

heparin bolus calculation

heparin bolus calculation is a critical skill in clinical settings, particularly in the management of patients requiring anticoagulation therapy. This process involves determining the appropriate initial dose of heparin to rapidly achieve therapeutic anticoagulation. Proper heparin bolus calculation ensures patient safety, effective treatment, and minimizes the risk of complications such as bleeding or thrombosis. This article provides an in-depth exploration of the principles behind heparin bolus dosing, factors influencing the calculation, and practical methods for accurate administration. Additionally, it covers common formulas, dosing guidelines, and adjustments based on patient-specific variables. Understanding these components is essential for healthcare professionals involved in anticoagulant therapy management. The following sections will guide readers through the fundamental concepts, calculation techniques, and clinical considerations related to heparin bolus dosing.

- Understanding Heparin and Its Clinical Use
- Principles of Heparin Bolus Calculation
- Step-by-Step Guide to Calculating Heparin Bolus
- Factors Affecting Heparin Bolus Dosing
- Common Heparin Bolus Dosing Protocols
- Safety Considerations and Monitoring

Understanding Heparin and Its Clinical Use

Heparin is an anticoagulant medication widely used to prevent and treat thromboembolic disorders. It works by enhancing the activity of antithrombin III, which inhibits clotting factors such as thrombin and factor Xa, thereby reducing blood clot formation. Heparin is commonly administered in both prophylactic and therapeutic settings, including during surgeries, dialysis, and in cases of deep vein thrombosis or pulmonary embolism.

There are two main types of heparin: unfractionated heparin (UFH) and low molecular weight heparin (LMWH). The bolus calculation primarily pertains to UFH due to its variable pharmacokinetics and need for close monitoring. UFH is typically administered intravenously with an initial bolus to quickly achieve therapeutic levels, followed by continuous infusion to maintain anticoagulation.

Principles of Heparin Bolus Calculation

The heparin bolus calculation aims to determine the correct initial dose based on patient-specific factors, primarily body weight. The goal is to rapidly attain an effective anticoagulant concentration without causing excessive bleeding risk. The bolus dose is followed by a maintenance infusion, adjusted according to activated partial thromboplastin time (aPTT) or anti-Xa levels.

Heparin dosing is often expressed in units per kilogram (units/kg), which allows dosing to be tailored according to the patient's weight. This weight-based dosing improves safety and efficacy compared to fixed dosing. The bolus dose is typically administered intravenously over a short period, generally 10 minutes or less, to achieve immediate anticoagulation.

Pharmacokinetics and Pharmacodynamics

Understanding heparin's pharmacokinetics is essential for accurate bolus calculation. UFH has a rapid onset of action when given intravenously, with an initial half-life of approximately 60 to 90 minutes. The anticoagulant effect is dose-dependent and influenced by factors such as plasma protein binding and clearance rates. This variability necessitates individualized dosing and frequent monitoring.

Importance of Weight-Based Dosing

Weight-based dosing helps prevent underdosing or overdosing, which can lead to therapeutic failure or hemorrhagic complications. The standard bolus dose for UFH ranges from 60 to 100 units/kg depending on clinical protocols and indication. Accurate weight measurement is crucial for precise dosing.

Step-by-Step Guide to Calculating Heparin Bolus

The process of heparin bolus calculation involves several straightforward steps to ensure correct dosing. These steps are designed to minimize errors and optimize patient outcomes in anticoagulation therapy.

Step 1: Obtain Patient Weight

Accurately measure or obtain the patient's current weight in kilograms. If the weight is recorded in pounds, convert it to kilograms by dividing by 2.2.

Step 2: Determine the Bolus Dose per Protocol

Identify the recommended bolus dose units per kilogram according to the clinical protocol or physician order. Common doses range between 60 to 100 units/kg.

Step 3: Calculate the Total Bolus Dose

Multiply the patient's weight (kg) by the bolus dose (units/kg) to determine the total number of heparin units to administer as a bolus.

Step 4: Prepare the Heparin Solution

Calculate the volume of heparin solution needed based on the concentration of the available vial (units per milliliter). This is done by dividing the total units calculated by the concentration.

Step 5: Administer the Bolus

Administer the calculated bolus dose intravenously over the recommended time frame, usually within 10 minutes, to ensure rapid onset of anticoagulation.

