewed on computers and archived electronically. Some radiologic technologists are making a career change to become information management experts. In that capacity, they capture, manipulate, transmit, archive, and retrieve images within a computer network or over the Internet.



Fig. 27.20 PACS Administrator
Managing archived images. *What is the name of computer system called that allows RTs to capture, manipulate, transmit, archive, and retrieve a patient imaging report within a network or over the Internet?*

When a patient's file is archived on the Internet, healthcare professionals can retrieve reports from practically anywhere (see **Figure 27.20**). The PACS Administrator is the person who oversees the PACS system planning, implementation, and maintenance. These individuals must have a understanding of clinical healthcare and information technology.

Reading Check

Explain the benefit of having patient files archived on the Internet.



Fig. 27.21 Radiology Aide Managing radiology files. Which individuals are hired by busy radiology departments to help transport patients and file radiology reports?

Radiology Aide

How does the radiology aide help a radiology department function?

Most busy radiology departments employ one or more radiology aides to provide assistance to members of the radiology team. Aides may take over some of the radiologic technician's functions listed above, such as transporting patients to and from the radiology department, keeping equipment and rooms clean, answering phones, filing, and developing films (see **Figure 27.21**).

Reading Check

List some of the job duties of the radiology aide.

27.1 Careers in Radiology and Radiologic Technology Review

After You Read

- 1. Explain** the two primary roles of a radiologist.
- 2. Identify** two primary roles of the radiologic technologist.
- 3. List** the radiologic technologist's advanced practice roles.
- 4. Describe** the settings in which radiologists and radiologic technologists may work.
- 5. Contrast** invasive and noninvasive diagnostic imaging procedures.
- 6. Explain** how the medical dosimetrist and the PACS administrator work to assist the radiology team.

Online Explorations

Entry Requirements

Research online to determine the requirements for a radiologic technology school in your area. Assess your career interests and current level of preparation. Write a short paragraph outlining what you would need to accomplish to enter this field.

27.2 Procedures in Radiology and Radiologic Technology

Radiation Protection

What methods are used to guard the body against overexposure to radiation?

Exposure to radiation causes cell damage. While some body tissue cells can recover fully from normal levels of radiation, others cannot. The damage can be permanent. Radiation can build up to a level that will cause damage to body cells. Before you perform any procedure, be aware of the dangers of radiation to protect yourself and your patients.

Safety is a key issue in the field of radiology. A career in radiology means working around radiation for many years. Members of the radiology team must protect patients as well as themselves from needless exposure. These precautions will help reduce unnecessary exposure.

- Perform the procedure correctly the first time to eliminate retakes.
- Use the correct film size and be familiar with X-ray film processing techniques that rely on the time, temperature, and specific chemistry methods. Replenish X-ray film processing chemistry regularly.
- Use lead shielding, such as lead-lined aprons, gloves, walls, and blocks, during examinations. These shields should cover the reproductive organs unless that is the site to be imaged. However, do not rely on shielding as the only method of radiation protection. Any body part outside of the shielding may not be protected. Also, a lead-lined wall or partition is not necessarily safe for persons on the other side. Radiation can bounce or scatter.
- Collimate to the part of the body requiring exposure. A **collimator** is a beam-restricting device mounted under the X-ray tube housing. This beam allows you to be precise when performing the radiograph (see **Figure 27.22**). Use the screen-film combination that provides adequate detail at the lowest exposure possible.
- Maintain a distance of at least six feet from the source of radiation.
- Wear a radiation badge that monitors and **registers** the amount of exposure; maximum allowed exposure is dependent upon age.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- collimator
- inverse square law

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of the book.

- register



Fig. 27.22 X-rays A typical X-ray setup. What is the box-like device that is hanging below the X-ray tube housing called? What is its purpose?



Medical Math

STEM CONNECTION

The Inverse Square Law

The **inverse square law** is used to determine a safe distance from the source of radiation while performing radiographs.

- Work within established guidelines. For example, individuals under 18 years of age are not permitted to work around radiation, because their tissue is more susceptible to radiation injury.

Reading Check

Explain why it is important to limit exposure to radiation.

