

Preface

Health care is an ever-changing and growing field. Flexibility is key to obtaining, maintaining, and improving your career. The concept of cross-training, or multiskilling, although not a new one, has become the expected rather than the exception. Cross-training allows you to be able to function in a variety of workplace settings doing diverse tasks. The fact that you are currently reading this book means that you are willing to acquire new skills or specialize the skills you already possess. This willingness translates into your enhanced value, job security, marketability, and mobility.

This second edition of *Electrocardiography for Health Care Personnel* was designed not just for classroom but also for independent and distance learning. Checkpoint Questions and student CD exercises have been added to make the learning process interactive and to promote increased comprehension. The variety of materials included with the program provides for multiple learning styles and ensures that you will be a success.

The text/workbook/CD is divided into seven chapters.

- *Chapter 1 Role of Electrocardiographer* introduces you into the field of electrocardiography and helps to promote the various roles in the field. You will also learn about the history and how ECGs are used.
- *Chapter 2 The Cardiovascular System* provides a complete introduction and review of the heart and its electrical system. The information focuses on what you “need to know” to understand and perform an ECG. Specific topics include anatomy of the heart, principles of circulation, cardiac cycle, conduction system and electrical stimulation, and the ECG waveform.
- *Chapter 3 The Electrocardiograph* creates a basic understanding of the ECG including producing the ECG waveform, the ECG machine, electrodes, and the ECG graph paper.
- *Chapter 4 Performing an ECG* describes the procedure for performing an ECG in a simple step-by-step fashion. Each part of the procedure is explained in detail taking into consideration the latest guidelines. The chapter is divided into the following topics: preparation, communication, anatomical landmarks, applying the electrodes and leads, safety and infection control, operating the ECG machine, checking the tracing, reporting results, and equipment maintenance. Extra sections are included regarding pediatric ECG, special patient circumstances, and emergencies. A competency checklist found in Appendix A provides the step-by-step procedure.
- *Chapter 5 ECG Interpretation and Clinical Significance* includes an introduction to dysrhythmias and all the basic dysrhythmias. Additional rhythms, ECG rhythm strips, figures, and exercises have been added to make this chapter easy to follow and comprehend.

- *Chapter 6 Exercise Electrocardiography* provides the information necessary to assist with an exercise electrocardiography. The competency checklist found in Appendix A will provide the step-by-step procedure for the student to become proficient at the skill.
- *Chapter 7 Ambulatory Monitoring* includes the latest information about various types of ambulatory monitors and includes what you need to know to apply and remove a monitor. A competency checklist is also provided in Appendix A for this skill.

Features of the Text/Workbook/CD

- **Key Terms, Glossary, and Audio Glossary:** Key terms are identified at the beginning of each chapter. These terms are in **bold** type within the chapter and are defined both in the chapter and in the glossary at the end of the book. Open the student CD to hear the pronunciation of each key term, and practice learning the term with the Key Term Concentration game.
- **Checkpoint Questions:** At the end of each main heading in the chapter are short-answer Checkpoint Questions. Answer these questions to make sure you have learned the basic concepts presented.
- **CD activities:** After you have finished the Checkpoint Questions, you are sent to the interactive student CD activity to further your review and practice of the concepts presented in each section. Be sure to complete the activities on the CD before you continue to the next section.
- **Troubleshooting:** The Troubleshooting feature identifies problems and situations that may arise when you are caring for patients or performing a procedure. At the end of this feature, you are asked a question to answer in your own words.
- **Safety and Infection Control:** You are responsible for providing safe care and preventing the spread of infection. This feature presents tips and techniques to help you practice these important skills relative to electrocardiography.
- **Patient Education and Communication:** Patient interaction and education and intrateam communication are integral parts of health care. As part of your daily duties, you must communicate effectively both orally and in writing, and you must provide patient education. Use this feature to learn ways to perform these tasks.
- **HIPAA, Law, and Ethics:** When working in health care, you must be conscious of the regulations of HIPAA (Health Insurance Portability and Accountability Act) and understand your legal responsibilities and the implications of your actions. You must perform duties within established ethical practices. This feature helps you gain insight into how HIPAA, law, and ethics relate to the performance of your duties.
- **Realistic ECG strips:** ECG rhythm strips have been provided for easy viewing and to make the task of learning the various dysrhythmias easier and more realistic. Activities and exercises throughout the program using these ECG rhythm strips provide for visual learners and improve understanding.

