## Contents

Contributors xi Preface xiii

PAI	RT I Framework
	J. Larry Durstine, PhD, FACSM
1	Introduction
	J. Larry Durstine, PhD, FACSM
	Concept of Exercise Is Medicine 4 = Evidence-Based Guidelines 4 = How to Use This Book 6 Problem-Oriented Management 7 = How to Use the Tables 8 = How to Read the Tables 8 What's in the Tables 8 = What's Not in the Tables 8
2	Approach to Exercise and Disease Management
	Geoffrey E. Moore, MD, FACSM • Anthony P. Marsh, PhD • J. Larry Durstine, PhD, FACSM
	Problem-Oriented Exercise Management 9 - Categories of Exercise Test Measures 12 - Exercise and Medications 16 Exercise Dose-Response 18 - Risk, Cost, and Benefit 19 - Putting It All Together 19
3	Exercise Is Medicine
	J. Larry Durstine, PhD, FACSM J. Brent Peel, MS Michael J. LaMonte, PhD, FACSM Steven J. Keteyian, PhD, FACSM Emma Fletcher, MA Geoffrey E. Moore, MD, FACSM
	Terminology 22 • Epidemiology 22 • Exercise and Cardiovascular Diseases 25 • Biological Plausibility 26 Current and Future Priorities 26 • Education for Exercise Professionals 27 • Summary 30
1	Managing Exercise in Persons With Multiple Chronic Conditions
	Geoffrey E. Moore, MD, FACSM Patricia L. Painter, PhD, FACSM G. William Lyerly, MS J. Larry Durstine, PhD, FACSM
	Overview of the Pathophysiology 31 • Effects on the Exercise Response 35 • Role of Exercise Training 35  Recommendations for Exercise Testing 36 • Recommendations for Exercise Programming 36 • Case Study 37
5	Physical Activity for Children and Adolescents
	William F. Riner, PhD, FACSM Richard J. Sabath, EdD, FACSM
	Effects of Health Status and Physical Activity on Growth and Development 39  Normal Responses to Physical Activity in Children and Adolescents 39 • Exercise Testing of Children and Adolescents 41  General Physical Activity Concerns for Children With a Chronic Health Condition or Disability 41  Selected Diseases and Disorders of Children and Youth 42 • Summary 44

PAR	T II Cardiovascular Diseases	47
	Scott O. Roberts, PhD, FACSM Peter H. Brubaker, PhD, FACSM	
6	Myocardial Infarction	49
	Overview of the Pathophysiology 49 • Effects on the Exercise Response 50 • Effects of Exercise Training 51 Management and Medications 51 • Special Precautions 52 • Recommendations for Exercise Testing 53 Recommendations for Exercise Programming 53 • Case Study 56	
7	Revascularization: CABG5 and PTCA or PCI Barry A. Franklin, PhD, FAC5M	58
	Overview of the Pathophysiology <b>58</b> • Effects on the Exercise Response <b>60</b> • Effects of Exercise Training <b>60</b> Management and Medications <b>61</b> • Recommendations for Exercise Testing <b>61</b> Recommendations for Exercise Programming <b>62</b> • Case Study <b>64</b>	
8	Angina and Silent Ischemia	60
	Daniel Friedman, MD, FACSM • Scott O. Roberts, PhD, FACSM	
	Overview of the Pathophysiology 66 = Effects on the Exercise Response 67 = Effects of Exercise Training 68  Management and Medications 68 = Recommendations for Exercise Testing 69  Recommendations for Exercise Programming 70 = Case Study 72	
9	Atrial Fibrillation	73
	J. Edwin Atwood, MD Jonathan N. Myers, PhD, FACSM	
	Overview of the Pathophysiology 73 • Effects on the Exercise Response 73 • Effects of Exercise Training 74  Management and Medications 74 • Recommendations for Exercise Testing 74  Recommendations for Exercise Programming 76 • Case Study 77	
10	Pacemakers 1 & bases 1 km may be 1 & 1880 At 1880 Brown and 1	
10	and Implantable Cardioverter Defibrillators	79
	Scott O. Roberts, PhD, FACSM Michael West, MD	
	Overview of the Pathophysiology <b>79</b> • Effects on the Exercise Response <b>80</b> • Effects of Exercise Training <b>81</b> Management and Medications <b>81</b> • Recommendations for Exercise Testing <b>81</b> Recommendations for Exercise Programming <b>81</b> • Case Study <b>83</b>	
11	Valvular Heart Disease	85
•••	Daniel Friedman, MD, FACSM Scott O. Roberts, PhD, FACSM	
	Overview of the Pathophysiology <b>85</b> • Effects on the Exercise Response <b>87</b> • Effects of Exercise Training <b>88</b> Management and Medications <b>88</b> • Surgical Considerations <b>88</b> • Recommendations for Exercise Testing <b>88</b> Recommendations for Exercise Programming <b>89</b> • Special Considerations <b>90</b> • Case Study <b>91</b>	
12	Chronic Heart Failure	98
	Jonathan N. Myers, PhD, FAC5M Peter H. Brubaker, PhD, FAC5M	
	Overview of the Pathophysiology 92 • Effects on the Exercise Response 92 • Effects of Exercise Training 93  Management and Medications 94 • Recommendations for Exercise Testing 94  Recommendations for Exercise Programming 96 • Case Study 97	
13	Cardiac Transplant	99
-3	Ross Arena, PhD, PT, FACSM • Reed Humphrey, PhD, PT, FACSM	
	Overview of the Pathophysiology 99 • Effects on the Exercise Response 100 • Effects of Exercise Training 100 Management and Medications 100 • Recommendations for Exercise Testing 101  Recommendations for Exercise Programming 103 • Case Study 105	0