Adult Posterior-Anterior (PA) Chest Radiographic

The purpose of this procedure is for you to experience the steps involved in one of the simplest and most frequently performed radiographic procedures, the adult posterior-anterior (PA) chest radiograph. The goal is to generate a PA chest radiograph of the highest quality, so that the radiologist can develop an accurate diagnosis for the patient's physician.

Adult PA Chest Radiographic Film Evaluation

A radiographer must troubleshoot problems. The time, temperature, and specific activity of the X-ray film processing play critical roles in getting the right contrast and density on the radiograph. These affect image quality just as the X-ray exposure settings and scatter radiation can affect image contrast and density. Automatic film processors are monitored and maintained by quality management technologists.

27.2 Procedures in Radiology and Radiologic Technology Review

After You Read

1. **Identify** an important way of protecting the patient from unnecessary radiation exposure.
2. **Summarize** how to protect the radiologic technologist from radiation exposure.
3. **State** the inverse square law.
4. **Name** the anatomy seen on a chest radiograph.
5. **Recall** why a patient must remove all clothing and objects from the chest prior to a chest radiograph.
6. **Explain** why it is important for a patient not to move during the radiographic exposure.
7. **Analyze** why it is preferable not to repeat a radiographic procedure at your school.

Online Explorations

PACS

Go online to learn more about PACS. What are the advantages of PACS? What skills must a healthcare professional have to use the PACS system? Write a brief report on your findings, including an illustration.

Chapter 27 Review

Chapter Summary

Section 27.1

- Diagnostic radiologists use the imaging modalities of radiography, fluoroscopy, computed tomography, ultrasound, magnetic resonance, and nuclear medicine in the diagnosis of disease and trauma.
- Radiation oncologists use radiation generated from external beam therapy or radioisotopes to treat cancer.
- Radiologic technologists are healthcare professionals who support radiologists in the performance of their duties. They perform the diagnostic procedures for the diagnostic radiologist or administer treatment plans for the radiation oncologist.
- Radiologic technologists in one of the primary fields can qualify to become cardiovascular-interventional technologists, computed tomography technologists, magnetic resonance technologists, mammographers, sonographers, bone densitometry technologists, and quality management technologists.
- Invasive imaging examinations, such as coronary angiography, require the introduction of contrast media into various systems of the body to assist with visualization. Noninvasive procedures, such as a PA chest radiograph, do not.

Section 27.2

- An important precaution that a radiographer can take to help protect the patient from unnecessary radiation exposure is to perform the procedure correctly the first time to eliminate the need for retakes.
- An important precaution that helps to protect radiologic technologists from unnecessary radiation exposure is the placement of a protective barrier between themselves and the source of radiation that is strong enough to stop the primary beam.
- The inverse square law states that radiation intensity is inversely proportional to the square of the distance.

Chapter 27 Assessment

Critical Thinking/Problem Solving

1. Radiation is used to help diagnose disease and treat cancers. What factors might distinguish the relatively safe use of radiation to diagnose disease from the relatively risky use of radiation to treat cancer? Is there any risk involved in using radiation as a diagnostic tool?
2. Explain why pregnant women should take extra precautions to avoid exposure to radiation. (Hint: fetal cells develop rapidly, as do cancer cells.)
3. You are about to undergo a radiographic procedure. The radiographic technologist gets everything ready, and you notice that they have not provided lead shielding to protect your reproductive organs from exposure to X-rays. What should you do? Why is that protection necessary?
4. As the “on-call” radiographer for a hospital, you are awakened at 2 A.M. You learn that there has been a major automobile accident, and that several patients are on the way to the emergency room. Many radiographs will be taken. At the hospital radiology department, you discover that all of the patients are bleeding and that body fluids are everywhere. How will you protect yourself from contracting blood-borne diseases? Should you just assume that your patients have no communicable diseases?
5. Determine all of the infection control practices that are needed to deal with the patients in Question 4. Make a list and give it to your instructor.

