Contents

Section 1: Cardiopulmonary System: Function and Dysfunction

1. Cardiovascular System and its Dysfunction 3
Narasimman Swaminathan, Neepa H Pandya

Cardiovascular System Function 3
Neepa H Pandya

Function of the Heart 3
Coronary Circulation 7

Cardiovascular System Dysfunction 9
Narasimman Swaminathan

Causes of Cardiac Dysfunction 9
Pathophysiology of Cardiac Dysfunction 9
Signs and Symptoms of Heart Failure 10
Physiotherapy Clinical Decision-Making 12

2. Respiratory System and its Dysfunction 14
Jaimala Shetye

Structure of the Respiratory System 14
Functions of the Respiratory System 17
Dysfunctions of the Respiratory System 20

3. ICF with Reference to Cardiopulmonary System 26
Vimal Telang, Mariya Jiandani

Models of Disability and Evolution to ICF 27
ICF Coding 30
ICF as an Outcome Measure 30
ICF Core Sets 30
Goal Setting Made Easy with ICF 34

4. Cardiopulmonary Response to Exercise 39
Veena Kiran Nambiar

Cardiovascular System 40
Short-term or Acute Cardiac Responses to Exercise 41
Stroke Volume Response to Submaximal and Maximal Exercise 42
Heart Rate Regulation 43
Long-term or Chronic Adaptations of the Heart to Exercise 44
Long-term Responses of the Nervous Control System 45
Vascular System 45
Pulmonary System 48
Short-term or Acute Ventilatory Responses to Exercise 50
Determinants of Maximal Oxygen Consumption during Dynamic Exercise 56

Section 2: Clinical Evaluation, Relevant Investigations and Pharmacological Management: Physiotherapy Perspective

5. Clinical Evaluation and Documentation of Heart and Lung Function 61
Titiksha Pol

History Taking or Subjective Evaluation 61
Objective Examination 66
Proforma 76

6. Biochemical Investigations 79
Hardini Jay Parikh

Serum Enzymes and Cardiac Biomarkers 80
Lipid Profile 82
Coagulation Profile 83
Electrolytes 84
Complete Blood Cell Count 85
Blood Sugar Profile 86
Creatinine 88
Blood Urea Nitrogen 88
C-reactive Protein 88
Investigations for Respiratory System Assessment 88
Liver Function Tests 88
Other Important Clinical Investigations 89

7. Radiological Investigations 93
Ruju Doshi

X-ray 93
Ultrasound 113
Computed Tomography Scan 113
Magnetic Resonance Imaging 120
Positron Emission Tomography-Computed Tomography 121

8. Pulmonary Function Testing 122
Tarpan Shah

Important Terminologies Related to Pulmonary Function Testing 123
Methods of Pulmonary Function Testing 124
Indications for Pulmonary Function Testing 128
Contraindications 128
Risks Involved in Pulmonary Function Testing 128
Bedside Pulmonary Function Testing 129
Pulmonary Function Testing Measurement Instruments/ Devices 130
Graphs in Pulmonary Function Testing 131

Approach to Pulmonary Function Testing Interpretation 132

9. Evaluation of Arterial Blood Gases and Acid-Base Balance 138
Khalil Ahmed Dalvi, Titiksha Pol

Importance of Arterial Blood Gas 138
Components of an Arterial Blood Gas Report 138
Steps to Interpret an Arterial Blood Gas Report 144
Clinical Examples of Arterial Blood Gas Interpretation 145

10. Electrocardiography 147
Hardik Parab

Normal Electrocardiogram Waveform 148
Interpretation of ECG 149

11. Special Investigations 161
Hardik Parab

Electrocardiography 162
Pulmonary Function Test 162
Exercise Oximetry 162
Functional Exercise Tests 162
Ankle Brachial Index 162
Echocardiography 163
Bronchoscopy 164
Cardiac Biomarkers 165
Holter Monitoring 166
Cardiac Computed Tomography 167
Cardiac Catheterization and Angiogram 167
Magnetic Resonance Imaging 169
Perfusion Scans 171
Implantable Event Recorder 172
Transtelephonic Pacemaker or Implantable Cardioverter/Defibrillator Transmission 172
Electrophysiology Studies 173

12. Exercise Tolerance Tests 176
Aditi Ketkar Berry, Kushal Madan, Abraham Samuel Babu

Evaluating Exercise Intolerance 176
Procedure for Testing 176
Interpretation of Test Results 180
Integrating Imaging and Physiological Assessments with Exercise Testing 182
Evaluating Exercise Capacity during the COVID-19 Pandemic 182

13. Disability Evaluation in Cardiorespiratory Dysfunction 184
Ravindran R

Disability Evaluation of the Respiratory System 185
Disability Evaluation of the Cardiovascular System 187