14	Hypertension  Neil F. Gordon, MD, PhD, MPH, FAC5M  Overview of the Pathophysiology 107 • Effects on the Exercise Response 107 • Effects of Exercise Training 108  Management and Medications 108 • Recommendations for Exercise Testing 110  Recommendations for Exercise Programming 111 • Case Study 113		
	Christopher J. Womack, PhD, FACSM • Andrew W. Gardner, PhD • Raha Nael, MD		
	Overview of the Pathophysiology 114 • Effects on the Exercise Response 115 • Effects of Exercise Training 115  Management and Medications 115 • Recommendations for Exercise Testing 115  Recommendations for Exercise Programming 117 • Case Study 118		
16	Aneurysms	120	
	Overview of the Pathophysiology 120 • Effects on the Exercise Response 121 • Effects of Exercise Training 121  Management and Medications 122 • Recommendations for Exercise Testing 122  Recommendations for Exercise Programming 122 • Special Considerations 123 • Case Study 125		
PAR	T III Pulmonary Diseases - Market and Day of the pulmon and the pu	127	
	Christopher B. Cooper, MD, FACSM		
17	Chronic Obstructive Pulmonary Disease	129	
	Overview of the Pathophysiology 129 • Effects on the Exercise Response 130 • Effects of Exercise Training 131  Management and Medications 131 • Recommendations for Exercise Testing 132  Recommendations for Exercise Programming 132 • Case Study 135		
18	Chronic Restrictive Pulmonary Disease	136	
	Overview of the Pathophysiology 136 • Effects on the Exercise Response 137 • Effects of Exercise Training 138  Management and Medications 138 • Recommendations for Exercise Testing 139  Recommendations for Exercise Programming 139 • Case Study 142		
19	Asthma	143	
	Overview of the Pathophysiology 143 - Effects on the Exercise Response 143 - Effects of Exercise Training 144  Management and Medications 144 - Recommendations for Exercise Testing 145  Recommendations for Exercise Programming 146 - Case Study 149		
50	Cystic Fibrosis	150	
	Overview of the Pathophysiology 150 • Effects on the Exercise Response 150 • Effects of Exercise Training 151  Management and Medications 151 • Recommendations for Exercise Testing 152  Recommendations for Exercise Programming 153 • Special Considerations 153 • Case Study 155		
21	Lung and Heart-Lung Transplantation	156	
	David L. Balfe, MD David J. Ross, MD		
	Overview of the Pathophysiology 156 = Effects on the Exercise Response 157 = Effects of Exercise Training 158  Management and Medications 158 = Recommendations for Exercise Testing 159  Recommendations for Exercise Programming 161 = Special Considerations 163 = Case Study 163		