21ST CENTURY SKILLS

6. **Teamwork** With a partner, practice placing each other in the position necessary to perform a chest radiograph. The patient should stand upright with their feet spread slightly apart and weight evenly distributed, then raise the chin and rest it on the film holder. The hands should be on the lower hips, palms out, elbows partially flexed and shoulders rotated against the film holder. Shoulder rotation is important to move the shadow of the shoulder blade out of the lung fields.
7. **Teamwork** Your partner is going to have an abdominal radiograph. Have them lie on a bed or treatment table in anatomical position. Using a towel or towels as a “shield,” place it on the correct area or areas to protect your partner during the procedure. Pretend that you are going to take the radiograph. Step away from your partner and give them the necessary instructions. Click the button to produce the radiograph at the correct moment in your partner’s breathing process. Give your partner post procedure instructions.

Sample Review - Not for Classroom Use

Chapter 28

Ophthalmic Care



Essential Question

As you read this chapter, keep this question in mind:

Would you rather be an optometrist or an ophthalmologist?

Without vision, you could not read this book or do many things that you take for granted. More than half of the people in the United States wear glasses or contact lenses to correct their vision. Corrective lenses are obtained from people working in the ophthalmic field. Ophthalmic simply means “pertaining to the eye.” People working in this field provide care for the eyes, including the prevention and treatment of eye and vision disorders. This chapter discusses careers including ophthalmologist, optometrist, orthoptist, dispensing optician, ophthalmic technologist, technician, assistant, and laboratory technician.

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Sample Review - Not for Classroom Use

Reading Guide

Objectives

After completing this chapter, you will be able to:

- **Compare** the roles and responsibilities of the optometrist and ophthalmologist.
- **Illustrate** the role and responsibilities of an orthoptist.
- **Describe** the roles and responsibilities of ophthalmic medical personnel.
- **Examine** ophthalmic career opportunities related to the preparation and fitting of corrective lenses.
- **Demonstrate** four ophthalmic procedures.



Before you Read

Connect: Have you ever been examined or treated by an ophthalmic professional? What was the experience like?

Main Idea

Individuals in the ophthalmic profession test vision, provide corrective lenses, and perform eye surgery to help prevent or correct vision problems.

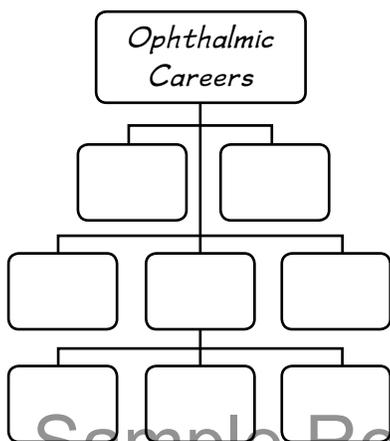
Note-Taking Activity

Draw this table. Write key terms and phrases under **Cues**. Write main ideas under **Note Taking**. Summarize the section under **Summary**.

Cues ◦ ◦	Note Taking ◦ ◦
Summary	

Graphic Organizer

Before you read the chapter, draw a diagram like the one below. As you read, write the careers covered in this chapter into the diagram.



28.1 Careers in Ophthalmology

The Optometrist and the Ophthalmologist

What types of eye doctor are there?

Two types of doctors can examine eyes and prescribe glasses. They are the ophthalmologist and the optometrist (see **Figure 28.1**). Although they are both eye doctors, their training and practice are not the same. The ophthalmologist is a medical doctor, who diagnoses and treats diseases, injuries, and disorders of the eye. They may perform eye surgery as well. An optometrist is a doctor of optometry but is not a medical doctor. They examine the eyes to diagnose vision problems and eye diseases. For an overview of all ophthalmic careers, see **Table 28.1**.

The Job of the Ophthalmologist

An ophthalmologist is an MD who is licensed to practice medicine and surgery. They may perform any or all of the same duties as an optometrist but they can also treat eye injuries and perform surgery on the eye.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- cataract
- myopia
- retina
- hyperopia
- astigmatism
- presbyopia
- cornea
- amblyopia
- strabismus

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of this book.

- focus



Fig. 28.1 Testing for Glaucoma Which two types of doctors are qualified to perform this test?