Example Calculation

- Patient weight: 70 kg
- Ordered bolus dose: 80 units/kg
- Total bolus units = $70 \text{ kg} \times 80 \text{ units/kg} = 5600 \text{ units}$
- Heparin concentration: 1000 units/mL
- Volume to administer = $5600 \text{ units} \div 1000 \text{ units/mL} = 5.6 \text{ mL}$

Factors Affecting Heparin Bolus Dosing

Several patient-specific and clinical factors influence the heparin bolus calculation and dosing adjustments. Recognizing these variables is essential for personalized anticoagulation management.

Renal and Hepatic Function

Although UFH is primarily cleared by the reticuloendothelial system, impaired liver or kidney function may alter its metabolism and increase bleeding risk. In such cases, dose adjustments and close monitoring are necessary.

Age and Body Composition

Older adults and patients with obesity or cachexia may require individualized dosing. Obesity can lead to increased volume of distribution, while low body weight can increase sensitivity to heparin's effects.

Concurrent Medications

Medications affecting coagulation, platelet function, or interacting with heparin can influence its efficacy and safety. Examples include antiplatelet agents, fibrinolytics, and other anticoagulants.

Clinical Indication and Risk Factors

The underlying condition necessitating anticoagulation impacts dosing. For example, treatment of acute thrombosis may require higher bolus doses compared to prophylactic anticoagulation. Additionally, bleeding risk factors must be assessed before dosing.

Common Heparin Bolus Dosing Protocols

Numerous standardized protocols exist to guide heparin bolus dosing in various clinical scenarios. These protocols aim to balance efficacy and safety through evidence-based dosing regimens.

Acute Coronary Syndrome (ACS) Protocols

In ACS settings, a typical heparin bolus dose is 60 to 70 units/kg, not exceeding 5000 units, followed by continuous infusion. This approach rapidly achieves anticoagulation to prevent clot propagation during intervention.

Venous Thromboembolism (VTE) Treatment

For treatment of deep vein thrombosis or pulmonary embolism, the bolus dose is often 80 units/kg followed by infusion at 18 units/kg/hour. Dose adjustments are guided by aPTT levels.

Dialysis Anticoagulation

Heparin bolus dosing during hemodialysis varies depending on the patient's bleeding risk and dialysis duration. Typical bolus doses range from 20 to 50 units/kg.

Prophylactic Dosing

Prophylactic dosing usually involves low fixed doses of heparin without bolus administration, but protocols may vary based on patient risk profiles.

Safety Considerations and Monitoring

Proper heparin bolus calculation is only part of safe anticoagulation management. Continuous monitoring and vigilance are required to prevent complications.

Monitoring Activated Partial Thromboplastin Time (aPTT)

aPTT is the standard laboratory test used to monitor the anticoagulant effect of UFH. Therapeutic ranges are typically 1.5 to 2.5 times the normal control value. Adjustments to infusion rates and subsequent bolus doses are based on aPTT results.

Bleeding Risk Assessment

Prior to heparin administration, assess bleeding risk factors such as recent surgery, active bleeding, thrombocytopenia, or concomitant use of other anticoagulants. Dose modifications or alternative therapies may be warranted.

Heparin-Induced Thrombocytopenia (HIT)

HIT is a serious immune-mediated adverse reaction characterized by a drop in platelet count and paradoxical thrombosis. Early recognition and discontinuation of heparin are critical. Monitoring platelet counts during therapy is recommended.

Documentation and Communication

Accurate documentation of heparin bolus calculation, dose administered, and patient response is essential for continuity of care. Clear communication among healthcare providers reduces dosing errors and enhances patient safety.

Frequently Asked Questions

What is a heparin bolus and why is it administered?

A heparin bolus is a single, large dose of heparin given intravenously to rapidly achieve therapeutic anticoagulation, often used in acute settings such as during a heart attack or before certain surgeries.

How do you calculate the heparin bolus dose for a patient?

The heparin bolus dose is typically calculated based on the patient's weight, commonly 70 to 100 units per kilogram of body weight, administered as an intravenous injection.

What units are used for heparin bolus calculations?

Heparin doses are usually calculated in units, with the bolus dose expressed as units per kilogram of the patient's body weight.

Are there standard protocols for heparin bolus calculation in different clinical scenarios?

Yes, protocols vary depending on the indication, such as acute coronary syndrome, deep vein thrombosis, or during cardiac surgery, with specific recommended bolus doses outlined in clinical guidelines.

How does renal function affect heparin bolus dosing?

