

EKG for Nursing

DeMYSTiFieD[®]

Hard stuff made easy[™]

**Step-by-step guidance on
PERFORMING EKGs in
everyday practice**

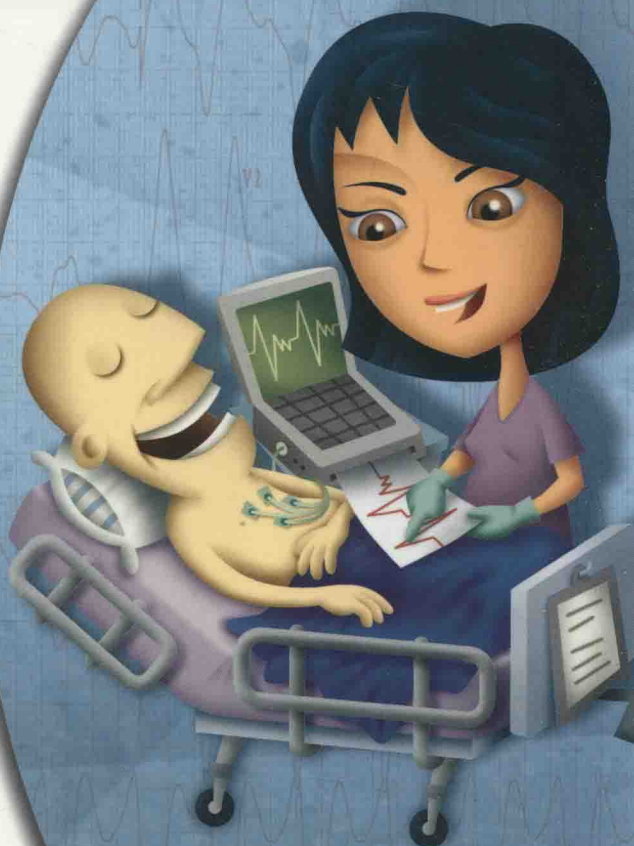
**INTERPRET common
DYSRHYTHMIAS that impact
your patient's health**

**Understand HYPERTROPHY,
ENLARGEMENT, and EKG changes
seen with MYOCARDIAL INFARCTION**

**QUIZZES and a FINAL EXAM help
you assess your knowledge**

**Mc
Graw
Hill
Education**

Patricia Clutter





EKG for Nursing

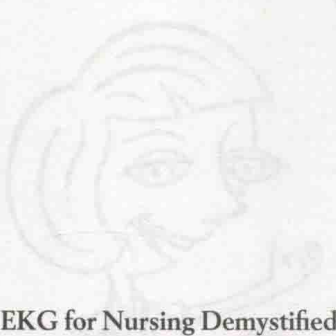
DeMYSTiFieD

Patricia Clutter, RN, MEd, CEN, FAEN

藏书章

**Mc
Graw
Hill**
Education

New York Chicago San Francisco Athens London Madrid
Mexico City Milan New Delhi Singapore Sydney Toronto



EKG for Nursing Demystified

Copyright © 2015 by McGraw-Hill Education, Inc. All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.

1 2 3 4 5 6 7 8 9 0 DOC/DOC 19 18 17 16 15 14

MHID 0-07-180169-3
ISBN 978-0-07-180169-0

This book was set in Berling by Cenveo® Publisher Services.
The editors were Michael Weitz and Regina Y. Brown.
The production supervisor was Richard Ruzycka.
Production management was provided by Anupriya Tyagi, Cenveo Publisher Services.
RR Donnelley was printer and binder.

This book is printed on acid-free paper.

Library of Congress Cataloging-in-Publication Data

Clutter, Patricia, author.

EKG for nursing demystified / Patricia Clutter.—First edition.

p.; cm.

Includes index.