PAR	T IV Metabolic Diseases Antique Malanaria and Metabolic Diseases	165
	Patricia L. Painter, PhD, FACSM J. Larry Durstine, PhD, FACSM	
22	Hyperlipidemia	167
	J. Larry Durstine, PhD, FACSM • Geoffrey E. Moore, MD, FACSM • Donna Polk, MD, MPI	Н
	Overview of the Pathophysiology 167 • Effects on the Exercise Response 168 • Effects of Exercise Training 168  Management and Medications 169 • Recommendations for Exercise Testing 171  Recommendations for Exercise Programming 171 • Case Study 173	
23	End-Stage Metabolic Disease:	
	Chronic Kidney Disease and Liver Failure	175
	Patricia L. Painter, PhD, FACSM Joanne B. Krasnoff, PhD	
	Overview of the Pathophysiology 175 • Effects on the Exercise Response 176 • Effects of Exercise Training 176  Management and Medications 177 • Recommendations for Exercise Testing 178  Recommendations for Exercise Programming 179 • Case Study 180	
24	Diabetes	182
ter	W. Guyton Hornsby Jr., PhD, CDE, FAC5M • Ann L. Albright, PhD, RD	報点的
	Overview of the Pathophysiology 182 • Effects on the Exercise Response 184 • Effects of Exercise Training 184  Management and Medications 184 • Recommendations for Exercise Testing 187  Recommendations for Exercise Programming 188 • Case Study 190	
25	Obesity	192
	Janet P. Wallace, PhD, FACSM Shahla Ray, PhD	
	Overview of the Pathophysiology 192 • Effects on the Exercise Response 194 • Effects of Exercise Training 195  Management and Medications 195 • Recommendations for Exercise Testing 196  Recommendations for Exercise Programming 196 • Special Considerations 197 • Case Study 199	
26	Frailty	201
LU	Constance Mols Bayles, PhD, FACSM • Selena Chan, BS • Joseph Robare, MS, RD, LDN	
	Overview of the Pathophysiology 201 = Effects on the Exercise Response 201 = Effects of Exercise Training 203  Management and Medications 203 = Recommendations for Exercise Testing 204  Recommendations for Exercise Programming 206 = Case Study 207	
ERI	Augustus Manner transporter and a service and a service A	
PAR	TV Immunological and Hematological Disorders	209
	Geoffrey E. Moore, MD, FACSM • Michael J. LaMonte, PhD, FACSM	
27	Cancer	.211
	Overview of the Pathophysiology 211 • Effects on the Exercise Response 211 • Effects of Exercise Training 212  Management and Medications 213 • Recommendations for Exercise Testing 214  Recommendations for Exercise Programming 214 • Case Study 217	
28	Acquired Immune Deficiency Syndrome (AIDS)	219
	Gregory A. Hand, PhD, FACSM • G. William Lyerly, MS • Wesley D. Dudgeon, PhD	
	Overview of the Pathophysiology 219 • Effects on the Exercise Response 220 • Effects of Exercise Training 221  Management and Medications 221 • Recommendations for Exercise Testing 222  Recommendations for Exercise Programming 223 • Special Considerations 224 • Case Study 224	

29	Abdominal Organ Transplant (Kidney, Liver, Pancreas)226 Patricia L. Painter, PhD, FACSM Joanne B. Krasnoff, PhD
	Overview of the Pathophysiology 226 • Effects on the Exercise Response 227 • Effects of Exercise Training 227  Management and Medications 227 • Recommendations for Exercise Testing 228  Recommendations for Exercise Programming 228 • Case Study 231
30	Chronic Fatigue Syndrome
	Overview of the Pathophysiology 233 • Effects on the Exercise Response 234 • Effects of Exercise Training 234  Management and Medications 234 • Recommendations for Exercise Testing 235  Recommendations for Exercise Programming 235 • Special Considerations 237 • Case Study 237
31	Fibromyalgia
	Overview of the Pathophysiology 239 • Effects on the Exercise Response 239 • Effects of Exercise Training 240  Management and Medications 240 • Recommendations for Exercise Testing 241  Recommendations for Exercise Programming 242 • Special Considerations 244 • Case Study 245
32	Anemia246 Kirsten L. Johansen, MD
	Overview of the Pathophysiology 246 • Effects on the Exercise Response 247 • Effects of Exercise Training 247  Management and Medications 247 • Recommendations for Exercise Testing 248  Recommendations for Exercise Programming 248 • Case Study 249
33	Bleeding and Clotting Disorders
	Overview of the Pathophysiology 250 • Effects on the Exercise Response 251 • Effects of Exercise Training 252  Management and Medications 253 • Recommendations for Exercise Testing 254  Recommendations for Exercise Programming 254 • Special Considerations 255 • Case Study 256
PAR	VI Orthopedic Diseases and Disabilities 257
	Kenneth H. Pitetti, PhD, FACSM
34	Arthritis
	Overview of the Pathophysiology 259 • Effects on the Exercise Response 260 • Effects of Exercise Training 260  Management and Medications 261 • Recommendations for Exercise Testing 261  Recommendations for Exercise Programming 262 • Case Study 265
35	Lower Back Pain Syndrome
	Overview of the Pathophysiology 266 • Effects on the Exercise Response 266 • Effects of Exercise Training 267  Management and Medications 267 • Recommendations for Exercise Testing 267  Recommendations for Exercise Programming 267 • Case Study 269

