Essentials of Polysomnography

A TRAINING GUIDE AND REFERENCE FOR SLEEP TECHNICIANS



Sudbury, Massachusetts

BOSTON TORONTO LONDON SINGAPORE

World Headquarters Jones and Bartlett Publishers 40 Tall Pine Drive Sudbury, MA 01776 978-443-5000 info@jbpub.com www.jbpub.com

Jones and Bartlett Publishers Canada 6339 Ormindale Way Mississauga, Ontario L5V 1J2 Canada

Jones and Bartlett Publishers International Barb House, Barb Mews London W6 7PA United Kingdom

Jones and Bartlett's books and products are available through most bookstores and online booksellers. To contact Jones and Bartlett Publishers directly, call 800-832-0034, fax 978-443-8000, or visit our website, www.jbpub.com.

Substantial discounts on bulk quantities of Jones and Bartlett's publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones and Bartlett via the above contact information or send an email to specialsales@jbpub.com.

Copyright © 2010 by Jones and Bartlett Publishers, LLC Copyright © 2008 by Sleep Ed, LLC

ISBN: 978-0-7637-8106-4

All rights reserved. No part of the material protected by this copyright may be reproduced or utilized in any form, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner.

The authors, editor, and publisher have made every effort to provide accurate information. However, they are not responsible for errors, omissions, or for any outcomes related to the use of the contents of this book and take no responsibility for the use of the products and procedures described. Treatments and side effects described in this book may not be applicable to all people; likewise, some people may require a dose or experience a side effect that is not described herein. Drugs and medical devices are discussed that may have limited availability controlled by the Food and Drug Administration (FDA) for use only in a research study or clinical trial. Research, clinical practice, and government regulations often change the accepted standard in this field. When consideration is being given to use of any drug in the clinical setting, the health care provider or reader is responsible for determining FDA status of the drug, reading the package insert, and reviewing prescribing information for the most up-to-date recommendations on dose, precautions, and contraindications, and determining the appropriate usage for the product. This is especially important in the case of drugs that are new or seldom used.

Production Credits

Publisher: David Cella Printing and Binding: Courier Kendallville Cover Printing: Courier Kendallville

6048
Printed in the United States of America
13 12 11 10 09 10 9 8 7 6 5 4 3 2 1

Acknowledgements

Sleep Healers

Many of the pictures in this book were taken at Sleep Healers labs. A few of the technicians at Sleep Healers, including Ryan Nish and Dawn Covington, performed studies using the new AASM rules long before it was required to do so. This allowed for some of the samples in this book to be used. A special thanks to Jim Rogers, RN, RPSGT, and Annette Ferrell, RPSGT at Sleep Healers for their assistance. Sleep Healers is a division of Medical Edge Healthcare Group in Dallas, Texas. www.sleephealers.net

Snow Canyon Clinic

Most of this sample epochs from sleep studies in this book are from Snow Canyon Clinic in Ivins, Utah. Snow Canyon Clinic began performing studies using the new AASM rules when they were first presented in 2007. Snow Canyon Clinic is a multi-disciplinary medical office that includes a 2-bed sleep lab. www.snowcanyonclinic.com

The Pediatric Sleep Institute

Some of the pictures and information in chapter 16 were provided by the Pediatric Sleep Institute in Plano, Texas. A special thanks to Lori Sands. www.pediatricsleepinstitute.com

Kamie Spriggs

Kamie drew some of the pictures in this book, took many of the photographs, and helped with formatting and layout. She also supported me throughout the long process of creating it. Thank you Kamie for all of your help... I love you.

About the Author

Will Spriggs started working as a sleep technician in 1998 at Salt Lake Regional Medical Center in Salt Lake City, Utah. He earned bachelor's degrees in psychology and sociology from the University of Utah in 2001. By this time, his work in the field of polysomnography had extended to managerial positions. He received his registry in polysomnography in 1999 and helped develop Sleep Management Services in South Jordan, Utah. While employed at Sleep Management Services, Will completed his first book, Principles of Polysomnography. Shortly after, he formed Sleep Ed, LLC, a company designed for developing and selling educational products for sleep technicians. Principles of Polysomnography is used in colleges, universities, hospitals, sleep labs, and physician's offices worldwide. In 2004, Will moved to Dallas, Texas, to work as an Area Manager for Wellnecessities. The following year, Will left Wellnecessities to work at Sleep Healers, where he worked as the Director of Operations. While under their employ, Will helped Sleep Healers grow to be the largest sleep disorder company in North Texas.

Will's newest book, <u>Essentials of Polysomnography</u>, is designed for sleep technicians interested in studying for the board exam, and for training technicians who are new to the field. However, the focus is expanded in this book to include managerial and daytime operations in the sleep lab, as well as an assistance for physicians interested in learning more about screening, diagnosing, and treating sleep disorders in their patients. <u>Essentials of Polysomnography</u> utilizes the updated recording and scoring rules presented by the American Academy of Sleep Medicine in 2007, as well as the Second Edition of the International Classification of Sleep Disorders developed by the American Academy of Sleep Medicine in 2005.