ISBN 978-0-07-180169-0 (pbk. : alk. paper)—ISBN 0-07-180169-3 (pbk. : alk. paper)

I. Title.

[DNLM: 1. Electrocardiography—methods—Nurses' Instruction. WG 140]

RC683.5.E5

616.1'207547—dc23

2014020120

McGraw-Hill Education books are available at special quantity discounts to use as premiums and sales promotions, or for use in corporate training programs. To contact a representative please e-mail us at bulksales@mcgraw-hill.com.

EKG for Nursing

DeMYSTiFieD

Notice

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The authors and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the authors nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they disclaim all responsibility for any errors or omissions or for the results obtained from use of the information contained in this work. Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this work is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.

This book is dedicated to the myriad of patients and their loved ones that I have had the joy to work with throughout my 40 plus years in the profession of emergency nursing. Through each of them, I have learned a little bit more each time and hopefully have provided the excellent care that I desired to provide. For each of my colleagues who have worked and continue to work beside me, I tip my nurses' hat and breathe a sigh of "thank you" for each time you offered your support and knowledge.

This book is also dedicated to my children, Justace and Ben, and the women in their lives, Huan and Melanie, my mother, Celia, and my sisters and brothers, who listened endlessly to the phrase, "I'm working on the book." They were awesome in their conversations with me and held me up when the strains of working on multiple projects and jobs attempted to overcome me.

And, of course, my husband, Randy, who has been my constant cheerleader and shoulder to cry upon when things didn't always go right at work and who was a saint during the writing of this book. He heard "just a minute" a million times and supported me during every written word. Thank you for always letting me "be me."

—Pat Clutter

CHAPTER 1	Introduction	1
	Overview	1
	History of EMT	2
	Clinical Uses of EMT	3
	Who Can Perform an EMT	4
	Conclusion	7
	Practical Considerations	7
	Answer Key	12
CHAPTER 2	Heart Anatomy and Physiology	9
	Overview	10
	Heart Layers	11
	Pericardial Space	15
	Heart Chambers	16
	Heart Valves	18
	Heart Sounds	20
	Heart Nerves	23
	Block of Flow Through the Heart	24
	Coronary Circulation	25
	Cardiac Cycle	27
	Cardiac Output	30
	Blood Pressure	31
	Conclusion	32



Preface

Understanding and interpreting EKGs and dysrhythmias can be a daunting task for nurses everywhere. Creating a knowledge base and incorporating tools that can help make this charge of our profession easier is the mission of this book. Once general rules are understood, the undertaking of this chore can be a positive addition to our roles of caring for our patients and their loved ones; for it is not only the patient who has multiple questions about the things that we do and the machines that we use to help us attain optimal care. Students who are studying to achieve an understanding of this aspect of care, new nurses who are building confidence in their skills, and the experienced nurse who desires to resharpen their knowledge can all benefit from the contents of this book.

We have worked hard to “demystify” this difficult facet of nursing by starting at the beginning and building upon the blocks of learning as each chapter takes on a different aspect of the world of electrocardiography. Through this book, we provide background physiology and pathophysiology, appreciation for concepts, and highlighted “clinical alerts” in order to provide a thorough comprehension of not only the science of this subject, but also the art that must be incorporated so that our patients feel comfortable with the process and with us.

Each chapter is built around the following tools that contribute to the reader’s ability to grasp the intent and purpose of each topic:

- Objectives and key terms that are used within that particular chapter
- An overview to highlight the target goals of each chapter
- Clinical alerts to bring out important components of subject matter
- Tables to provide information in an easy to understand format

Boxes that highlight significant factors
 Figures to visualize essential portions of information
 Real world practical wisdom that has stood the test of time
 Key points highlighted in the conclusion
 Practice questions to explore the reader's comprehension
 Answer keys with rationales and reiteration of concepts
 A final exam to test the learner's knowledge level

We hope that you enjoy your journey through this part of the prism that extends to so many facets of care. Each of us must continue the learning process throughout our careers in our chosen specialties so that we may provide excellent attention to the details of our patient care. May you attain and maintain wisdom and knowledge, clarity of thought, skillful hands, and a compassionate heart as we all work towards the highest level of protection for those entrusted to our care.