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Sample Review - Not for Classroom Use

Table 28.1 Overview of Ophthalmic Careers

Occupation	Educational Requirements	Certification or Licensing Agency	Job Outlook
Ophthalmologist	Four years undergraduate education, four years graduate education, three years minimum specialization in ophthalmology	Individual state boards of medical examiners, additional board examinations specific to ophthalmology as administered by the state medical board	Average growth
Optometrist	At least three years of preoptometric study, a four-year doctor of optometry degree from an accredited optometry school	State board of optometry, American Optometric Association	Much faster than average due to an aging population and increased attention to vision care
Orthoptist	Completion of a 24-month accredited program that includes a residency after completion of a 4-year college degree	Certificate of proficiency from the American Orthoptic Council	Much faster than average growth
Ophthalmic Technologist	Completion of an ophthalmic medical technologist training program accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP)	Certification from the Joint Commission on Allied Health Personnel in Ophthalmology (JCAHPO), demonstration of ability required for certification	Above average growth as the need for qualified clinical support personnel increases
Ophthalmic Technician	Completion of an ophthalmic medical technician training program accredited by CAAHEP	Certification from the Joint Commission on Allied Health Personnel in Ophthalmology (JCAHPO), demonstration of ability required for certification	Above average growth as the need for qualified clinical support personnel increases
Ophthalmic Assistant	Completion of a clinical ophthalmic medical assisting training program approved by the Committee on Accreditation for Ophthalmic Medical Personnel (CoA-OMP) or on-the-job training. Independent study courses are also available	Certification not required but can be obtained through the Joint Commission on Allied Health Personnel in Ophthalmology (JCAHPO)	Above average growth as the need for qualified clinical support personnel increases
Ophthalmic Laboratory Technician	On-the-job training	None	Slow to no growth due to automated lens creation
Dispensing Optician	On-the-job training, sometimes as an apprenticeship; a two-year degree is also available	About half the states require a license through a state licensing group. The American Board of Opticianry (ABO) and the National Contact Lens Examiners (NCLE) also provide certification for skills acquired	Average growth

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Eye Surgery

One common type of surgery is to remove **cataracts** (see **Figure 28.2**). Cataracts are cloudy areas on a normally clear eye lens. They interfere with the entrance of light into the eye and cause loss of vision. The surgery removes the cloudy lens and replaces it with an artificial one. A new lens can be made to improve the patient's vision so they may need less or no vision correction. Patients without cataract can actually have their lens exchanged to improve their vision.

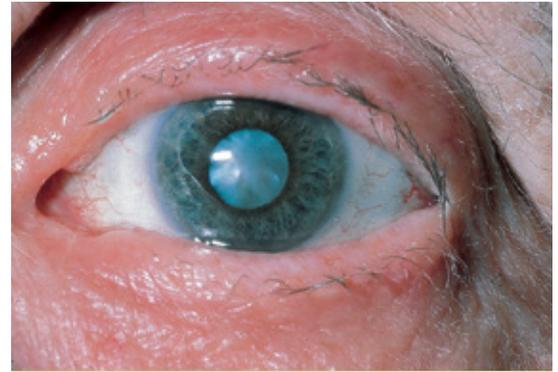


Fig. 28.2 Cataract Cataracts are cloudy areas. What can be done to correct this cloudy lens?

Another common type of surgery is corrective eye surgery, which corrects visual acuity or the ability to see. The objective of the surgery is to reduce or eliminate the need for glasses and contacts. Corrective eye surgery can help visual disorders such as:

- Nearsightedness is also called **myopia**. This is a condition in which visual images come to a **focus** in front of the **retina**. The result is defective vision of distant objects.
- Farsightedness is also called **hyperopia**. This is a condition in which images come to a focus behind the retina. Near objects are blurry, but far objects are in focus.
- **Astigmatism** is a condition caused by an irregularly shaped cornea. It results in blurred vision.
- **Presbyopia** is the inability of the eye lens to focus incoming light. This results in blurred vision at a reading distance and eyestrain. Most people develop presbyopia in their 40s.