Heparin is metabolized primarily by the liver, so renal function has less impact on bolus dosing; however, careful monitoring is essential in all patients to avoid bleeding complications.

What are common errors to avoid in heparin bolus calculation?

Common errors include incorrect weight measurement, confusing units (mg vs. units), and failure to adjust for patient-specific factors, which can lead to under- or overdosing.

How is the effectiveness of a heparin bolus dose monitored post-administration?

Effectiveness is monitored by assessing activated partial thromboplastin time (aPTT) or anti-factor Xa levels to ensure therapeutic anticoagulation is achieved without causing bleeding.

Additional Resources

1. *Heparin Dosing and Management: A Clinical Guide*

This book provides an in-depth look at the principles of heparin therapy, including bolus calculation and continuous infusion protocols. It covers pharmacokinetics, monitoring strategies, and adjustment based on patient-specific factors. Ideal for clinicians and pharmacists seeking a comprehensive understanding of heparin dosing.

2. *Practical Anticoagulation: Heparin Bolus and Maintenance Calculations*

Focused on practical applications, this book simplifies the process of calculating heparin bolus doses and maintenance infusions. It includes case studies and step-by-step examples to help healthcare providers accurately dose heparin in various clinical scenarios. The text is designed for nurses, residents, and pharmacists.

3. *Anticoagulant Therapy: Heparin Protocols and Calculations*

This resource details standardized heparin protocols, emphasizing bolus calculation methods and monitoring using aPTT and anti-Xa levels. It discusses adjustments for renal function, weight, and bleeding risk. The book serves as a reference for hospital pharmacists and clinicians managing anticoagulation therapy.

4. *Clinical Calculations in Anticoagulant Therapy: Heparin and Beyond*

Covering a broad spectrum of anticoagulants, this book highlights the specific challenges and calculations involved in heparin bolus dosing. It integrates clinical scenarios, dosing algorithms, and safety considerations to promote effective and safe anticoagulation management.

5. *Heparin and Low Molecular Weight Heparin: Dosage and Monitoring*

This text contrasts the dosing and monitoring strategies of unfractionated heparin boluses with low molecular weight heparins. It explains the calculation formulas and adjustment criteria for bolus dosing in acute care settings. Useful for clinicians seeking to optimize anticoagulation therapy.

6. *Pharmacology and Calculation of Heparin Dosages in Critical Care*

Focusing on critical care environments, this book offers detailed guidance on calculating heparin bolus and infusion doses. It includes pharmacologic principles, patient variability, and management of complications like heparin-induced thrombocytopenia. Perfect for intensivists and pharmacists.

7. *Anticoagulation Therapy Made Easy: Heparin Bolus Calculations Explained*

This beginner-friendly guide breaks down the formulas and clinical reasoning behind heparin bolus dosing. It provides clear examples, common pitfalls, and tips for ensuring dosing accuracy. A great resource for medical students and junior healthcare professionals.

8. *Heparin Bolus Calculation and Adjustment in Cardiovascular Medicine*

Targeting cardiologists and cardiac surgeons, this book addresses the unique considerations for heparin bolus dosing in cardiac procedures and interventions. It highlights protocol variations, patient risk

stratification, and heparin resistance. It is an essential text for cardiovascular specialists.

9. Safe and Effective Heparin Use: Bolus Calculation and Clinical Applications

Emphasizing patient safety, this book discusses strategies to calculate heparin bolus doses accurately while minimizing bleeding risks. It reviews evidence-based guidelines, monitoring tools, and case-based learning to enhance clinical decision-making. Suitable for all healthcare providers involved in anticoagulation management.

Heparin Bolus Calculation

Heparin Bolus Calculation: A Comprehensive Guide for Healthcare Professionals

This ebook provides a detailed explanation of heparin bolus calculations, emphasizing accuracy, safety, and the clinical implications of proper dosing in various patient populations. Understanding these calculations is crucial for preventing adverse events associated with anticoagulation therapy and ensuring optimal patient outcomes.

Ebook Title: Mastering Heparin Bolus Calculations: A Practical Guide for Clinicians

Contents:

Introduction: Defining heparin, its mechanism of action, and the importance of accurate bolus dosing.

Chapter 1: Understanding Heparin Pharmacology: Exploring the different types of heparin (unfractionated heparin (UFH) and low molecular weight heparin (LMWH)), their pharmacokinetic and pharmacodynamic properties, and factors influencing their anticoagulant effect.

