

CONTENTS

| | |
|---|-------|
| <i>Dedication</i> | v |
| <i>Introduction</i> | vi |
| <i>Contributors</i> | vii |
| <i>Preface</i> | xxii |
| <i>A Selected Glossary of Abbreviations</i> | xxxii |

PART ONE ■ CRITICAL CARE INTEGRATION

SECTION I ■ INTRODUCTION TO THE PRACTICE OF PEDIATRIC CRITICAL CARE

| | | |
|------------------|---|-----------|
| Chapter 1 | Pediatric Intensive Care: A Global Perspective | 3 |
| | <i>Trevor Duke, Niranjana "Tex" Kissoon, and Edwin Van Der Voort</i> | |
| Chapter 2 | Impact of Pediatric Critical Care on the Family, Community, and Society | 11 |
| | <i>Lewis H. Romer, David G. Nichols, Jessica Mesman, Heather Woods Barthel, Matt Norvell, Melissa J. Sacco, Khaliyah Johnson, and Jos M. Latour</i> | |

SECTION II ■ PROFESSIONALISM, LEADERSHIP, AND SYSTEMS-BASED PRACTICE

| | | |
|------------------|--|-----------|
| Chapter 3 | Professionalism and Leadership in Pediatric Critical Care | 23 |
| | <i>Vinay M. Nadkarni and Alice D. Ackerman</i> | |
| Chapter 4 | Simulation Training and Team Dynamics | 29 |
| | <i>Elizabeth A. Hunt, David Grant, and Michael Rosen</i> | |
| Chapter 5 | PICU Organization and Physical Design | 37 |
| | <i>M. Michele Moss and Shari Simone</i> | |
| Chapter 6 | Practice Management: The Business of Pediatric Critical Care | 50 |
| | <i>Meredith G. Van Der Velden and Jeffrey P. Burns</i> | |
| Chapter 7 | Research Design and Statistical Analysis | 57 |
| | <i>Wynne E. Morrison, Elizabeth A. Hunt, J. Michael Dean, and Anne-Marie Guerguerian</i> | |
| Chapter 8 | Evidence-Based Medicine | 77 |
| | <i>Barry P. Markovitz and Kathleen L. Meert</i> | |
| Chapter 9 | Quality Improvement, Patient Safety, and Medical Error | 86 |
| | <i>Andrew C. Argent and Vicki L. Montgomery</i> | |

SECTION III ■ INFORMATION MANAGEMENT

- Chapter 10** Severity-of-Illness Measurement: Foundations, Principles, and Applications 96
Anthony D. Slonim, James P. Marcin, and Murray M. Pollack
- Chapter 11** Communication and Information Technology in the PICU 103
Steven Pon and Barry P. Markovitz
- Chapter 12** Learning from the Data—Discovery Informatics for Critically Ill Children 114
Randall C. Wetzel

SECTION IV ■ ETHICAL AND PALLIATIVE CONCERNS IN THE CARE OF THE CRITICALLY ILL

- Chapter 13** Integrating Palliative Care and Critical Care 122
Wynne E. Morrison, Patricia Lago, Jefferson Pedro Piva, and Kathleen L. Meert
- Chapter 14** Pain and Sedation Management 132
Sapna R. Kudchadkar, R. Blaine Easley, Kenneth M. Brady, and Myron Yaster
- Chapter 15** Ethics 164
George E. Hardart and Denis J. Devictor
- Chapter 16** Organ Donation 177
Kristen L. Nelson McMillan, Thomas A. Nakagawa, and Ivor D. Berkowitz
- Chapter 17** Rehabilitation 196
Melissa K. Trovato, Glendaliz Bosques, Robert J. Graham, Megan E. Kramer, Frank S. Pidcock, Suzanne V. Prestwich, Cristina L. Sadowsky, and Scott C. Schultz