Table of Contents

<u>Chapter/Section</u>		Page
Chapter 1:	Normal Sleep	7
	The Need for Sleep	10
	Human Circadian Rhythm	11
	Human Sleep	12
	Sleep Architecture	15
	Sleep and Aging	17
	Changes to Normal Sleep Architecture	18
	Drug Effects on Sleep	19
	Pregnancy and Sleep	22
	Chapter Summary	23
Chapter 2:	Sleep Disorders	25
	History of Sleep Disorders	29
	Classification of Sleep Disorders	29
	Insomnia	33
	Sleep Related Breathing Disorders	36
	Hypersomnias of Central Origin	46
	Circadian Rhythm Sleep Disorders	50
	Parasomnias	51
	Sleep Related Movement Disorders	52
	Isolated Symptoms	62
	Other Sleep Disorders	63
	Chapter Summary	64
Chapter 3:	Patient Flow Process	67
	Living With a Sleep Disorder	70
	Physician Screening	71
	Referral Process	74
	Patient Scheduling and Billing	75
	Sleep Study Process	76
	Patient Education	78
	Scoring and Interpreting Process	78
	Second Night Studies	79
	DME Setup	79
	Patient Follow-Up	81
	Chapter Summary	82

Chapter 4:	Life As A Sleep Technician	84
	Shift Work	87
	Responsibility as a Healthcare Worker	88
	Infection Control	88
	Patient Safety	89
	Professionalism	90
	Patient Confidentiality	90
	Quality Control	91
	Technician Training and Continuing Education	91
	Board Exam Preparation	92
	Test Taking Tricks and Tips	93
	Chapter Summary	94
Chapter 5:	Diagnostic Equipment	96
	Basic Electronics	99
	Signal Pathways	100
	Monitoring Devices	102
	Differential Amplifiers	107
	Digital Polysomnography	112
	Chapter Summary	113
Chapter 6:	Patient Hookup Procedures	115
	International 10-20 System	118
	Electrode Sites	133
	Electrode Application	136
	Impedance Checks	139
	Technician Tricks and Tips	139
	Chapter Summary	141
Chapter 7:	Viewing a Polysomnogram	143
	EEG Channels	146
	EOG Channels	150
	EMG Channels	154
	EKG Channels	158
	Respiratory Channels	160
	SpO2	163
	Body Position	167
	Chapter Summary	168
Chapter 8:	Artifacts and Troubleshooting	170
	Artifacts	173

	EKG Artifact	173
	Movement Artifact	180
	Sweat, Slow Wave, and Sway Artifact	184
	Snore Artifact	190
	60Hz Interference and High Impedances	193
	Electrode Popping	201
	Pen Blocking	204
	Improper Gain/Sensitivity Settings	207
	Improper Filter Settings	212
	Correcting Artifacts	214
	Chapter Summary	216
Chapter 9:	Performing an Overnight Sleep Study	219
	Order of Operations	222
	Reviewing the Patient Chart	222
	Preparing the Patient Tray	223
	Preparing the Patient Room	223
	Connecting the Diagnostic Equipment	223
	Selecting a Montage	224
	Amplifier Calibrations	228
	Patient Questionnaires	247
	Patient Hookup and Education	248
	Physiologic Calibrations	248
	Technician Notes and Documentation	249
	Ending the Study	251
	Patient Discharge	251
	Chapter Summary	252
Chapter 10:	Performing a CPAP Titration	254
	How CPAP Works	257
	Mask Fitting	257
	CPAP Equipment	258
	Purpose of CPAP Titrations	259
	Increasing CPAP	261
	Decreasing CPAP	261
	Bi-Level PAP	263
	Split-Night Polysomnography	266
	Supplemental O2	268
	Chapter Summary	270
Chapter 11:	Performing Other Types of Sleep Studies	272
	MSLT	275
	MWT	275

	REM Behavior Disorder Study	276
	Nocturnal Seizure Study	276
	Ambulatory Sleep Study	276
	Other Diagnostic Procedures	277
	Chapter Summary	279
Chapter 12:	Sleep Staging	281
	R&K	284
	EEG Waveforms	284
	Stage W	286
	Stage N1	297
	Stage N2	308
	Stage N3	319
	Stage R	330
	Chapter Summary	341
Chapter 13:	Abnormal Events	343
	EEG Arousals	346
	Beta Spindles	352
	Nocturnal Seizures	357
	Leg Movements	357
	Bruxism	365
	Obstructive Apneas	369
	Hypopneas	377
	Central Apneas	382
	Mixed Apneas	388
	Cheyne-Stokes Breathing	393
	Snores	393
	Respiratory Effort Related Arousals	400
	Chapter Summary	401
Chapter 14:	EKG Rhythms	403
	Reading EKG Tracings	406
	Normal EKG Ranges	408
	Sinus Rhythms	410
	Atrial Rhythms	413
	Ventricular Rhythms	415
	AV Blocks	417
	Chapter Review	420
Chapter 15:	Scoring and Reporting	422
	Sleep Study Times, Formulas, and Calculations	425

	Types of Sleep Reports	426
	Sample Sleep Reports	427
	Scoring Notes	432
	Chapter Review	434
Chapter 16:	Pediatric Sleep Medicine	436
	Significance of Pediatric Sleep Medicine	439
	Special Considerations	439
	Pediatric Patient Hookup	440
	Pediatric Sleep Recordings	441
	Scoring Pediatric Sleep Studies	441
	Chapter Review	443
Comprehensive Posttest		445
Answers and Explanations Glossary		566 584
References		613