Chapter 2: Weight-Based Heparin Bolus Calculation: A step-by-step guide to calculating heparin bolus doses based on patient weight, focusing on different weight units and conversion factors. This includes calculations for both UFH and LMWH.

Chapter 3: Body Surface Area (BSA)-Based Heparin Bolus Calculation: Detailing the method of calculating heparin boluses using BSA, including formulas and practical examples. Comparison of weight-based versus BSA-based calculations will be provided.

Chapter 4: Clinical Considerations and Dosage Adjustments: Discussing factors influencing heparin dosing, such as renal function, age, concomitant medications, and specific clinical scenarios (e.g., acute coronary syndrome, stroke). This section will include recent research on optimal dosing strategies.

Chapter 5: Monitoring Anticoagulation and Adverse Effects: Explaining the importance of monitoring activated partial thromboplastin time (aPTT) or anti-Xa levels, recognizing signs and symptoms of heparin-induced thrombocytopenia (HIT), and managing bleeding complications.

Chapter 6: Case Studies and Practice Problems: Presenting real-world clinical scenarios to reinforce

understanding and test knowledge of heparin bolus calculation methods.

Conclusion: Summarizing key concepts, emphasizing the importance of continuous learning and adherence to best practices in heparin administration.

Detailed Explanation of Each Section:

Introduction: This section will define heparin, explaining its role as an anticoagulant, its mechanism of action (inhibition of thrombin and factor Xa), and why precise bolus dosing is critical for achieving therapeutic anticoagulation without excessive bleeding. The introduction also sets the stage for the importance of accurate calculations in preventing complications.

Chapter 1: Understanding Heparin Pharmacology: This chapter dives into the nuances of heparin types (UFH and LMWH), their differences in pharmacokinetics (absorption, distribution, metabolism, excretion), pharmacodynamics (how they affect coagulation), and the impact of these properties on dosing. The varying half-lives and durations of action will be explained.

Chapter 2: Weight-Based Heparin Bolus Calculation: This chapter provides a detailed, step-by-step guide to calculating heparin bolus doses using patient weight. It will include numerous examples, using both kilograms and pounds as starting points, illustrating unit conversions and the application of different weight-based formulas, with clear explanations of each step in the calculation. Different formulas for UFH and LMWH will be compared and contrasted.

Chapter 3: BSA-Based Heparin Bolus Calculation: This chapter will explain the use of body surface area (BSA) in determining heparin bolus doses. The Du Bois formula and other relevant formulas will be presented with clear examples of how to use them. This section will compare and contrast the advantages and disadvantages of BSA-based vs. weight-based calculations, highlighting situations where one method might be preferred over the other.

Chapter 4: Clinical Considerations and Dosage Adjustments: This section will explore the complexities of heparin dosing in diverse patient populations. It will address the influence of renal function (creatinine clearance), age, liver disease, concomitant medications (e.g., NSAIDs, other anticoagulants), and specific clinical contexts (e.g., post-surgical patients, patients with acute coronary syndrome, those with a history of HIT) on the appropriate heparin dose. Recent research findings related to optimized dosing strategies in these populations will be incorporated.

Chapter 5: Monitoring Anticoagulation and Adverse Effects: This chapter will detail the methods for monitoring the effectiveness of heparin therapy, primarily focusing on aPTT (for UFH) and anti-Xa levels (for LMWH). It will also address the serious complication of heparin-induced thrombocytopenia (HIT), explaining its pathogenesis, diagnosis, and management. Strategies for recognizing and managing bleeding complications will be included.

Chapter 6: Case Studies and Practice Problems: This section will include several realistic clinical case studies to solidify understanding. These cases will challenge readers to apply the knowledge gained throughout the ebook to calculate appropriate heparin bolus doses and manage potential complications. Detailed solutions and explanations will be provided.

Conclusion: This final section will summarize the key concepts discussed throughout the ebook. It will reiterate the importance of accurate heparin bolus calculation in ensuring patient safety and effective anticoagulation. The conclusion will also encourage ongoing professional development and staying updated on the latest research and best practices in heparin management.