SECTION V ■ BASIC SCIENCE CONCEPTS OF PEDIATRIC CRITICAL CARE

- Chapter 18** Omics and Critical Care 208
Mary K. Dahmer and Michael Quasney
- Chapter 19** Innate Immunity and Inflammation 225
James A. Thomas
- Chapter 20** Cellular Adaptations to Stress 240
Derek S. Wheeler and Hector R. Wong
- Chapter 21** Shock, Ischemia, and Reperfusion Injury 253
Basilina Zingarelli
- Chapter 22** Pharmacology 269
Athena F. Zuppa
- Chapter 23** Multiple Organ Dysfunction Syndrome 286
Scott L. Weiss, Yong Y. Han, Thomas P. Shanley, and Joseph A. Carcillo

PART TWO ■ EMERGENCY CARE AND ACUTE MANAGEMENT**SECTION I ■ INITIAL STABILIZATION**

- Chapter 24** Airway Management 305
Dominic Cave, Jonathan P. Duff, Allan De Caen, and Mary Fran Hazinski

| | | |
|--|---|-----|
| Chapter 25 | Cardiopulmonary Resuscitation <i>Robert A. Berg, Katsuyuki Miyasaka, Antonio Rodríguez-Núñez, Mary Fran Hazinski, David Anthony Zideman, and Vinay M. Nadkarni</i> | 329 |
| Chapter 26 | Stabilization and Transport <i>Monica E. Kleinman, Aaron J. Donoghue, Richard A. Orr, and Niranjan "Tex" Kissoon</i> | 348 |
| Chapter 27 | Invasive Procedures <i>Stephen M. Schexnayder, Praveen Khilnani, and Naoki Shimizu</i> | 363 |
| Chapter 28 | Recognition and Initial Management of Shock <i>Ruchi Sinha, Simon Nadel, Niranjan "Tex" Kissoon, and Suchitra Ranjit</i> | 380 |
| Chapter 29 | Rapid Response Systems <i>Christopher P. Bonafide, Richard J. Brilli, James Tibballs, Christopher S. Parshuram, Patrick W. Brady, and Derek S. Wheeler</i> | 394 |
| SECTION II ■ ENVIRONMENTAL CRISES | | |
| Chapter 30 | Multiple Trauma <i>John Scott Baird and Arthur Cooper</i> | 404 |
| Chapter 31 | Drowning <i>Katherine V. Biagas and Linda Aponte-Patel</i> | 428 |
| Chapter 32 | Burns and Smoke Inhalation <i>Roger W. Yurt, James J. Gallagher, Joy D. Howell, and Bruce M. Greenwald</i> | 436 |
| Chapter 33 | Injury From Chemical, Biologic, Radiologic, and Nuclear Agents <i>Peter Silver, F. Meredith Sonnett, and George L. Foltin</i> | 451 |
| Chapter 34 | Mass Casualty Events <i>Maria Cristina Esperanza</i> | 462 |
| Chapter 35 | Poisoning <i>Michael A. Nares, G. Patricia Cantwell, and Richard S. Weisman</i> | 476 |
| Chapter 36 | Thermoregulation <i>Adnan M. Bakar and Charles L. Schleien</i> | 499 |
| Chapter 37 | Envenomation Syndromes <i>James Tibballs and Kenneth D. Winkel</i> | 515 |
| SECTION III ■ LIFE-SUPPORT TECHNOLOGIES | | |
| Chapter 38 | Mechanical Ventilation <i>Mark J. Heulitt, Courtney Ranallo, Gerhard K. Wolf, and John H. Arnold</i> | 541 |
| Chapter 39 | Inhaled Gases and Noninvasive Ventilation <i>Angela T. Wratney, Donna S. Hamel, Ira M. Cheifetz, and David G. Nichols</i> | 565 |
| Chapter 40 | Extracorporeal Life Support <i>Graeme Maclaren, Steven A. Conrad, and Heidi J. Dalton</i> | 581 |
| Chapter 41 | Extracorporeal Organ Support Therapy <i>Warwick W. Butt, Peter W. Skippen, Phillippe Jouvet, and Jim Fortenberry</i> | 600 |
| Chapter 42 | Blood Products and Transfusion Therapy <i>Oliver Karam, Philip C. Spinella, Edward C.C. Wong, and Naomi L.C. Luban</i> | 621 |

