CONTENTS

List of Tables xv

UNIT 1 OVERVIEW OF INFUSION THERAPY

1 History of Infusion Therapy 3
   Early History and Methodology 3
   The Infusion Nurses Society, Inc. 8
   Infusion Nursing in the 21st Century 8

2 Minimizing Risk and Improving Performance 10
   Professional Nursing and Legal Safeguards 10
   Professional Nursing and Performance Improvement 16

3 Nursing Role and Responsibilities 24
   Collaborative Role of the Nurse 24
   Role of Infusion Nursing Teams 25
   Resource Nurse 25
   Mentor 25
   Educator and Knowledge-Sharer 25
   Magnet Team Member 27
   Shared Governance 28
   Role as a Leader 28
   IV Department Considerations 28
   Impact of Cost Containment on Teams 33
   The Future of Infusion Nursing 33

4 Application of Infusion Nurses Society Standards of Practice 39
   The Standards 39
   Policies, Procedures, and Infusion Therapy 39
   Competencies in Practice 40

UNIT 2 ASSESSMENT AND MONITORING

5 Anatomy and Physiology Applied to Infusion Therapy 53
   Vascular Anatomy and Therapeutic Goals 53
   Systems and Organs Involved in Infusion Therapy 54

6 Laboratory Tests and Values 63
   Reference Range 63
   Peak and Trough Testing 64
   Collection of Venous Blood 64
   Common Laboratory Tests 71
   Herbal Preparations and Effect on Drug Levels 90

7 Fluid and Electrolyte Balance 94
   Overview of Physiology 94
   Objectives of Fluid and Electrolyte Therapy 108
   Fluid and Electrolyte Disturbances in Specific Patients 111
## Contents

### UNIT 2  CLINICAL DECISION MAKING

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Principles of Parenteral Fluid Administration</td>
<td>124</td>
</tr>
<tr>
<td></td>
<td>Parenteral Fluids</td>
<td>124</td>
</tr>
<tr>
<td></td>
<td>Intravenous Infusion</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>Kinds and Composition of Fluids</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>Evaluation of Water and Electrolyte Balance</td>
<td>139</td>
</tr>
<tr>
<td></td>
<td>Clinical Disturbances of Water and Electrolyte Metabolism</td>
<td>145</td>
</tr>
<tr>
<td>9</td>
<td>Complications and Interventions</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>Understanding Complications</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>Local Complications</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Systemic Complications</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>Additional Hazards: Particulates</td>
<td>179</td>
</tr>
<tr>
<td></td>
<td>Ongoing Monitoring and Precautions</td>
<td>181</td>
</tr>
<tr>
<td>10</td>
<td>Evidence-Based Infusion Practice</td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>Evidence-Based Nursing</td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>Competency-Based Programs and Documentation</td>
<td>198</td>
</tr>
<tr>
<td>11</td>
<td>Infusion Equipment and Safety</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>Physical Principles of Equipment Use</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>Safety Principles and Selection of Equipment</td>
<td>211</td>
</tr>
<tr>
<td></td>
<td>Equipment Safety and Use</td>
<td>238</td>
</tr>
<tr>
<td>12</td>
<td>Peripheral Infusion Therapy Techniques</td>
<td>242</td>
</tr>
<tr>
<td></td>
<td>Approach to Preparation</td>
<td>242</td>
</tr>
<tr>
<td></td>
<td>Considerations for Vein Selection</td>
<td>245</td>
</tr>
<tr>
<td></td>
<td>Considerations Before Beginning the Infusion</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>Considerations for Venipuncture Procedure</td>
<td>251</td>
</tr>
<tr>
<td>13</td>
<td>Short Peripheral Access</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Short Peripheral Catheters</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Insertion Techniques</td>
<td>260</td>
</tr>
<tr>
<td>14</td>
<td>Central Venous Access</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>Central Venous Access</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>Overview of CVC Types, Materials, and Properties</td>
<td>280</td>
</tr>
<tr>
<td></td>
<td>Central Venous Access Device Selection</td>
<td>285</td>
</tr>
<tr>
<td></td>
<td>Preparation for CVC Insertion</td>
<td>287</td>
</tr>
<tr>
<td></td>
<td>Insertion of the Central Venous Catheter</td>
<td>289</td>
</tr>
<tr>
<td></td>
<td>Uses for Central Venous Catheters</td>
<td>291</td>
</tr>
<tr>
<td></td>
<td>Central Venous Access Device Descriptions, Insertions, and Considerations</td>
<td>295</td>
</tr>
<tr>
<td></td>
<td>Peripherally Inserted Central Catheter (PICC): Considerations and Insertion Information</td>
<td>297</td>
</tr>
<tr>
<td></td>
<td>Implanted Ports</td>
<td>304</td>
</tr>
<tr>
<td></td>
<td>Implanted Pumps</td>
<td>306</td>
</tr>
<tr>
<td></td>
<td>Care and Maintenance of Central Venous Access Devices</td>
<td>308</td>
</tr>
<tr>
<td></td>
<td>Complications of Indwelling Central Venous Catheters or Devices</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td>Nursing Practice: Skilled, Knowledgeable, and Safe</td>
<td>325</td>
</tr>
</tbody>
</table>