Patricia Clutter, RN, MEd, CEN, FAEN



Acknowledgments

My sincerest gratitude and appreciation to the individuals at McGraw-Hill—Michael Weitz, and Regina Brown; and Anupriya Tyagi (Cenveo Publisher Services)—who kept me on track and helped me understand this process. Their patience was overwhelming! Also, much thanks to Joanna Cain who believed in me and approached me regarding taking on this project. I owe each of these individuals a great deal.



Contents

<i>Preface</i>	<i>xi</i>
<i>Acknowledgments</i>	<i>xiii</i>

CHAPTER 1	Introduction	1
	Overview	2
	History of EKG	3
	Clinical Uses of EKG	4
	Who Can Perform an EKG?	6
	Conclusion	7
	Practice Questions	7
	Answer Key	8

CHAPTER 2	Heart Anatomy and Physiology	9
	Overview	10
	Heart Layers	12
	Pericardial Space	15
	Heart Chambers	16
	Heart Valves	18
	Heart Sounds	20
	Heart Nerves	23
	Blood Flow Through the Heart	24
	Coronary Circulation	26
	Cardiac Cycle	27
	Cardiac Output	30
	Blood Pressure	32
	Conclusion	33

	Practice Questions	34
	Answer Key	36
CHAPTER 3	Cardiac Electrical Conduction System	37
	Overview	38
	Cardiac Conduction	38
	Cardiac Conduction System	46
	Abnormal Heart Impulses	52
	Conclusion	57
	Practice Questions	58
	Answer Key	61
CHAPTER 4	Cardiac Monitoring and 12-Lead EKG Basics	63
	Overview	64
	Types of Electrocardiograms	64
	Monitoring Systems	65
	The Process	66
	Leads	79
	Conclusion	88
	Practice Questions	90
	Answer Key	92
CHAPTER 5	Waves, Complexes, Straight Lines, and Intervals/ Labeling and Interpreting	95
	Overview	96
	Waves and Complexes	97
	Segments	107
	Intervals	109
	The Whole Picture	112
	Systematic Interpretation	112
	Normal Sinus Rhythm	117
	Conclusion	118
	Practice Questions	121
	Answer Key	123
CHAPTER 6	Axis, Hypertrophy, and Bundle Branch Blocks	127
	Overview	128
	Hypertrophy and Enlargement	132
	Bundle Branch Blocks	141
	Conclusion	148
	Practice Questions	151
	Answer Key	154

CHAPTER 7	Sinus Node Related Dysrhythmias	157
	Overview	158
	Sinus Rhythms	160
	Conclusion	173
	Practice Questions	176
	Answer Key	179
CHAPTER 8	Atrial/AV Nodal and Junctional Dysrhythmias	181
	Overview	182
	Atrial/AV Nodal Dysrhythmias	183
	Junctional Dysrhythmias	208
	Conclusion	213
	Practice Questions	217
	Answer Key	221
CHAPTER 9	Ventricular Dysrhythmias and AV Nodal Blocks	223
	Overview	224
	Ventricular Dysrhythmias	225
	AV Nodal Blocks	241
	Conclusion	248
	Practice Questions	250
	Answer Key	255
CHAPTER 10	Acute Myocardial Infarction Patterns	257
	Overview	258
	Acute Coronary Syndrome	260
	EKG Changes	262
	Areas of Infarction	266
	Biomarkers	274
	Symptoms	275
	Treatment	275
	Conclusion	276
	Practice Questions	278
	Answer Key	281
CHAPTER 11	EKG Changes Other Than Myocardial Infarction	283
	Overview	284
	Electrolyte Imbalances	286
	Environmental	288
	Central Nervous System	289
	Pulmonary System	289
	Cardiac System	292
	Medications	298

	Conclusion	299
	Practice Questions	301
	Answer Key	304
CHAPTER 12	Final Exam	307
	Final Exam Answers and Rationales	326
	Index	335

chapter 1

Introduction



LEARNING OBJECTIVES

At the end of this chapter, the student will be able to:

- 1 Describe an electrocardiogram (EKG) and the equipment needed to perform this diagnostic test.
- 2 Detail the history of EKG and related advances in today's technology.
- 3 List the clinical uses for EKG.
- 4 Distinguish the health care personnel who may conduct EKG and the certification opportunities available in the discipline.