PART THREE ■ CRITICAL CARE ORGAN SYSTEMS

SECTION I ■ RESPIRATORY DISEASE

- Chapter 43** Respiratory Physiology 641
Frank L. Powell, Gregory P. Heldt, and Gabriel G. Haddad
- Chapter 44** The Molecular Biology of Acute Lung Injury 670
Todd Carpenter and Kurt R. Stenmark
- Chapter 45** Respiratory Monitoring 686
Ira M. Cheifetz, Jan Hau Lee, and Shekhar T. Venkataraman
- Chapter 46** Status Asthmaticus 710
Michael T. Bigham and Richard J. Brill
- Chapter 47** Neonatal Respiratory Failure 721
Narayan Prabhu Iyer, Philippe S. Friedlich, Elisabeth L. Raab, Rangasamy Ramanathan, and Istvan Seri

- Chapter 48** Pneumonia and Bronchiolitis 745
Werther Brunow De Carvalho, Marcelo Cunio Machado Fonseca, Cintia Johnston, and David G. Nichols
- Chapter 49** Acute Lung Injury and Acute Respiratory Distress Syndrome 766
Kathleen M. Ventre and John H. Arnold
- Chapter 50** Chronic Respiratory Failure 794
Thomas G. Keens, Sheila S. Kun, and Sally L. Davidson Ward
- Chapter 51** Sleep and Breathing 808
Sally L. Davidson Ward and Thomas G. Keens

SECTION II ■ NEUROMUSCULAR DISEASE

- Chapter 52** Electrodiagnostic Techniques in Neuromuscular Disease 818
Matthew Pitt
- Chapter 53** Acute Neuromuscular Disease 829
Sunit C. Singhi, Naveen Sankhyan, and Arun Bansal
- Chapter 54** Chronic Neuromuscular Disease 851
Elena Cavazzoni, Jonathan Gillis, and Monique M. Ryan

SECTION III ■ NEUROLOGIC DISEASE

- Chapter 55** Developmental Neurobiology, Neurophysiology, and the PICU 861
Larry W. Jenkins and Patrick M. Kochanek
- Chapter 56** Molecular Biology of Brain Injury 877
Patrick M. Kochanek, Hülya Bayir, Larry W. Jenkins, and Robert S.B. Clark
- Chapter 57** Evaluation of the Comatose Child 896
Nicholas S. Abend and Daniel J. Licht
- Chapter 58** Neurologic Monitoring 907
Robert C. Tasker, Mateo Aboy, Alan Graham, and Brahm Goldstein
- Chapter 59** Neurologic Imaging 920
David J. Michelson and Stephen Ashwal
- Chapter 60** Neurosurgical and Neuroradiological Critical Care 937
Michael L. McManus, Craig D. McClain, and Robert C. Tasker