36	Osteoporosis	270
	Susan S. Smith, PT, PhD, CCD • Che-Hsiang Elizabeth Wang, PT, MS Susan A. Bloomfield, PhD, FACSM	
	Overview of the Pathophysiology 270 • Effects on the Exercise Response 272 • Effects of Exercise Training 272  Management and Medications 272 • Recommendations for Exercise Testing 273  Recommendations for Exercise Programming 275 • Special Considerations 276 • Case Study 277	272
37	Lower Limb Amputation	280
	Kenneth H. Pitetti, PhD, FAC5M • Mark H. Pedrotty, PhD	
	Overview of the Pathophysiology 280 • Effects on the Exercise Response 281 • Effects on Exercise Training 281  Management and Medications 281 • Recommendations for Exercise Testing 282  Recommendations for Exercise Programming 283 • Case Study 284	
PAR	T VII Neuromuscular Disorders	285
	Terry Nicola, MD, MS	
38	Stroke and Brain Injury	287
	Karen Palmer-McLean, PhD, PT Kimberly B. Harbst, PhD, PT	
	Overview of the Pathophysiology 287 • Effects on the Exercise Response 288 • Effects of Exercise Training 289  Management and Medications 289 • Recommendations for Exercise Testing 290  Recommendations for Exercise Programming 292 • Case Study 295	
39		298
	Stephen F. Figoni, PhD, RKT, FACSM	
	Overview of the Pathophysiology 298 • Effects on the Exercise Response 299  Effects of Exercise Training 299 • Management and Medications 299 • Recommendations for Exercise Testing 301  Recommendations for Exercise Programming 301 • Special Considerations 302 • Case Study 304	0
40	Muscular Dystrophy	306
	Mark A. Tarnopolsky, MD, PhD	
	Overview of the Pathophysiology 306 • Effects on the Exercise Response 307 • Effects of Exercise Training 307  Management and Medications 308 • Recommendations for Exercise Testing 308	
	Recommendations for Exercise Programming 310 • Special Considerations 311 • Case Study 312	
41	Epilepsy	314
	Karl Otto Nakken, MD, PhD	
	Overview of the Pathophysiology 314 • Effects on the Exercise Response 316 • Effects of Exercise Training 316 Management and Medications 316 • Recommendations for Exercise Testing 318 Recommendations for Exercise Programming 318 • Case Study 320	
42	Multiple Sclerosis	321
	Kurt Jackson, PhD, PT, GCS Janet A. Mulcare, PhD, FACSM	
	Overview of the Pathophysiology 321 • Effects on the Exercise Response 321 • Effects of Exercise Training 321  Management and Medications 322 • Recommendations for Exercise Testing 322  Recommendations for Exercise Programming 323 • Special Considerations 324 • Case Study 325	