LASIK, or “laser-assisted in situ keratomileusis,” is one type of corrective laser eye surgery. During this surgery an instrument is used to create a thin, circular flap in the **cornea**. The cornea is the transparent anterior portion of the outer layer of the eyeball. It is important in the correct focus of light. The surgeon folds the flap created out of the way, and removes some corneal tissue with a laser. The laser uses a cool ultraviolet light beam to remove precisely very tiny bits of tissue from the cornea to reshape it. When you reshape the cornea correctly, it provides clearer vision than before. The flap is then laid back in place, covering the area where the corneal tissue was removed. The actual procedure takes less than one minute for each eye (see **Figure 28.3**).

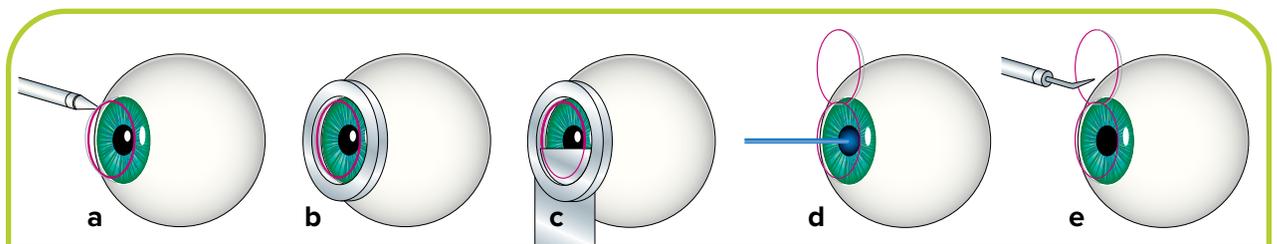


Fig. 28.3 LASIK LASIK is one type of corrective eye surgery. **(a)** After administering drops to numb the eye, the ophthalmologist marks the eye where the flap will be cut and then replaced. **(b)** A suction ring holds the eye still and pressurizes it until it is firm enough to cut. **(c)** A tiny flap is sliced in the cornea. **(d)** The flap is moved out of the way but remains attached. **(e)** A laser is used to remove tissue to reshape the cornea and the flap is replaced. How is a laser used to correct vision?

There are other types of corrective eye surgery. Photorefractive keratectomy (PRK), corneal implants, and radial keratotomy are examples. In general, these procedures all aim to correct the shape of the cornea. The shape of the cornea affects the way light focuses onto the retina and therefore changing its shape improves and corrects vision.

The Job of the Optometrist

Most optometrists work in a private practice. They may have their own offices and hire workers to assist them. Operating a professional office requires the owner to have the skills to develop a patient base; hire, train, and manage employees; keep records; order equipment and supplies; and oversee the finances of the business.

The optometrist

- uses instruments and observation to determine eye health. The ophthalmoscope (see **Figure 28.4**) is one type of instrument commonly used.
- tests patients' visual acuity, depth and color perception, and ability to coordinate and focus the eye.
- prescribes eyeglasses and contact lenses.
- provides vision therapy and rehabilitation.
- administers drugs to aid in the diagnosis of vision problems.
- prescribes drugs to treat some eye diseases.
- diagnoses eye conditions due to diseases such as diabetes and high blood pressure.
- refers patients to other healthcare practitioners.

Optometrists may choose to specialize in any of the following areas:

- Working with the elderly, children, or partially sighted patients to develop specialized visual devices
- Developing and implementing ways of protecting workers' eyes from on-the-job strain or injury
- Providing contact lenses
- Providing sports vision care and/or vision therapy
- Working with ophthalmologists to provide preoperative and postoperative care to patients whose vision has been corrected by laser surgery or have had cataract or other eye surgery



Fig. 28.4 Ophthalmoscope The ophthalmoscope is a common instrument used to view the interior eye structures including the retina, optic nerve, and the blood vessels. *Which vision disorders can occur if light is focused in front of the retina or behind the retina?*

- Working as a consultant for industrial safety programs, insurance companies, and manufacturers of ophthalmic products
- Teaching optometry and performing optometry research

Reading Check

Compare and contrast the job responsibilities of the ophthalmologist and the optometrist.

Orthoptist

What conditions are the result of problems with eye muscles?