| | | |
|-------------------|--|------|
| Chapter 61 | Head and Spinal Cord Trauma <i>Robert C. Tasker and P. David Adelson</i> | 951 |
| Chapter 62 | Abusive Head Trauma <i>Rachel P. Berger, Dennis Simon, Jennifer E. Wolford, and Michael J. Bell</i> | 982 |
| Chapter 63 | Status Epilepticus <i>Kimberly S. Bennett and Colin B. Van Orman</i> | 990 |
| Chapter 64 | Cerebrovascular Disease and Stroke <i>John Pappachan, Robert C. Tasker, and Fenella Kirkham</i> | 1009 |
| Chapter 65 | Hypoxic–Ischemic Encephalopathy <i>Ericka L. Fink, Mioara D. Manole, and Robert S.B. Clark</i> | 1033 |
| Chapter 66 | Metabolic Encephalopathies in Children <i>Laurence Ducharme-Crevier, Genevieve Dupont-Thibodeau, Anne Lortie, Bruno Maranda, Robert C. Tasker, and Philippe Jowet</i> | 1053 |
| Chapter 67 | The Determination of Brain Death <i>Thomas A. Nakagawa and Mudit Mathur</i> | 1066 |
| SECTION IV | CARDIOVASCULAR DISEASE | |
| Chapter 68 | Cardiac Anatomy <i>Steven M. Schwartz, Zdenek Slavik, and Siew Yen Ho</i> | 1077 |
| Chapter 69 | Cardiovascular Physiology <i>Peter Oishi, Rebecca Johnson Kameny, Julien I. Hoffman, and Jeffrey R. Fineman</i> | 1091 |
| Chapter 70 | Cardiorespiratory Interactions in Children with Heart Disease <i>Ronald A. Bronicki and Lara S. Shekerdeman</i> | 1108 |
| Chapter 71 | Hemodynamic Monitoring <i>Ronald A. Bronicki and Neil C. Spenceley</i> | 1120 |
| Chapter 72 | Heart Failure: Etiology, Pathophysiology, and Diagnosis <i>Mary E. McBride, John M. Costello, and Conrad L. Epting</i> | 1137 |
| Chapter 73 | Cardiomyopathy, Myocarditis, and Mechanical Circulatory Support <i>William G. Harmon, Aparna Hoskote, and Ann Karimova</i> | 1148 |
| Chapter 74 | Treatment of Heart Failure: Medical Management <i>Joseph W. Rossano, Jack F. Price, and David P. Nelson</i> | 1170 |
| Chapter 75 | Treatment of Heart Failure: Mechanical Support <i>Iki Adachi, Lara Shekerdeman, Paul A. Checchia, and Charles D. Fraser Jr</i> | 1188 |
| Chapter 76 | Thoracic Transplantation <i>Steven A. Webber, Laura L. Loftis, Aarti Bavare, Renee M. Potera, and Nikoleta S. Kolovos</i> | 1196 |
| Chapter 77 | Cardiac Conduction, Dysrhythmias, and Pacing <i>Richard J. Czonek, David S. Spar, Jeffrey B. Anderson, Timothy K. Knilans, and Bradley S. Marino</i> | 1214 |
| Chapter 78 | Preoperative Care of the Pediatric Cardiac Surgical Patient <i>Jennifer J. Schuette, Alain Fraisse, and David L. Wessel</i> | 1241 |
| Chapter 79 | Postoperative Care of the Pediatric Cardiac Surgical Patient <i>Ronald A. Bronicki, John M. Costello, and Kate L. Brown</i> | 1252 |
| Chapter 80 | Pulmonary Hypertension <i>John K. McGuire, Silvia M. Hartmann, and Apichai Khongphatthanayothin</i> | 1277 |

SECTION V ■ IMMUNOLOGIC DISEASES

- Chapter 81** The Immune System 1288
Rachel S. Agbeko, Nigel J. Klein, and Mark J. Peters
- Chapter 82** Neurohormonal Control in the Immune System 1305
Kathryn A. Felmet
- Chapter 83** The Polymorphonuclear Leukocyte in Critical Illness 1317
M. Michele Mariscalco
- Chapter 84** The Immune System and Viral Illness 1332
Lesley Doughty
- Chapter 85** Immune Modulation and Immunotherapy in Critical Illness 1345
Mark W. Hall and Jennifer A. Muszynski
- Chapter 86** Immune Deficiency Disorders 1355
Tracy B. Fausnight, E. Scott Halstead, Sachin S. Jogal, and Jennifer A. McArthur