- **Chapter Summary and Review:** Once you have completed each chapter, take time to read the summary and complete the chapter review questions, which are presented in a variety of formats. These questions help you understand the content presented in each chapter.
- **Get Connected and the Online Learning Center:** The Get Connected activity directs you to the Online Learning Center (OLC) that accompanies the text/workbook. The OLC provides links for you to complete research and activities relative to the information presented in the chapter. You will also find other review activities and materials on the OLC to assist you in learning electrocardiography.
- **Chapter test:** Open the student CD to take a final test of your knowledge relative to each chapter. Review the material again with the Spin the Wheel game and then take the chapter test. You can print or e-mail your score to your instructor.

Instructor's Manual and Instructor CD

Look to the instructor's manual and the instructor CD for multiple resources to use while teaching *Electrocardiography for Health Care Personnel*. PowerPoint presentations for each chapter have Apply Your Knowledge questions at the end of each section and can be used for classroom presentation and discussion. An EZ-Test test bank that contains a variety of questions with graphics allows you to simply and easily create your own final or chapter exam. Also available are suggested classroom activities that will increase the interest level and comprehension of the text/workbook/CD material. Anticipatory set activities for each chapter help stimulate and enhance student learning as you begin each new topic. Curriculum suggestions provide information on how to use the materials based on your course length and depth. All media on the student CD are conveniently provided on the instructor CD for classroom presentations.

Guided Tour

Features to Help You Study and Learn

Chapter Outlines, Learning Outcomes, Key Terms, and an Introduction begin each chapter to introduce you to the chapter and help prepare you for the information that will be presented.

3 The Electrocardiograph

Chapter Outline

- 3.1 Introduction
- 3.2 Producing the ECG Waveform (pg. x)
- 3.3 ECG Machines (pg. x)
- 3.4 Electrodes (pg. x)
- 3.5 ECG Graph Paper (pg. x)

Learning Outcomes

- Identify the three types of leads.
- Explain how each lead is recorded.
- Compare and contrast the differences between a single channel and a multichannel ECG machine.
- List the functions of common ECG machines.
- Discuss the ECG machine controls and identify how each control is used.
- Describe the parts of the electrocardiograph.
- Identify common electrodes.
- Describe the ECG graph paper.
- Identify the measurements of an ECG waveform on the ECG graph paper.

Key Terms

artifact	mV (millivolt)
augmented	oscilloscope
bipolar	output display
bradycardia	precordial
Einthoven triangle	signal processing
electrodes	single-channel recorder
gain	speed
input	standardization
lead	stylus
limb	tachycardia
mm (millimeter)	unipolar
multichannel recorder	

Checkpoint Questions are provided at the end of each section in the chapter to help you understand the information you just read.

Checkpoint Questions 4-8

1. What is the cause of the following artifact?

2. Name three causes of wandering baseline.

CD-ROM references direct you to the interactive CD activity to further your review and practice the concepts presented in each section.

“The CD ROM is a great learning tool and is user friendly. The information on universal precautions is very important and not covered in other EKG texts.” Sheri Melton, PhD, West Chester University

Answer the preceding questions and complete the “Checking the ECG Tracing” activity on the student CD under Chapter 4 before you proceed to the next section.

Troubleshooting exercises identify problems and situations that may arise on the job. You may be asked to answer a question about the situation.

4.9 Reporting ECG Results

When you have completed an ECG, use the method your facility requires for _____

Attach the blood pressure cuff and electrodes. Check the manufacturer’s instructions for the system you are using and the policy at your facility for correct placement of the electrodes (see Figure 6-5). Some machines include a diagram that provides information for correct placement (see Figure 6-6). Many exercise electrocardiography monitors include leads for both chest and back.

Troubleshooting Reporting Problems

If your patient has any complaints or problems during exercise electrocardiography, you should be prepared to respond. Keep in mind that while the physician should be in the room, he or she may not always be aware of the patient’s complaints or problems. Any symptoms that the patient reports such as extreme fatigue, dizziness, shortness of breath, or chest pain should be immediately reported to the physician.

What should you do if the patient collapses?

Prior to the exercise test, a series of blood pressures and 12-lead ECGs will be obtained with the patient in different positions. The following is a

Patient Education and Communication boxes give you helpful information communicating effectively—both orally and written—with patients.

“I have been examining textbooks for approximately eight years now and this ECG text provides students with the most complete and accurate information without overwhelming them.” Donna Folmar, Belmont Technical College

Patients must be prepared for the ambulatory monitoring procedure both emotionally and physically. Many times the patient will be apprehensive. Children may be especially fearful. The first step in reducing the fear is to help them understand the procedure. Take time with the patient to explain each step of the procedure as you perform it. For children, be sure to explain in terms they can understand. Let the patient know it is normal to have some fear and allow the patient to express his or her feelings. Allow the patient to ask questions, and answer as completely as you can. If you do not know the answer, ask a licensed practitioner or your supervisor.