### UNIT 4  PATIENT-SPECIFIC THERAPIES

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Alternate Access</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>Role of Arterial Blood Gas Analysis</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>Access Sites for Arterial Blood Analysis</td>
<td>333</td>
</tr>
<tr>
<td></td>
<td>One-Time Arterial Blood Sampling</td>
<td>334</td>
</tr>
<tr>
<td></td>
<td>Use of an Indwelling Arterial Catheter</td>
<td>338</td>
</tr>
<tr>
<td></td>
<td>Intra-Arterial Parameters and Interpretation</td>
<td>345</td>
</tr>
<tr>
<td>16</td>
<td>Parenteral Nutrition</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td>History of Parenteral Nutrition</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td>Indications for Parenteral Nutrition</td>
<td>362</td>
</tr>
</tbody>
</table>
Nutritional Assessment 363  
Nutritional Requirements 373  
Parenteral Nutrition Solutions 377  
Administration of Parenteral Nutrition 383  
Nursing Management in Parenteral Nutrition 391  
Complications of Parenteral Nutrition 394  
Home Parenteral Nutrition 405

17 Transfusion Therapy 413  
Transfusion Therapy—21st Century Considerations 413  
Basic Immunohematology 415  
Pre-Transfusion Testing, Blood Donation, and Blood Preservation 418  
Whole Blood 422  
Red Blood Cells 423  
Platelets 426  
Granulocytes 427  
Plasma 428  
Transfusion Reactions 438  
Blood Administration 451  
Factor V Leiden 459

18 Pharmacology Applied to Infusion Therapy 465  
Administrating Drug Therapy by the Intravenous Route 465  
Advantages of the Intravenous Route 465  
Disadvantages of the Intravenous Route 469  
Safeguards to Minimize Hazards of Administering Intravenous Drugs 476

19 Antineoplastic Therapy 486  
Role of the Intravenous Nurse in Chemotherapy/Biotherapy Education 486  
Safe Preparation, Handling, and Disposal of Chemotherapeutic and Biologic Agents 496  
Overview of Antineoplastic Therapy 497

Systemic Drug Delivery Technique 532  
Complications of Chemotherapy 544  
Management of Side Effects 562

20 Pain Management 576  
Role of Nurses in Pain Management 576  
Acute Pain 580  
Chronic Pain 582  
Opioids 582  
Staff Education 598  
Intravenous Conscious Sedation 598  
Continuous Local Anesthetics 603  
Documentation 603

UNIT 5 SPECIAL APPLICATIONS OF INTRAVENOUS THERAPY

21 Pediatric Intravenous Therapy 613  
Intravenous Therapy in Infants and Children 613  
Physiologic and Psychologic Stages of Development 613  
Conditions and Disease States 625  
Infusion Therapies for Neonates and Children 638  
Intravenous Administration Equipment 649  
Vascular Access Devices 650  
Peripheral Intravenous Access 669  
Alternative-Site Pediatric Intravenous Therapy 680

22 Infusion Therapy in an Older Adult Patient 686  
Demographics: An Aging Population 686  
The Older Patient as a Health Care Consumer 687  
Physiology of Aging 688  
Access and Equipment 692  
Maintenance and Monitoring 695