KEY WORDS

Angina	Endocarditis
Arrhythmia	Heart failure
Auscultation	Heart valve disease
Bradycardia	Holter monitor
Cardiologist	Ischemia
Cardiomyopathy	Myocardial infarction
Congenital heart defects	Pacemaker
Coronary heart disease	Pericarditis
Dysrhythmia	Physiologist
Electrocardiogram	Stress test
Electrodes	Tachycardia

Overview

Electrocardiogram, or EKG—also referred to as ECG—is a diagnostic test, performed at the bedside, that assists in the assessment of problems or disturbances with the electrical activity of the heart. This electrical activity within the heart is observed by means of an external EKG machine that connects via cables to **electrodes**. These electrodes are placed on the patient's skin where they detect the heart's electrical impulses. These electrical impulses are then “translated” by the EKG machine and recorded as line tracings on paper. The tracings on the special paper are referred to as a “12 lead.” A “rhythm strip” is different than an EKG. An EKG looks at all angles of the electrical conduction system providing 12 views. (There are also 15- and 18-lead EKGs that are performed to diagnose specific **myocardial infarction** processes.) A “rhythm strip” shows one lead. This is useful to determine rate and rhythm and as an ongoing tool during patient observation. Today's cardiac monitors have many tools built into them to assist health care personnel to screen for patient problems. A rhythm strip can also be produced by an EKG machine.

Figure 1-1 shows a normal EKG strip and Fig. 1-2 shows a 12-lead EKG. By the time you finish this book, you will be able to recognize a normal EKG rhythm strip that can be obtained from an EKG tracing or a cardiac monitor, identify all the common electrical cardiac abnormalities, and understand common concepts relative to the EKG and disease processes.

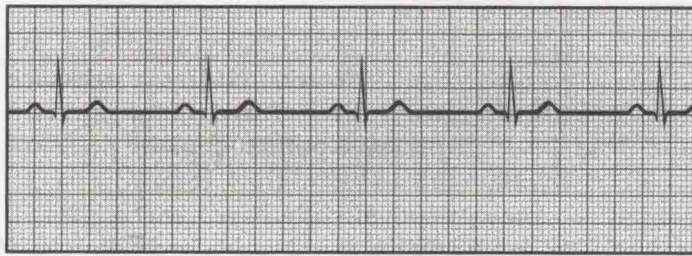


FIGURE 1-1 • Normal EKG strip. Strip shows normal sinus rhythm. [From Saladin KS. (2012). *Anatomy & Physiology: The Unity of Form and Function*, 6e. McGraw-Hill.]