The patient should understand the physical requirements of the monitoring procedure. If the patient is male, he may have to have his chest shaved in order to place the electrodes. For both males and females, there may be some discomfort while the electrodes are in place. You should remind patients that during the procedure they should maintain all regular physical activities.

Patient Education & Communication **Pediatric Patients**

Pediatric patients require special consideration when explaining the ambulatory monitoring procedure. Consider the child's age and use terms that he or she will understand. To decrease the child's potential anxieties and fears, allow the patient to touch the equipment prior to applying it. Be sure to instruct the parent as well.

Checkpoint Question 7-6

1. While answering questions for a patient, she asks something and you do not know the answer. What would you say?

Answer the preceding question and complete the “Preparing the Patient” activity on the student CD under Chapter 7 before you proceed to the next section.

Figure 3-12 Choose the right size and type of graph paper for the ECG machine you will be using.



3.4 Electrodes

Electrodes are sensors that are placed on a person's skin to pick up the electrical activity of the heart and conduct it to the ECG machine. The standard 12-lead ECG uses 10 electrodes. These electrodes come in a variety of types and are usually disposable. Reusable electrodes are essentially a thing of the past. If used, they however, do require care and maintenance.

Disposable Electrodes

Disposable electrodes are used because they reduce the possibility of cross-contamination and can be simply removed and discarded for easier cleanup (see Figure 3-12). The self-adhesive types stick easily to the patient's body. The gel is already applied so the electrodes will properly conduct the electrical impulses.

Safety and Infection Control

Do Not Mix Electrodes

You should never mix two different types of electrodes. This could cause an inaccurate tracing, which could result in incorrect treatment for the patient.

Each disposable electrode is normally used on only one ECG. The only exception occurs when a second ECG is performed on the same patient immediately after the first and the electrodes are not disturbed. For example, if you are transferring a patient from an outpatient facility to a hospital, you should leave the electrodes in place for the emergency medical personnel. They will be recording one or more ECGs on the way to the hospital. If the electrodes stay on the patient's skin any longer than two sequential readings, the gel will dry out, resulting in inaccurate ECG tracings.

For hospitalized patients, longer-lasting silver electrodes are now available. These electrodes are used for patients who require multiple and frequent ECGs (serial ECGs). When serial ECGs are required, it is important

2. Remain-
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ing a “stat”

Safety and Infection Control boxes present tips and techniques for you to apply on the job.

HIPAA, Law, and Ethics boxes help you gain insight into necessary information related to the performance of your duties.

HIPAA, Law & Ethics

What is HIPAA?

HIPAA or the Health Insurance Portability and Accountability Act was established in 1996 and passed into law in 2003. It is a national standard for the transfer of health care information. It established security and privacy for exchanging health data electronically and protects patient information. A patient's information cannot be shared among health care professionals unless it is for the patient's treatment. Fines may occur if you violate this law.

New technology has allowed for evaluation and monitoring of patients and their rhythms from a remote location. This is being referred to as an e-KU. Patients are miles away being monitored by nurses for their heart rhythm and vital signs. This is in addition to the close monitoring done at the hospital.

Performing ECGs in Doctors' Offices and Ambulatory Care Clinics

A 12-lead ECG is a routine diagnostic test performed in almost any doctor's office or ambulatory care facility. It may be performed as part of a general or routine examination. This routine ECG provides a baseline tracing to be used for comparison if problems arise with a patient. The physician or trained expert looks for changes in a tracing that may indicate different types of health problems. Table 1-2 provides a complete list of conditions that may be diagnosed by an ECG. The procedure for performing a 12-lead ECG is discussed in Chapter 4.

Two other ECG-type tests that may be performed in an office include treadmill stress testing and the ambulatory monitor or **Halter monitor** testing (see Figure 1-4 and Figure 1-5).

The treadmill stress test, also known as exercise electrocardiography, is done to determine if the heart gets adequate blood flow during stress or exercise. While the stress test is being performed, the patient is attached to an ECG monitor as he or she is walking on the treadmill. The speed of the

ECG rhythm strips make the task of learning the various dysrhythmias easier and more realistic.