SECTION VI ■ INFECTIOUS DISEASES

- Chapter 87** Bacterial Sepsis 1377
Neal J. Thomas, Robert F. Tamburro, Surender Rajasekaran, Julie C. Fitzgerald, Scott L. Weiss, and Mark W. Hall
- Chapter 88** Principles of Antimicrobial Therapy 1397
Cheryl L. Sargel, Todd J. Karsies, Lulu Jin, and Kevin B. Spicer
- Chapter 89** Dengue and Other Hemorrhagic Viral Infections 1426
Siripen Kalayanaroj and Rakesh Lodha
- Chapter 90** Critical Viral Infections 1442
Rakesh Lodha, Sunit C. Singhi, and James D. Campbell
- Chapter 91** Central Nervous System Infections 1461
Pratibha D. Singhi and Sunit C. Singhi
- Chapter 92** Nosocomial Infections in the PICU 1503
Jason W. Custer, Jill S. Thomas, and John P. Straumanis
- Chapter 93** International and Emerging Infections 1524
Troy E. Dominguez, Chitra Ravishankar, Miriam K. Laufer, and Mark W. Hall
- Chapter 94** Toxin-Related Diseases 1547
Sunit C. Singhi, M. Jayashree, John P. Straumanis, and Karen L. Kotloff
- Chapter 95** Opportunistic Infections 1572
Sushil K. Kabra and Matthew B. Laurens

SECTION VII ■ NUTRITIONAL AND GASTROINTESTINAL DISORDERS

- Chapter 96** Principles of Gastrointestinal Physiology, Nutrition, and Metabolism 1593
Patrick O'Neal Maynard and Z. Leah Harris
- Chapter 97** Nutritional Support 1615
Werther Brunow De Carvalho, Artur F. Delgado, and Heitor Pons Leite
- Chapter 98** Secretory and Motility Issues of the Gastrointestinal Tract 1633
Eitan Rubinstein and Samuel Nurko

| | | |
|---|---|------|
| Chapter 99 | Gastrointestinal Bleeding <i>Sabina Mir and Douglas S. Fishman</i> | 1642 |
| Chapter 100 | Abdominal Compartment Syndrome <i>Mudit Mathur and Janeth C. Ejike</i> | 1652 |
| Chapter 101 | The Acute Abdomen <i>Eduardo J. Schnitzler, Tomas Iølster, and Ricardo D. Russo</i> | 1660 |
| Chapter 102 | Diagnostic Imaging of the Abdomen <i>Swapnil S. Bagade and Rebecca Hulett Bowling</i> | 1677 |
| Chapter 103 | Acute Liver Failure and Liver Transplantation <i>Pierre Tissieres and Denis J. Devictor</i> | 1705 |
| Chapter 104 | Pediatric Intestinal and Multivisceral Transplantations <i>Geoffrey J. Bond, Kathryn A. Felmet, Ronald Jaffe, Kyle A. Soltys, Jeffrey A. Rudolph, Dolly Martin, Rakesh Sindhi, and George V. Mazariegos</i> | 1725 |
| SECTION VIII ■ RENAL, ENDOCRINE, AND METABOLIC DISORDERS | | |
| Chapter 105 | Adrenal Dysfunction <i>Abeer Hassoun and Sharon E. Oberfield</i> | 1737 |
| Chapter 106 | Disorders of Glucose Homeostasis <i>Edward Vincent S. Faustino, Stuart A. Weinzimmer, Michael F. Canarie, and Clifford W. Bogue</i> | 1752 |
| Chapter 107 | Disorders of Water, Sodium, and Potassium Homeostasis <i>James Schneider and Andrea Kelly</i> | 1767 |
| Chapter 108 | Disorders of Calcium, Magnesium, and Phosphate <i>Kenneth J. Banasiak</i> | 1790 |
| Chapter 109 | Thyroid Disease <i>Ori Eyal and Susan R. Rose</i> | 1804 |
| Chapter 110 | Acute Kidney Injury <i>Christine B. Sethna, Nataliya Chorny, Smarika Sapkota, and James Schneider</i> | 1815 |
| Chapter 111 | Chronic Kidney Disease, Dialysis, and Renal Transplantation <i>Vinai Modem, Robert P. Woroniecki, and Fangming Lin</i> | 1830 |
| Chapter 112 | Hypertensive Crisis <i>George Ofori-Amanfo, Arthur Smerling, and Charles L. Schleien</i> | 1837 |
| Chapter 113 | Inborn Errors of Metabolism <i>Michael Wilhelm and Wendy K. Chung</i> | 1847 |
| SECTION IX ■ ONCOLOGIC AND HEMATOLOGIC DISORDERS | | |
| Chapter 114 | Cancer Therapy: Mechanisms and Toxicity <i>David M. Loeb and Masanori Hayashi</i> | 1861 |
| Chapter 115 | Oncologic Emergencies and Complications <i>Rodrigo Mejia, Nidra I. Rodriguez, Jose A. Cortes, Sanju S. Samuel, Fernando F. Corrales-Medina, Regina Okhuysen, Riza C. Mauricio, and Winston W. Hub</i> | 1872 |
| Chapter 116 | Hematologic Emergencies <i>Michael C. McCrory, Kenneth M. Brady, Clifford M. Takemoto, and R. Blaine Easley</i> | 1894 |