23 Infusion Therapy in Alternate Clinical Settings: Cost Factors and Treatment Modalities 699  
The Changing Health Care Environment 699
<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influence of Managed Care</td>
<td>700</td>
</tr>
<tr>
<td>Home Health Care</td>
<td>701</td>
</tr>
<tr>
<td>Hospice</td>
<td>717</td>
</tr>
<tr>
<td>Subacute Care Facilities</td>
<td>717</td>
</tr>
<tr>
<td>Ambulatory Infusion Centers</td>
<td>718</td>
</tr>
<tr>
<td>Long-Term Care</td>
<td>719</td>
</tr>
<tr>
<td>Future Infusion Technology for Alternate Care Programs</td>
<td>720</td>
</tr>
<tr>
<td>The Future of Infusion Nursing</td>
<td>723</td>
</tr>
<tr>
<td>Strategic Partnering</td>
<td>723</td>
</tr>
<tr>
<td>Impression of the Profession</td>
<td>723</td>
</tr>
<tr>
<td>Safe Working Environment</td>
<td>724</td>
</tr>
<tr>
<td>Workforce Shortage and Safe Staffing</td>
<td>724</td>
</tr>
<tr>
<td>International Migration</td>
<td>724</td>
</tr>
<tr>
<td>A Universal Perspective</td>
<td>725</td>
</tr>
<tr>
<td>Answers to Questions</td>
<td>727</td>
</tr>
<tr>
<td>Glossary</td>
<td>729</td>
</tr>
<tr>
<td>Index</td>
<td>735</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1-1 20th- and 21st-Century Progress in Infusion Therapy  5
Table 2-1 Sources of Standards of Care Related to IV Therapy  12
Table 3-1 Reassessing the Role of the Infusion Team  36
Table 4-1 Infiltration Scale  44
Table 4-2 Recognizing and Managing Infiltration or Inflammation  44
Table 5-1 Determining the Appropriate Peripheral Venipuncture Site  59
Table 6-1 Standards for Diagnostic Testing  65
Table 6-2 Selected Laboratory Values  72
Table 6-3 Examples of Conversions to Système International (SI) Units  74
Table 6-4 Recommended Laboratory Evaluation for Patients Suspected of Having an Underlying Hypercoagulable State  86
Table 6-5 Clinically Important Interactions of St. John’s Wort  91
Table 7-1 Intracellular and Extracellular Concentrations and Related Serum Values  104
Table 7-2 Plasma Electrolytes  105
Table 7-3 Fluid and Electrolyte Maintenance Requirements  109
Table 7-4 Differentiating Acidosis from Alkalosis  111
Table 7-5 Selected Nursing Diagnoses for Postoperative Patient After Abdominal Surgery  117
Table 7-6 The Burn Patient Receiving Parenteral Fluid Therapy  118
Table 7-7 Rule of Nines for Estimating Burned Body Area in Adults  119
Table 7-8 Factors Contributing to Development of DKA or HHNC in Susceptible Persons  121
Table 8-1 Results of Infusion of Fluids With Different Tonocities  126
Table 8-2 Contents of Selected Water and Electrolyte Solutions  140
Table 8-3 Rapid Fluid Imbalance Assessment Guide  142
Table 9-1 Approximate Risks of Bloodstream Infection Associated With Various Types of Devices for Intravascular Access  160
Table 9-2 Genesis of Thrombosis  162
Table 9-3 Microorganisms Most Frequently Encountered in Various Forms of Intravascular Line–related Infection  169
Table 9-4 Particle Size Comparisons  179
Table 10-1 National Quality Indicators  193
Table 10-2 Summary of Documented PICC Malpositions and Methods of Resolution  194
Table 11-1 Examples of Situations Requiring Vigilance to Avoid Errors 215
Table 11-2 Common Barriers to Safe Medication Administration 216
Table 11-3 Peripheral Venous Access Devices and Their Use 222
Table 11-4 Type I Reactions to Latex 233
Table 12-1 Site Selection: Superficial Veins of the Arm 246
Table 12-2 Comparing Approaches to Venipuncture 252
Table 13-1 Positive Displacement 266
Table 14-1 Complications of Central Venous Catheter or Device Insertion 292
Table 14-2 Central Venous Access Device Descriptions, Insertion Techniques, and Considerations 298
Table 14-3 Central Venous Catheter (CVC) or Device: Dressing Changes, Flushing, and Capping 310
Table 14-4 Potential Complications of Indwelling Central Venous Access Catheters and Devices 316
Table 14-5 Solutions Causing Intraluminal Precipitates and Possible Clearing Agents 319
Table 15-1 Choosing the Site of an Arterial Blood Sample 333
Table 15-2 Malfunctions Occurring in Arterial Pressure Monitoring 343
Table 16-1 Physical Assessment Findings in Nutritional Deficiencies 369
Table 16-2 Evaluation of Weight Change 370
Table 16-3 Determination of Body Frame 371
Table 16-4 Visceral Proteins 372
Table 16-5 Correction Factors for Estimating Nonprotein Energy Requirements of Hospitalized Patients 375
Table 16-6 Daily Electrolyte Additions to Adult Parenteral Nutrition Solutions 380
Table 16-7 Visible Phenomena in Total Nutrient Admixture Solutions 382
Table 16-8 Laboratory Monitoring of Parenteral Nutrition 394
Table 16-9 Potential Metabolic Complications of Parenteral Nutrition 399
Table 16-10 Catheter-Related Infections 404
Table 17-1 ABO Classification of Human Blood 416
Table 17-2 ABO Compatibilities for Red Blood Cell Components, Fresh Frozen Plasma, and Whole Blood 424
Table 17-3 Blood Components and Whole Blood: Action and Use, Volume and Infusion Guide, and Special Considerations and Risks 431
Table 18-1 Selected Therapeutic Drug Concentrations and Toxic Values 468
Table 18-2 Responsibilities for Intravenous Drug Administration 471
Table 18-3 Resources for Patients and Education Programs 484
Table 19-1 Potential Barriers to Successful Patient Learning 492
Table 19-2 Educational Essentials for Patients Receiving Chemotherapy 493
Table 19-3 Quick Reference to Commonly Administered Parenteral Chemotherapeutic Agents 503
Table 19-4 Biotherapy Agents 522
Table 19-5 Hemopoietic Growth Factors 523
Table 19-6 Monoclonal Antibodies 525
Table 19-7 Routes of Administration of Antineoplastic Agents 536
Table 19-8 Nursing Assessment of Extravasation Versus Other Reactions 546
List of Tables