SEO Optimized Headings and Subheadings: (These would be used throughout the ebook, integrated within the text as appropriate)

- # Heparin Bolus Calculation: A Comprehensive Guide
 - ## Understanding Heparin Pharmacology
 - ### Unfractionated Heparin (UFH)
 - ### Low Molecular Weight Heparin (LMWH)
 - ## Weight-Based Heparin Bolus Calculation: Step-by-Step Guide
 - ### Example Calculation: UFH in Kilograms
 - ### Example Calculation: LMWH in Pounds
 - ## Body Surface Area (BSA)-Based Heparin Bolus Calculation
 - ### Calculating BSA using the Du Bois Formula
 - ## Clinical Considerations and Dosage Adjustments
 - ### Renal Function and Heparin Dosing
 - ### Age-Related Adjustments
 - ### Concomitant Medications and Heparin Interactions
 - ## Monitoring Anticoagulation and Adverse Effects
 - ### Activated Partial Thromboplastin Time (aPTT) Monitoring
 - ### Anti-Xa Level Monitoring
 - ### Heparin-Induced Thrombocytopenia (HIT)
 - ## Case Studies and Practice Problems
 - ### Case Study 1: Post-Surgical Patient
 - ### Case Study 2: Acute Coronary Syndrome

FAQs:

1. What is the difference between UFH and LMWH?
2. How is the aPTT used to monitor UFH therapy?
3. What are the common adverse effects of heparin?
4. How do I calculate a heparin bolus using patient weight?
5. How do I calculate a heparin bolus using BSA?
6. What are the risk factors for HIT?
7. How is HIT diagnosed and treated?
8. What are the signs and symptoms of heparin overdose?
9. What should I do if I suspect a heparin-related complication?

Related Articles:

1. Heparin Infusion Rate Calculation: This article focuses on calculating the continuous infusion rate of heparin after the initial bolus dose.
2. Anti-Xa Monitoring in Heparin Therapy: A detailed guide to understanding and interpreting anti-Xa levels.
3. Management of Heparin-Induced Thrombocytopenia (HIT): A comprehensive overview of the diagnosis and treatment of HIT.
4. Anticoagulation in Patients with Renal Impairment: Discusses the adjustments needed for anticoagulation therapy in patients with kidney problems.
5. The Role of Heparin in Acute Coronary Syndrome: Explores the use of heparin in managing acute coronary events.
6. Heparin and Pregnancy: Covers the special considerations for using heparin during pregnancy.

7. Bridging Anticoagulation with Heparin and Warfarin: Details the strategy of transitioning between heparin and warfarin.
8. Bleeding Complications Associated with Heparin Therapy: Discusses the recognition and management of bleeding risks.
9. Pharmacokinetics and Pharmacodynamics of Anticoagulant Drugs: A broader overview of the properties of various anticoagulants.

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heparin bolus calculation: Calculate with Confidence - E-Book Deborah C. Gray Morris, 2014-01-30 Calculate with Confidence provides a clear consistent format with a step-by-step approach to the calculation and administration of drug dosages. It covers the ratio and proportion, formula, and dimensional analysis methods. This popular text focuses on enhancing the learning experience of students at all curricular levels by making content clinically applicable. Concepts relating to critical thinking, logical thinking, and nursing process are presented throughout. New practice problems have been added throughout this edition and rationales for the answers continue to be provided giving the students a better understanding of principles related to drug dosages. This fifth edition addresses the increasing responsibility of nurses in medication and administration; emphasizes the priority for client care, and presents material that reflects the current scope of the nursing practice. A clear and consistent, step-by-step approach to calculations and administration makes it easy to understand. Ratio and Proportion, Formula, and Dimensional Analysis content provides you with well-rounded coverage. Pretest and post-test help identify strengths and

weaknesses in competency of basic math before and assess your comprehension after Unit One: Math Review. Points to Remember boxes highlighted in each chapter help you remember important concepts. Critical thinking information that should be applied in the clinical setting to help avoid drug calculation and administration errors is boxed throughout the text. Full-color illustrations, photographs, and drug labels familiarize you with what you'll encounter in the clinical setting. Current recommendations from The Joint Commission and Institute for Safe Medication Practices are followed throughout. Caution boxes identify issues that may lead to medication errors and strengthen actions that must be taken to avoid calculation errors. Tips for Clinical Practice calls attention to information critical to math calculation and patient safety as well as issues related to practice. Rule boxes familiarize students with information needed to accurately solve drug calculation problems.

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the material. - Medication Administration chapter covers medication safety, a discussion on client rights, the basic six rights of medication administration, and routes of medication administration. - Chapter review problems test your comprehension of all major topics, with the answers at the end of the chapter. - Points to Remember list bulleted key points from the chapter.