Chapter 117 Hematopoietic Cell Transplantation
Monica Bhatia and Katherine V. Biagas

Chapter 118 Coagulation Issues in the PICU
Robert I. Parker and David G. Nichols

Chapter 119 Sickle Cell Disease
*Kevin J. Sullivan, Erin Coletti, Salvatore R. Goodwin, Cynthia Gauger,
 and Niranjana "Tex" Kissoon*

1928

1946

1977

**Appendix
 Index**

BLS bare lymphocyte syndrome

BLS basic life support

BM bone marrow

BMD bone mineral

BMDI bedside medical device interface

BMI body mass index

BMPR-II bone morphogenetic protein receptor type II

BMT bone marrow transplantation

BMT bone marrow transplantation

BNP brain natriuretic peptide

BNP B-type natriuretic peptide

BO bronchiolitis obliterans

BOOP bronchiolitis obliterans with organizing pneumonia

BOS bronchiolitis obliterans syndrome

BP blood pressure

BPNA Bereaved Parent Needs Assessment

BPD bronchopulmonary dysplasia

BPEG British Paediatric Endophysiology Society

ABCD amphotericin B colloidal dispersion

ABC bactericidal/active against increasing bacterial blood gas

ABI advanced brain injury

BSA body surface area

BSAER amphotericin B lipid complex

BSL biosafety level

BSSL bid

BTK bronchovascular tangle

BTPS American College of Obstetrics and Gynecology

BUN blood urea nitrogen

BURP backward

BVVL Brevard-Vanderbilt Van Nuys

CA calcium

CA angiotensin-converting enzyme

CA-MRSA community-acquired methicillin-resistant *Staphylococcus aureus*

CAD cardiac

CAD cardiac

C-AMB cyclosporin A

cAMP cyclic adenosine monophosphate

CAMTS Commission on Accreditation of Medical Transcription Services

CaO₂ arterial oxygen content

CAP community-acquired pneumonia

CAR calcium

CARS compensatory anti-inflammatory response syndrome

CASQ2 calcium-sensing receptor

CASR calcium-sensing receptor

CAT catalase

CAUT catheter-associated urinary tract infection

CAVH continuous venovenous hemofiltration

CB cord

CCG cerebral

CBF cerebral blood flow

CBRN chemical, biological, radiologic, and nuclear

CBT cognitive behavioral therapy

CBV cerebral blood volume

CC cholelithiasis

CCB calcium channel blocker

CCVH continuous venovenous hemofiltration

CCHF Crimean-Congo hemorrhagic fever

CCHQ American Heart Association

CCHQ Agency for Healthcare Research and Quality

**A1
 II**