“Practice ECG rhythm strips are key tool for practicing rhythm recognition. An excellent comprehensive textbook for the Electrocardiography student.” Stephen Nardozi, Westchester Community College


The patient who exhibits sinus tachycardia may or may not experience signs and symptoms of low cardiac output. When administering an ECG to a patient with a slow heart rate, it is important to observe for the symptoms of low cardiac output (see Table 5-2). Remember, though the patient may look all right, he or she can quickly experience difficulties with low cardiac output. When you observe symptoms of low cardiac output, report any findings to a licensed practitioner immediately. This rhythm may require drug administration or application of a pacemaker.

Sinus Tachycardia
Sinus tachycardia is a condition in which the sinoatrial node fires and the electrical impulse travels through the normal conduction pathway but the rate of impulse firing is faster than 100 beats per minute (see Figure 5-9).

Criteria for Classification

- **Rhythm:** The R-R interval and P-P interval will be equal and constant.
- **Rate:** Both the atrial and ventricular rates will be the same, between 100 and 150 beats per minute.

Figure 5-9 Sinus tachycardia



122 Chapter 5 ECG Interpretation and Clinical Significance

Key points in the Chapter Summaries help you review what was just learned.

Chapter Summary

- The patient, the room, and the equipment must be properly prepared prior to performing an ECG.
- When a patient refuses an ECG, you should identify the cause, alleviate any fears, notify your supervisor, and document the refusal on the medical record.
- In order to place the electrodes properly for an ECG you must be able to locate anatomical landmarks including the midclavicular line, anterior axillary line, intercostal spaces, suprasternal notch, and the angle of Louis.
- Following standard precautions and performing hand hygiene are two ways to prevent infection during an ECG. In addition, isolation precautions may be used in a hospital or other in-patient health care facility.
- Maintain safety during an ECG by checking the plug and power cord, raising the bed to a working height, keeping the side rail up on the opposite side of the bed, and performing hand hygiene and wearing personal protective equipment, when necessary.
- To ensure HIPAA compliance when identifying a patient, you must use at least two patient identifiers, neither of which should be the patient's room number.
- Three types of artifact include somatic tremor caused by muscle movement, wandering baseline usually caused by improperly applied electrodes, or poor skin prep, and AC interference caused by some type of electrical interference.
- ECGs are recorded electronically and in paper fashion. Although they may be “read” by the machine, they must be provided promptly in a proper format to the practitioner who will be interpreting them.
- Single channel ECG tracings are cut and mounted for easy viewing and interpretation.
- During a pediatric ECG the chest lead V3 may need to be placed on the right side of the chest due to the small size of the chest.
- Many special patient considerations can occur during an ECG, such as for female patients, pregnant patients, amputees, and geriatric patients.
- Upon completion of an ECG the equipment must be cleaned and stored properly according to your facility guidelines and the manufacturer's recommendations.

Chapter Review

Chapter Reviews consist of various methods of quizzing you. True/False, Multiple Choice, Matching, and Critical Thinking questions appeal to all types of learners.

At the end of each chapter, you will be directed to visit the Internet and the student CD to experience more interactive activities about the information you just learned.

The Matching

Match these terms with the correct definition. Place the appropriate letter on the line to the left of each term.

___ 1. cardiovascular	a. an instrument used to record the electrical activity of the heart
___ 2. electrocardiogram	b. a tracing of the signal produced by the heart's electrical activity and used for diagnostic evaluation of the heart
___ 3. arrhythmia	c. the study of the heart's electrical activity
___ 4. electrocardiology	d. abnormal or absence of normal heartbeat, also known as dysrhythmia
___ 5. electrocardiograph	e. used to analyze the heart rhythm and produce a shock if necessary
___ 6. defibrillator	f. related to the heart and blood vessels (veins and arteries)
___ 7. AED	g. a machine that produces and sends an electrical shock to the heart that is intended to correct the abnormal electrical pattern of the heart

True/False

Read each statement and determine if it is true or false. Place a T or F on the line provided. For each of the false (F) statements, correct them to “make them true.”

- ___ 8. An ECG machine produces and records the electrical activity of the heart.
- ___ 9. Standard precautions are guidelines written for health care providers to help prevent the spread of infection.
- ___ 10. When performing an ECG, you should know the equipment, infection control principles, communication techniques, and safety guidelines.
- ___ 11. A transtelephonic monitor transmits an ECG over the Internet.

Multiple Choice

Circle the correct answer.

12. Which of the following is *not* a reason that an ECG is performed?
 a. To determine how well the heart is pumping.
 b. To determine if a person will experience a heart attack in the next month.

Acknowledgments

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