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heparin bolus calculation: Medical-Surgical Nursing Test Success Karen K. Gittings, DNP, RN, CNE, CNEcl, Rhonda M. Brogdon, DNP, MSN, MBA, RN, Frances H. Cornelius, PhD, MSN, RN-BC, CNE, 2013-06-28 This is a unique case study reference for students in the medical surgical nursing core course and a review/workbook for students about to embark on the NCLEX-RN exam. Unlike other reviews, the book embeds required information into compelling, unfolding case studies that evolve over time in order to promote active learning and facilitate knowledge retention. These unfolding case studies are of particular value because they closely mimic real-life situations in nursing and provide situational mental models that assist students with problem-solving and critical thinking techniques. The unfolding case study method also assists in the development of skills that are important for NCLEX-RN success in assessment, planning, intervention, and evaluation of patient care. All content areas required for NCLEX-RN success—safe and effective care, health promotion, physiological and psychological integrity—are interwoven in an enjoyable format that dispels the drudgery of straightforward memorization. A variety of NCLEX-style question formats are used throughout the book to help students assess their own learning. Additionally, eResource links to additional information are included throughout the book. Key Features: Uses unique unfolding case study method to present medical-surgical concepts Promotes active learning and knowledge retention Develops problem-solving and critical thinking skills Provides all of types of NCLEX-style questions for exam preparation Offers eResources throughout the Review for enhanced learning opportunities

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clinicians, researchers and medical students in the fields of cardiothoracic surgery, cardiac anesthesiology, intensive care, and perfusion technology. - Offers comprehensive and cutting-edge knowledge of cardiopulmonary bypass and extracorporeal life support during surgery and non-surgical situations - Discusses basic science principles along with practical clinical applications - Includes content from authors who are well-known experts in the field, and whose authoritative contributions are invaluable for early-career and experienced practitioners alike

heparin bolus calculation: NCLEX-RN® EXCEL Ruth A. Wittmann-Price, PhD, RN, CNS, CNE, CNEcl, CHSE, ANEF, FAAN, Frances H. Cornelius, PhD, MSN, RN-BC, CNE, 2016-11-15 Promotes mastery of the more challenging 2016 exam! This ultimate NCLEX-RN® review book that “helps you think like a nurse” has been fully updated to incorporate the 2016 test plan. Including more complex case studies to reflect the difficulty of the exam, this comprehensive review encourages active learning to master the content. Each evolving case study is broken down into realistic clinical problems that students can solve only by using the critical thinking skills necessary for the NCLEX-RN exam. Interspersed with over 700 interactive questions and rationales, audio-based questions, and electronic learning resources, the case studies mimic real-life nursing situations and provide models to help students problem-solve when taking the actual test. The review is presented in an enjoyable format without the drudgery of question after unrelated question or medical terminology flashcards. Multiple-choice questions, select all that apply, hot spots, matching, true and false, prioritizing, gaming, and calculations replicate the actual NCLEX-RN exam and keep students engaged throughout the review process. Each nursing specialty features a chapter on its specific pharmacology principles, culminating in a stand-alone chapter solely dedicated to reviewing pharmacological principles. Beyond its utility as an exam review, this resource is also a unique case study book designed to assist instructors in delivering content in an innovative format. New to the Second Edition: Fully updated to mirror the new 2016 test plan Reflects new changes in nursing, including prioritization, delegation, room assignment, The Joint Commission competencies, work-arounds, Situation, Background, Assessment, and Recommendation (SBAR) reporting, and value-based care More in-depth case studies to reflect greater exam complexity New chapters on gerontology nursing, men’s health, and veterans’ health New question types, including audio-based New e-learning component New responses to questions are defined by test plan categories and difficulty level Adds many new interactive questions and answers Key Features: Uses unfolding case study approach, integrating all patient care content areas with practice and professional roles Mirrors NCLEX test blueprint Offers an enjoyable study option distinct from traditional Q & A Provides over 700 questions and answers using varied NCLEX question styles Includes references at the end of chapters for self-remediation NCLEX-RN® is a registered trademark of the National Council of State Boards of Nursing, Inc. Test names are the property of the respective trademark holders, none of whom endorse or are affiliated with Springer Publishing Company.

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Problems sections. - NEW! Updated content and patient safety guidelines throughout the text reflects the latest practices and procedures. - NEW! Updated practice problems across the text incorporate the latest drugs and dosages.

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also includes ECG characteristics of disorders, drugs, pacemakers, and implantable cardioverter-defibrillators and a chapter on basic 12-lead electrocardiography.

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