14. Pharmacological Management: Drugs Used in Heart and Lung Diseases 198
Supriya Malhotra, Falguni Majmudar, Amee Pandya

Drugs Used for Cardiovascular Therapeutics 199
Drugs for Hypertension 199
Drugs for Heart Failure 203
Drugs for Ischemic Heart Disease 208
Drugs for Arrhythmias 210
Drugs for Peripheral Vascular Disease 212
Drug Therapy in Respiratory Therapeutics 213
Drug Therapy for Bronchial Asthma and Chronic Obstructive Pulmonary Disease 213
Mucoregulators 215
Mucolytics 215
Expectorants 215
Antitussives 216
Occupational and Environmental Lung Disorders 216
Bronchiectasis 216
Cystic Fibrosis 216
Interstitial Lung Disease 216
Sleep Apnea 216

15. Drugs Affecting Physical Performance 218
Falguni Majmudar, Supriya Malhotra, Nehal Parikh

Performance-enhancing Drugs 219
Performance-affecting Drugs 221
Drugs Causing Sexual Dysfunction 222

Section 3: Physiotherapy Approaches in Management of Cardiopulmonary Dysfunction

16. Patient Education 227
Poorvi Devani

Patient-centered Care Model 227
Benefits of Patient Education 228
Approaches to Patient Education 229
A Model for Patient Education 229
Suggestions for Enhancing the Patient Education Process 232
Factors Affecting Patient Education 232

17. Humidification and Nebulization 234
Mariya Jiandani, Farah Jiandani

Definition of Terms 234
Process of Humidification 234
Humidifiers 235
Nebulization (Aerosol Therapy) 238

18. Bronchial Hygiene and Use of Assistive Devices 245
Mariya Jiandani

Normal and Impaired Mucociliary Clearance 245
Techniques of Bronchial Hygiene or Airway Clearance 247
Techniques of Airway Clearance 248
Assistive Devices 258
Clinical Decision-making in Technique Selection 262

19. Therapeutic Body Positioning 265
KV Haribabu, Gauri Mayank Afle

Various Body Positions 266
Effects of Therapeutic Body Positioning 268

Modes of Giving Body Positioning 271
Therapeutic Body Positioning in Lung Pathologies 272

20. Strategies to Improve Lung Volumes 275
Anuprita Thakur
Therapeutic Approaches to Increasing Lung Volume 276
Mechanical Devices to Increase Lung Volume 279
Complementary Therapies to Improve Lung Volume 285
Technology to Improve Lung Volume 285

21. Work of Breathing 288
Rachna Arora
What is Work of Breathing? 289
Work of Breathing in Disease 291
Factors Affecting Work of Breathing 292
Assessment of a Breathless Patient 293
Management of a Breathless Patient 295
Physiotherapy Interventions to Reduce Work of Breathing 296

22. Respiratory Muscle Dysfunction and Training 300
Vidhi Thakar, Neepa H Pandya
Respiratory Musculature Mechanics 300
Respiratory Muscle Dysfunction 301
Evaluation of Respiratory Muscles 302
Training of the Respiratory Muscles 304

23. Energy Conservation Techniques 309
Maniarasi Shunmugam
Measurement of Energy Expenditure 310
Ventilatory Muscle Demand 310
Energy Conservation 312
Assessment 312
Aims and Goals 313
Energy Conservation Techniques 313
Benefits of Energy Conservation in Chronic Obstructive Pulmonary Disease 314
Educating the Patient 315
Bioenergetic Therapy 315

Section 4: Physiotherapy Management of Common Cardiopulmonary Conditions

24. Airway and Parenchymal Diseases 319
Ankita Asher, Neepa H Pandya
Airway Diseases 319
Chronic Obstructive Pulmonary Disease 319
Asthma 322
Bronchiectasis 322
Parenchymal Diseases 324
Cystic Fibrosis 324
Pneumonia 324
Interstitial Lung Diseases 325
Chronic Fibrosing Interstitial Pneumonias 325
Hydatid Cyst/Echinococcal Disease 327
Lung Abscess 327
Exercise Performance in Chronic Lung Diseases 328

25. Disorders of Pleura and Thoracic Cage 332
Bela Agarwal
Anatomy and Physiology of Pleura 332
Pleural Disorders 336
Disorders of the Thoracic Cage 346

26. Physiotherapy in Infectious Disease-COVID-19 352
Mariya Jiandani
Overview of SARS-CoV-2 353
Physiotherapy in COVID-19 360
Post-acute COVID-19 Syndrome 366
Physiotherapy in Post-COVID-19 367
Safety Considerations 374