43	Polio and Post-Polio Syndrome	327
	Overview of the Pathophysiology 327 • Effects on the Exercise Response 328 • Effects of Exercise Training 328  Management and Medications 328 • Recommendations for Exercise Testing 329  Recommendations for Exercise Programming 331 • Special Considerations 333 • Case Study 333	
44	Amyotrophic Lateral Sclerosis	336
	Vanina Dal Bello-Haas, PhD, PT  Lisa Stroud Krivickas, MD	
	Overview of the Pathophysiology 336 • Effects on the Exercise Response 337 • Effects of Exercise Training 337  Management and Medications 338 • Recommendations for Exercise Testing 338  Recommendations for Exercise Programming 338 • Special Considerations 340 • Case Study 342	
45	Cerebral Palsy	343
	Overview of the Pathophysiology 343 • Effects on the Exercise Response 344 • Effects of Exercise Training 344 Management and Medications 345 • Recommendations for Exercise Testing 345 Recommendations for Exercise Programming 347 • Case Study 348	
46	Parkinson's Disease	350
	Elizabeth J. Protas, PhD, PT, FACSM • Rhonda K. Stanley, PhD, PT • Joseph Jankovic,	MD
	Overview of the Pathophysiology 350 • Effects on the Exercise Response 351 • Effects of Exercise Training 351  Management and Medications 352 • Recommendations for Exercise Testing 353  Recommendations for Exercise Programming 353 • Case Study 355	
PAR	Management and Medications 352 - Recommendations for Exercise Testing 353	
PAR	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355	357
PAR	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  T VIII Cognitive, Psychological,	357
PAR 47	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  T VIII Cognitive, Psychological, and Sensory Disorders	<b>357</b>
PAR 47	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  T VIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FACSM  Intellectual Disabilities	
47	Management and Medications 352 * Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 * Case Study 355  TVIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FACSM  Intellectual Disabilities Patricia Fegan, PhD  Overview of the Pathophysiology 359 * Effects on the Exercise Response 361 * Effects of Exercise Training 361 Management and Medications 362 * Recommendations for Exercise Testing 362 Recommendations for Exercise Programming 365 * Special Considerations 366 * Case Study 367	<b>359</b>
PAR 47	Management and Medications 352 * Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 * Case Study 355  TVIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FAC5M  Intellectual Disabilities Patricia Fegan, PhD  Overview of the Pathophysiology 359 * Effects on the Exercise Response 361 * Effects of Exercise Training 361 Management and Medications 362 * Recommendations for Exercise Testing 362 Recommendations for Exercise Programming 365 * Special Considerations 366 * Case Study 367	
47	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  TVIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FACSM  Intellectual Disabilities Patricia Fegan, PhD  Overview of the Pathophysiology 359 • Effects on the Exercise Response 361 • Effects of Exercise Training 361 Management and Medications 362 • Recommendations for Exercise Testing 362 Recommendations for Exercise Programming 365 • Special Considerations 366 • Case Study 367  Alzheimer's Disease	359
47	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  TVIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FAC5M  Intellectual Disabilities Patricia Fegan, PhD  Overview of the Pathophysiology 359 • Effects on the Exercise Response 361 • Effects of Exercise Training 361 Management and Medications 362 • Recommendations for Exercise Testing 362 Recommendations for Exercise Programming 365 • Special Considerations 366 • Case Study 367  Alzheimer's Disease  James H. Rimmer, PhD • Donald L. Smith, M5, RCEP  Overview of the Pathophysiology 368 • Management and Medications 370 Effects on the Exercise Response and Exercise Training 370 • Recommendations for Exercise Testing 370	<b>359</b>
47	Management and Medications 352 • Recommendations for Exercise Testing 353 Recommendations for Exercise Programming 353 • Case Study 355  TVIII Cognitive, Psychological, and Sensory Disorders  Lorraine E. Colson Bloomquist, EdD, FAC5M  Intellectual Disabilities Patricia Fegan, PhD  Overview of the Pathophysiology 359 • Effects on the Exercise Response 361 • Effects of Exercise Training 361 Management and Medications 362 • Recommendations for Exercise Testing 362 Recommendations for Exercise Programming 365 • Special Considerations 366 • Case Study 367  Alzheimer's Disease  James H. Rimmer, PhD • Donald L. Smith, MS, RCEP  Overview of the Pathophysiology 368 • Management and Medications 370 Effects on the Exercise Response and Exercise Training 370 • Recommendations for Exercise Testing 370 Recommendations for Exercise Programming 371 • Special Considerations 373 • Case Study 374	359

50	Stress and Anxiety Disorders
	Overview of the Pathophysiology 379 • Effects on the Exercise Response 380 • Effects of Exercise Training 380 Management and Medications 381 • Recommendations for Exercise Testing 382 Recommendations for Exercise Programming 382 • Special Considerations 383 • Case Study 383
51	Deaf and Hard of Hearing
	Overview of the Pathophysiology 385 • Effects on the Exercise Response 387 • Effects of Exercise Training 387 Recommendations for Exercise Testing 388 • Recommendations for Exercise Programming 388 Special Considerations 388 • Case Study 390
52	Visual Impairment
	Overview of the Pathophysiology 392 = Effects on the Exercise Response 392 = Effects of Exercise Training 393  Management and Medications 393 = Recommendations for Exercise Testing 393  Recommendations for Exercise Programming 394 = Case Study 395
	Appendix 397 Suggested Readings 407 Index 429 About the ACSM 440