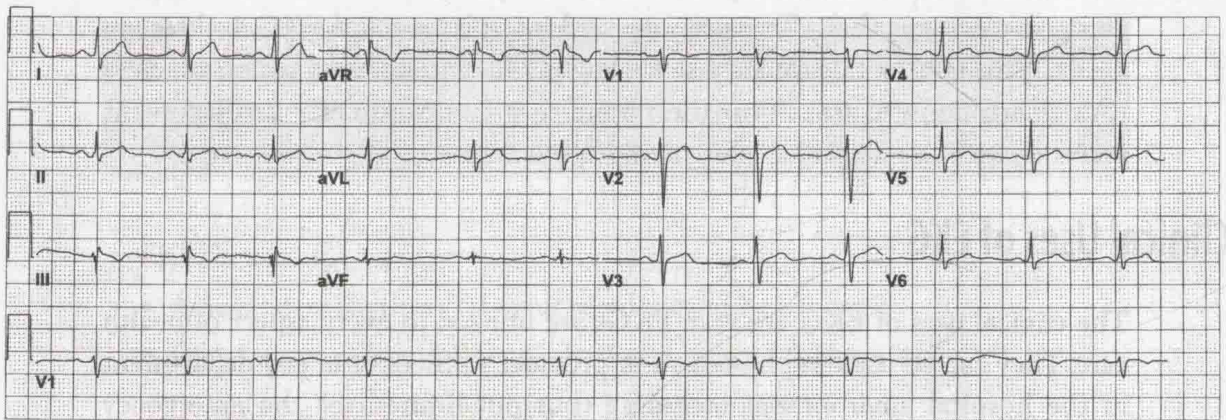


FIGURE 1-2 • 12-lead electrocardiogram. A standard 12-lead electrocardiogram showing a rhythm strip taken from lead V₁. [From Raff, Hershel and Levitzky, Michael, (2011). *Medical Physiology A Systems Approach*, McGraw-Hill.]

History of EKG

Willem Einthoven, a Dutch **physiologist**, introduced the EKG in 1903. Although Carl Ludwig and his student Augustus Waller are credited with initially tracing the heartbeat onto a phonographic plate fixed to a toy train that allowed the heartbeat to be recorded in real time in 1887, Einthoven perfected this system in 1903 to create a much more sensitive device. Einthoven's participants would immerse each of their limbs into containers of salt solution from which the EKG was recorded as opposed to today's method of using self-adhesive electrodes. This original machine weighed 500 pounds and required multiple people to function.

Einthoven assigned the letters P, Q, R, S, and T, still used today, to the waves and segments found in the EKG (Fig. 1-3). This earned him the Nobel Prize in Medicine in 1924.

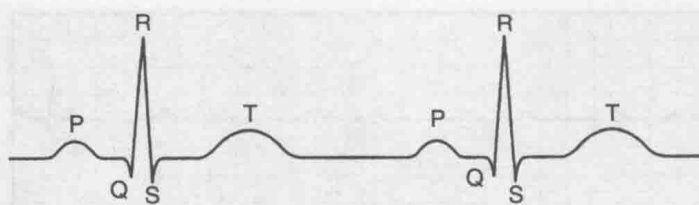


FIGURE 1-3 • Normal electrocardiogram showing the P, Q, R, S, T waves. [From Huff, Jane.(2012). *ECG Workout Exercises in Arrhythmia Interpretation 6e.*]

Many advances have been made in electrocardiography through the decades. Once cumbersome laboratory machines, today's EKG devices are compact electronic systems that offer computerized interpretation of EKG. In keeping with the future's mobile trends, a sleek, low-power wireless case can be attached to a smartphone to transform the phone to a clinical-quality cardiac event recorder with the help of a smartphone application.

Clinical Uses of EKG

The clinical uses of EKG are vast. EKGs are utilized in every aspect of health care. They can be used in physician's or provider's offices or in any department in the hospital environment including (but not limited to) the emergency department, medical/surgical departments, intensive care units, labor and delivery, surgery, postanesthesia care unit, and pediatrics. EKGs are also used routinely in the prehospital setting, often being electronically transmitted to the emergency department physician prior to arrival. They can also be completed in a patient's home by home health care agency personnel or individuals who work for insurance companies. EKGs may be performed at health screenings, routine physical examinations, or presurgical workups in a planned elective situation. They are also an emergent diagnostic tool in potentially life-threatening situations. The individual receiving an EKG ranges from someone who is initiating a new exercise regimen to a person who is having chest pain. The use of the EKG is cross-generational, providing clues to care for all age groups from the infant with congenital heart disease to the centenarian with shortness of breath.

EKGs are also performed to determine heart rhythms that are different than the normal rhythm when abnormal electrical impulses disturb the cardiac cycle. These are called **arrhythmias** or **dysrhythmias** (Fig. 1-4). These terms are usually used interchangeably; however, "dysrhythmia" is more accurate since the term "arrhythmia" can officially mean an absence of heart rhythm. In this book, the term dysrhythmia will be utilized to differentiate an abnormal rhythm. These dysrhythmias will be explored in detail later in this book.