When a patient has a condition of the eyes that involves the eye muscles, they may seek treatment from an orthoptist. Orthoptists diagnose and treat patients with **amblyopia**, **strabismus**, and defects in their eye movements or their binocular vision. Amblyopia, which is poor vision in one eye, is also known as “lazy eye.” Strabismus occurs when one eye focuses properly, but the other eye strays. This creates a cross-eyed appearance. Orthoptists teach patients or their parents how to perform corrective exercises at home.

Most patients are children who suffer from strabismus or other visual disabilities. Children with faulty vision often lack self-esteem. A visual disability can also slow the learning process and make the child feel that they are a slow learner. Helping children improve their vision may also help them acquire self-confidence.

An orthoptist usually works with an ophthalmologist, performing any or all of the following tasks:

- Evaluating vision and ocular alignment using special examination techniques
- Measuring visual acuity, ability to focus, and movement of the eyes
- Checking near vision and depth perception
- Estimating the eyeglass correction
- Performing glaucoma tests
- Evaluating color vision
- Assisting in ophthalmic surgery
- Teaching patients and parents exercises to strengthen eye muscles
- Performing research to evaluate current methods of treatment, devise new modes of exercises, and increase the understanding of binocular vision
- Teach orthoptics in hospitals or clinics

Reading Check

Recall some ways in which an orthoptist can help a child.

Ophthalmic Medical Personnel

How does a career as an ophthalmic assistant begin?

The ophthalmic technologist, ophthalmic technician, and ophthalmic assistant are all classified as ophthalmic medical personnel (OMP). Most work in private clinics or offices under the direction of an ophthalmologist or optometrist. The main OMP function is to assist the ophthalmologist or optometrist, collect data, dispense treatments ordered, and supervise patients. OMPs may also assist with ophthalmic surgery.

Ophthalmic technologists are also trained to perform numerous other duties. They may take ophthalmic photographs or use ultrasound imaging equipment. They may provide instruction and supervise other workers. They are expected to perform at a higher skill level than ophthalmic technicians and assistants and to use clinical technical judgment. However, they do not work on their own. They cannot diagnose or treat eye disorders or prescribe medications.

The tasks of the ophthalmic technician overlap in many ways with those of the ophthalmic technologist. However, the technologist has completed more advanced training than the technician, and has assumed a larger number of advanced responsibilities as a result of that training.

Many ophthalmic medical personnel start with little or no training. They may begin as receptionists in an ophthalmic medical office. With motivation and training, these workers may move up to a more technical position and perform additional duties. Some individuals start as medical assistants, and then specialize to become certified in ophthalmic care.

The Job of Ophthalmic Medical Personnel

Depending upon the type of practice and the level of training and certification, OMP may perform any or all of the following tasks:

- Take medical history and perform diagnostic tests
- Take measurements of the eye and surrounding tissue
- Test visual acuity and ocular fields
- Perform all the ophthalmologic tests necessary for both preliminary and highly specific eye exams
- Administer topical ophthalmic and oral medications
- Instruct the patient in the care and use of contact lenses
- Maintain and sterilize surgical instruments
- Assist with ophthalmic surgery
- Assist with fitting contact lenses
- Provide supervision and instruction to other OMP



Preventive Care & Wellness

Protect Your Vision

To protect your eyes and vision, follow these simple guidelines:

- Have an eye examination at least every one to two years.
- Have regular health examinations. Your general health can affect your vision.
- Report any abnormalities such as blurred vision, double vision, eye pain, increased sensitivity to light, flashes of light, regular headaches, loss of vision, excessive tearing or dryness, loss of color perception, or halos around lights.
- Wear sunglasses or prescription glasses with ultraviolet (UV) light protection when in the sun, even during winter.
- Wear protective eye equipment when working with chemicals, during sports, when cutting grass and weeds, or in any other situation in which material may fly into your eyes.

The Ophthalmic Laboratory Technician

How are prescription eyeglasses made?