Table 19-9  Emergency Drugs for Hypersensitivity or Anaphylaxis  549
Table 19-10 Extravasation Kit: Items and Quantities  551
Table 19-11 Extravasation of Vesicant Antineoplastic Agents: Preventive Strategies  552
Table 19-12 Vesicant and Irritant Drugs  556
Table 20-1  Conversion to Subcutaneous Opioids  587
Table 20-2  Curriculum for Nurse Involvement With Epidural/Intrathecal Infusions  599
Table 21-1  Body Surface Area, Fluid Distribution, and Blood Volume for Various Ages  615
Table 21-2  Growth, Development, and Intravenous Insertion Tips for Various Pediatric Stages  620
Table 21-3  Local Numbing Methods for Pediatric Intravenous Access Procedures  624
Table 21-4  Assessment Parameters Used to Determine Degree of Dehydration  626
Table 21-5  Antineoplastic Agents Used for Pediatric Patients  636
Table 21-6  Formula for Calculating Maintenance Fluid Requirements  639
Table 21-7  Blood Component Therapy for Pediatric Patients  644
Table 21-8  Routine Care and Maintenance of Pediatric Intravenous Access Devices  655
Table 21-9  Intraosseous Infusions  669
Table 21-10  Peripheral Intravenous Access Sites for Pediatric Patients  675
Table 22-1  The Aging of the Body’s Systems  689
Table 22-2  Special Techniques in the Older Adult Patient  694
Table 22-3  Occlusion Assessment and Nursing Interventions  696
Table 23-1  Home Infusion Coverage  702
Table 23-2  Potential Home Infusion Diagnosis and Suggested Therapies  703
Table 23-3  Comparison of JCAHO, ACHC, and CHAP  709
Table 24-1  Terminology Associated With Knowledge Management  725