27. Diseases of the Cardiovascular System 379
Pooja Akhtar, Neepa H Pandya
Overview 380
Coronary Artery Disease 380
Neepa H Pandya
Pathophysiology 381
Impact on Exercise Performance 382
Clinical Features 383
Assessment 384
Medical Management 384
Valvular Heart Diseases 385
Pooja Akhtar
Mitral Stenosis 386
Mitral Regurgitation 389
Aortic Stenosis 391
Aortic Regurgitation 393
Heart Failure 395
Pooja Akhtar
Classification of Heart Failure 395
Pathophysiology 395
Precipitating Causes of Heart Failure 397
Clinical Manifestations 398
Investigations 399
Medical Management 400
Physiotherapy Management of Chronic Heart Failure 401

28. Cardiopulmonary Physiotherapy in Neuromuscular Disorders 406
Neepa H Pandya, Mihir Mehta
Pathophysiology 406
Physiotherapy Management 410

29. Physiotherapy in Cardiac Surgeries 417
Sushama A Bhandare
Coronary Artery Bypass Graft 418
Minimal Invasive Cardiac Surgery 419
Valve Replacement Surgery 419

Congenital Heart Diseases and Diseases of the Great Vessels 420
Complications in Cardiac Surgeries 426
Physiotherapy Management 428

30. Physiotherapy in Pulmonary Surgeries 439
Sushama A Bhandare
Indications of Pulmonary Resection 439
Types of Pulmonary Surgeries/Resection 440
Incision/Thoracotomy 441
Preoperative Investigations 442
Complications of Pulmonary Surgery 443
Postoperative Drainage 443
Postoperative Problem List after Lung Surgery 445
Physiotherapy Management 445

31. Physiotherapy in Abdominal Surgeries 451
Megha Sheth, Neepa H Pandya
Postoperative Complications 451
Physiotherapy Assessment in Abdominal Surgery Patients 453
Physiotherapy Management 454

32. Yoga: A Physiotherapist's Perspective 458
Nilima Patel
Introduction: Yoga—A Psychophysical Spiritual Approach in Health Care 458
Introduction to Ashtanga Yoga 459
Ashtanga Yoga: Principles and Guidelines for a Healthy Heart 460
Chair Yoga for Cardiopulmonary Health 467

33. Yoga and Cardiopulmonary Conditions 473
Rashmi Mahulkar Muthal
Role of Yoga Therapy in Obstructive Airway Disease 473
Integrated Approach of Pranayama Therapy in Asthma 474
Cascade of Biomechanical Changes Occurring in Bronchial Asthma 477
Neurophysiological Changes Occurring in Asthmatic Patients as an Effect of Pranayama 478
Integrated Approach of Pranayama 478
Mechanism of Action of Pranayama Upon Increase in Breath-holding Period 480
Role of Yoga Therapy in Coronary Artery Disease 480
Changes in the Cardiovascular System with Integrated Yogic Practices at the Root Level 480
Effects of Yoga on the Autonomic Nervous System 481
Effect of Yoga on Blood Vessels 481
Yoga and Coronary Artery Diseases 482

34. Nutritional Counseling in Cardiopulmonary Conditions 486
Shivani Sheth, Charmi Shah, Neeta Vyas
Importance of Nutritional Counseling 487
Interference of Diet with Cardiac and Respiratory Drugs 487
Food Items to be Avoided in Cardiac and Respiratory Conditions 487
Dietary Guidelines for Heart Diseases 488
Postcardiac Surgery Nutrient Recommendations 490

Section 5: Physiotherapy for Intensive Care Unit

35. Intensive Care Unit Setup and Equipment 495
Sapna D Gupta, Jaldipsinh N Gohil
Guidelines for Intensive Care Unit Setup and Equipment 496
Categorization of Services for the Critically Ill Patient 497
Recommendations for Intensive Care Unit Admission 497
Fire Safety in Intensive Care Unit 497
Intensive Care Unit Equipment 499

36. Mechanical Ventilation and Weaning 510
Farah Jiandani, Mariya Jiandani
Respiratory Failure 510
Mechanical Ventilator 511
Types of Mechanical Ventilators 512
Phases of a Mechanical Ventilator 513
Modes of Mechanical Ventilation 513
Settings 517
Complications of Mechanical Ventilation 520
Weaning 520

37. Oxygen Therapy 525
Harita Vyas
Hypoxia and its Features 526
Indications/Goals of Oxygen Therapy 526
Oxygen Therapy as a Drug 527
Oxygen Delivery Systems 528
Long-term Oxygen Therapy and Portable Devices 531
Oxygen Therapy in Pediatric Population 532
Delivery Approach for Oxygen Therapy and Physiotherapy 533
British Thoracic Society Guidelines for Oxygen Delivery for Various Diseases 533
Exercise and Oxygen Therapy 533
Hazards of Oxygen Therapy for Healthcare Professionals 534