The ophthalmic laboratory technician works with the dispensing optician to prepare corrective lenses. Ophthalmic laboratory technicians are also known as manufacturing opticians, optical mechanics, or optical goods workers. They prepare prescription eyeglasses or contact lenses, and some make lenses for other optical instruments, such as telescopes and binoculars. They cut, grind, edge, and finish lenses according to specifications given by dispensing opticians, optometrists, or ophthalmologists. They may also insert lenses into frames to produce finished glasses. Technicians use automated equipment to make lenses and many dispensing opticians grind and insert lenses themselves. For these two reasons the profession of ophthalmic laboratory technician is expected to remain the same.

The Dispensing Optician

How do dispensing opticians assist ophthalmologists or optometrists?

Dispensing opticians fit eyeglasses and contact lenses (see **Figure 28.5**), following prescriptions written by ophthalmologists or optometrists. Many dispensing opticians are trained on the job. Formal education programs lasting up to two years are also available.

Both ophthalmologists and optometrists may employ dispensing opticians. A dispensing optician may also choose a career in the optical department of a retail store or pharmacy or work for an online optical dispensary. More individuals are ordering their glasses online which continues to change the career of the dispensing optician. Whatever their place of employment, dispensing opticians always work directly with patients in person or online. They may perform any or all of the following duties:

- Examine written prescriptions to determine lens specifications.
- Recommend eyeglass frames, lenses, and lens coatings after considering the prescription and the patient's occupation, habits, and facial features.
- Measure patients' eyes, including the distance between the centers of the pupils and the distance between the eye surface and each lens.
- Prepare work orders that give ophthalmic laboratory technicians the information needed to grind and insert lenses into their frames.
- Verify that the lenses have been ground to specifications. (Or they may grind and insert the lenses themselves.)
- Reshape or bend the frame so that the eyeglasses fit the patient properly.
- Regrind lenses that have been slightly scratched.



Fig. 28.5 Dispensing Optician A dispensing optician fits glasses and contact lenses. *In what settings could this optician choose to be employed?*

- Fix, adjust, and refit broken frames.
- Instruct patients about adapting to, wearing, or caring for eyeglasses.
- Teach insertion, removal and care of contact lenses.
- Keep records on customer prescriptions, work orders, and payments.
- Track inventory and sales, and perform other administrative duties.

Reading Check

Name several tasks that go into the making of eyeglasses.

28.1 Careers in Ophthalmology Review

After You Read

1. **Explain** the purpose of LASIK surgery.
2. **Identify** two eye conditions that are treated by an orthoptist.
3. **List** at least three duties of ophthalmic medical personnel.
4. **Assess** how the job of an ophthalmic technologist differs from that of an ophthalmic assistant.
5. **Compare** the responsibilities of an ophthalmic laboratory technician and a dispensing optician.
6. **Contrast** an MD and an OD.

Online Explorations

Eye Surgery

Search online for information about new types of eye surgery available to correct vision. Choose one type of surgery and write a brief report describing the procedure, its purpose, and possible complications.

28.2 Procedures in Ophthalmic Care

Ophthalmology Career Skills

How can you assess another person's vision?

The procedures in this section involve some of the career skills that are performed by optometrists, ophthalmologists, and other eye-care professionals. Correctly assessing the vision of patients (both their ability to see objects at different distances and their perception of color) is a skill central to these professions.

Helping patients care for eyeglasses and administering eye drops are additional tasks that you may perform, depending on your chosen career path and the environment in which you work. Eye drops are often used before the optometrist or ophthalmologist performs an examination. They may also be used for reasons including pain management, antibiotic treatment, glaucoma, antihistamine treatment, or eye lubrication.

Measuring Visual Acuity

Visual acuity, or the ability to see, is tested as part of a physical or visual exam. Routine vision screening tests near and far **vision**. The Snellen eye chart is most commonly used to test far vision. Variations of the Snellen eye chart are used for young children and others who are unable to read.

Testing Color Vision

The ability to perceive color is based upon seeing red, green, and blue. Most people with color deficiency have difficulty seeing one or two of those colors, not all three. It is uncommon for someone to see no color at all.

Caring for Eyeglasses

Eyewear is an important investment and must be cared for properly. Glasses can easily be broken or scratched. Replacing an expensive pair of glasses is a hardship for many patients.