38. Physiotherapy in the Intensive Care Unit 536
Razia Nagarwala, Mariya Jiandani
Intensive Care Unit Environment 537
Patient in the Intensive Care Unit 537
Intensive Care Unit-related Complications 537
Goals of Physiotherapy in Intensive Care Unit 538
Techniques to Prevent Complication and Optimize Care for Early Discharge from ICU 539
Early Mobilization 546
Safety Criteria 549
Benefits of Physiotherapy Intervention in ICU 549

39. Physiotherapy Management in an Organ Transplant Unit 552
Dipali Rana, Neeta Vyas
Benefits of Physiotherapy in Transplantation 553
Comprehensive Examination 553
Early Postoperative Physiotherapy 554
Physiotherapy in the Intensive Care Unit 554

40. Physiotherapy in a Cancer Intensive Care Unit 559
Anuradha Abhijeet Daptardar, Ajeeta Mohan Kulkarni
Cancer Treatment and its Side Effects 560
Surgery 560
Postoperative Complications 563
Chemotherapy 564
Radiotherapy 564
Enhanced Recovery after Surgery 565
Palliative Care 566

41. Pediatric and Neonatal Intensive Care Unit 570
Priya Singh Rangey
Anatomy and Physiology of the Pediatric Cardiorespiratory System 571
PICU and NICU Equipment and Setup 571
Reasons for Admission to NICU and PICU 575
Assessment 575
Management 576
Management of Specific Neonatal Disorders 582
Dying Children 582
Care of Parents 583

42. Cardiopulmonary Resuscitation 585
Priyanshu Rathod
Introduction to Cardiopulmonary Resuscitation (CPR) 585
Cardiac Arrest Versus Heart Attack 585
Basic Skills when Giving Cardiopulmonary Resuscitation 586
Adult Cardiopulmonary Resuscitation and Automated External Defibrillator Skills 590
Child Cardiopulmonary Resuscitation 591
Infant Cardiopulmonary Resuscitation 592
General Breathing Problems 592
Helping a Choking Adult 592
Using Epinephrine Pens 593
Safety Measures in Infective Conditions—Cardiopulmonary Resuscitation during the COVID-19 Pandemic 593

Section 6: Rehabilitation

43. Cardiac Rehabilitation 597
Neepa H Pandya, Sarla V Bhatt
Overview 597
Exercise Response in Cardiac Patients 598
Rationale for Exercise Training 598
Exercise Prescription 599
Exercise Training Program 600
Phases of Cardiac Rehabilitation 604
Risks Associated with Exercise Training 604
Boundaries of Exercise Training Session 607
Outcomes of Cardiac Rehabilitation 607

44. Pulmonary Rehabilitation 609
Mariya Jiandani, Neepa H Pandya
Overview 609
Common Impairments Associated with Respiratory Diseases 610
Definition of Pulmonary Rehabilitation 611
Program Goals 611
Types of Pulmonary Rehabilitation Programs 612
Components of Pulmonary Rehabilitation 612
Strength of Evidence for Pulmonary Rehabilitation 622
Management of Acute Exacerbations 622
Outcomes of Pulmonary Rehabilitation 623
Disease-specific Considerations in Pulmonary Rehabilitation 623

45. Telerehabilitation 627
Mrinmayee Koltharkar, Mariya Jiandani
Telemedicine Around the World and in India 627
History of Telerehabilitation 628
Barriers for Center-based Physical Rehabilitation 629
Advantages of Telerehabilitation 629
Concerns of Telerehabilitation 629
Fields Involved in Telerehabilitation 630
Modes of Delivery 630
Use of Mobile Technology in Telerehabilitation 631
Principles for the Use of Telerehabilitation 631
Clinical Application 632
Future Perspectives 637

46. Cardiopulmonary Rehabilitation: Future Trends 640
Anup Bhat, Ganesha Poojari, Akhila Satyamurthy, Abraham Samuel Babu
Current State of Cardiac and Pulmonary Rehabilitation 640
Impact of COVID-19 on Cardiac and Pulmonary Rehabilitation 641
Strategies to Advance Cardiopulmonary Rehabilitation 642
Future of Cardiopulmonary Rehabilitation 644

47. Palliative Care in Cardiopulmonary Conditions 647
Anjali Ravindra Bhise
Multi- and Interdisciplinary Team 648
Physical Therapy 648
Physiotherapy Management for Common Symptoms 650
Pulmonary Rehabilitation Versus Palliative Care 652

Index 657