Administering Eye Drops

Eye drops may be used for a variety of reasons, some of which are pain management, antibiotic treatment, antihistamine treatment, or eye lubrication. They are also used to treat certain conditions such as infections and **glaucoma**, a group of diseases involving pressure in the eye. Eye drops are often used before the optometrist or ophthalmologist performs an examination.

Vocabulary

Content Vocabulary

You will learn these content vocabulary terms in this section.

- visual acuity
- glaucoma

Academic Vocabulary

You will see this word in your reading and on your tests. Find its meaning in the Glossary in the back of this book.

- vision

28.2

Procedures in Ophthalmic Care Review

After You Read

1. **Determine** how far the vision chart should be from the patient when testing far vision or when testing near vision.
2. **Indicate** three ways that you may be able to tell a patient is having difficulty when screening for visual acuity.
3. **Describe** what it means to have the vision problem known as color deficiency.
4. **Name** at least two ways to prevent scratching and breaking eyeglasses when cleaning or caring for them.
5. **Identify** three reasons why a patient would need eye drops.

Online Explorations

Visual Acuity

Search for an online visual acuity or color vision-screening test. Read the directions carefully and test your own or a partner's vision or color vision. Compile the results into a written report.

Chapter 28 Review

Chapter Summary

Section 28.1

- The ophthalmologist and the optometrist are both doctors who examine eyes and prescribe glasses. However, the ophthalmologist is a medical doctor and can also perform surgery on the eye.
- The orthoptist works with patients who have visual problems that require eye exercises and other visual therapies.
- Ophthalmic medical personnel include the ophthalmic technologist, ophthalmic technician, and the ophthalmic assistant. These individuals assist the ophthalmologist or optometrist with care and treatment of the eye and vision.
- Careers in ophthalmic care that involve the preparation and fitting of corrective lenses are those of the ophthalmic laboratory technician and the dispensing optician.

Section 28.2

- When performing vision screening, you will test for near and far vision using specially designed charts. These determine the vision based upon the size of the letter and the distance from the patient.
- Color deficiency is the inability to see one or more of the primary colors of red, green, or blue. Color vision must be tested in children and in individuals who require perfect color perception as part of their job.
- Keeping the patient's glasses clean will prevent accidents. Care must be taken to ensure the glasses are not broken or scratched during the cleaning process.
- Eye drops are administered during eye examinations to treat disease, infection, and pain. Eye drops may be administered by various levels of ophthalmic personnel depending upon the type of medication.

Chapter 28 Assessment

Critical Thinking/Problem Solving

1. As an ophthalmic assistant, you are performing a vision screening. The patient starts reading the letters on the 20/20 line in order. Once you start randomly pointing at the letters on that line, you notice the patient is squinting and leaning forward. After not being able to read the line in a random fashion, the patient becomes angry and says, "I've already read that line. You don't have to test me anymore." What should you do?
2. You are administering a color vision test and come to a plate with a number to be identified. The patient says, "There's no number there! Why are you asking me about a number?" What should you say or do?
3. Explain what it would be like to practice as an ophthalmologist as compared to other medical specialties such as internal medicine, general surgery, gastroenterology, or emergency medicine.
4. How would you handle setting up an eye examination for a person who is confused or impaired because of Alzheimer's disease or dementia? Which testing tools could you use?
5. The patient has had eye drops administered to dilate his pupil. After a few minutes, he becomes agitated and says, "I can't see! I'm going blind!" What should you say or do in response?
6. Get a pair of old glasses or goggles and coat the lenses with Vaseline or semi-transparent tape. Put on the glasses and try to do some of your normal activities, including eating lunch, talking with friends, or changing classes. Write a brief report or tell the class how it felt to have limited vision. Explain what techniques you used to cope with your limited vision.

21ST CENTURY SKILLS

7. **Teamwork** In pairs, practice caring for eyeglasses.
8. **Information Literacy** Go online to research an ophthalmic care career. Learn more about the career you choose and its education requirements. Find the website of a school in your area and determine the requirements for entry. If possible, contact a member of the administrative staff at that facility and conduct an interview to learn more about the qualifications for employment. Prepare a brief report to share with the class.

Sample Review - Not for Classroom Use