9TH EDITION

PHARMACOTHERAPY

A PATHOPHYSIOLOGIC APPROACH

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PHARMACOTHERAPY

A PATHOPHYSIOLOGIC APPROACH

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Dedication

To our patients, who have challenged and inspired us and given meaning to all our endeavors.

To practitioners who continue to improve patient health outcomes and thereby serve as role models for their colleagues and students while clinging tenaciously to the highest standards of practice.

To our mentors, whose vision provided educational and training programs that encouraged our professional growth and challenged us to be innovators in our patient care, research, and education.

To our faculty colleagues for their efforts and support for our mission to provide a comprehensive and challenging educational foundation for the pharmacists of the future.

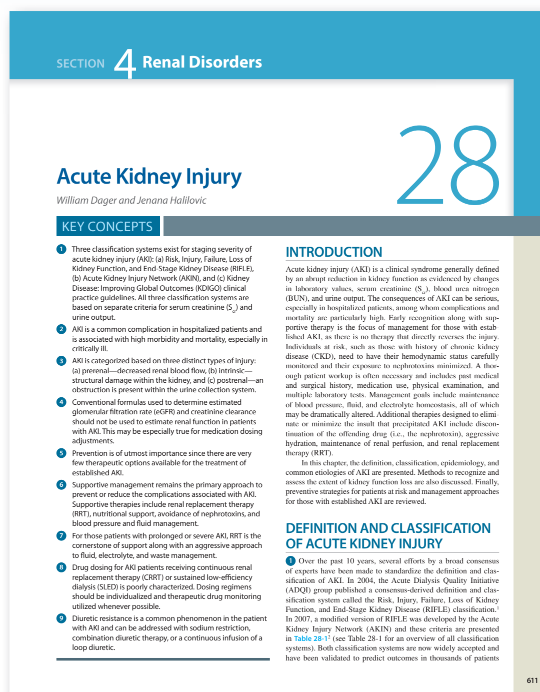
And finally to our families for the time that they have sacrificed so that this ninth edition would become a reality.

No other text helps you achieve optimal patient outcomes through evidence-based medication therapy like DiPiro's

Pharmacotherapy: A Pathophysiologic Approach, Ninth Edition

KEY FEATURES

- Goes beyond drug indications and doses to include drug selection, administration, and monitoring
- Enriched by more than 300 expert contributors
- Revised and updated to reflect the latest evidence-based information and recommendations
- Includes valuable learning aids such Key Concepts at the beginning of each chapter, Clinical Presentation tables that summarize disease signs and symptoms, and Clinical Controversies boxes that examine the complicated issues faced by students and clinicians in providing drug therapy



SECTION 4 Renal Disorders

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Acute Kidney Injury

William Dager and Jenana Halilovic

KEY CONCEPTS

1. Three classification systems exist for staging severity of acute kidney injury (AKI): (a) Risk, Injury, Failure, Loss of Kidney Function, and End-Stage Kidney Disease (RIFLE), (b) Acute Kidney Injury Network (AKIN), and (c) Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guidelines. All three classification systems are based on separate criteria for serum creatinine (S_{cr}) and urine output.
2. AKI is a common complication in hospitalized patients and is associated with high morbidity and mortality, especially in critically ill.
3. AKI is categorized based on three distinct types of injury: (a) prerenal—decreased renal blood flow, (b) intrinsic—structural damage within the kidney, and (c) postrenal—an obstruction is present within the urine collection system.
4. Conventional formulas used to determine estimated glomerular filtration rate (eGFR) and creatinine clearance should not be used to estimate renal function in patients with AKI. This may be especially true for medication dosing adjustments.
5. Prevention is of utmost importance since there are very few therapeutic options available for the treatment of established AKI.
6. Supportive management remains the primary approach to prevent or reduce the complications associated with AKI. Supportive therapies include renal replacement therapy (RRT), nutritional support, avoidance of nephrotoxins, and blood pressure and fluid management.
7. For those patients with prolonged or severe AKI, RRT is the cornerstone of support along with an aggressive approach to fluid, electrolyte, and waste management.
8. Drug dosing for AKI patients receiving continuous renal replacement therapy (CRRT) or sustained low-efficiency dialysis (SLED) is poorly characterized. Dosing regimens should be individualized and therapeutic drug monitoring utilized whenever possible.
9. Diuretic resistance is a common phenomenon in the patient with AKI and can be addressed with sodium restriction, combination diuretic therapy, or a continuous infusion of a loop diuretic.

INTRODUCTION

Acute kidney injury (AKI) is a clinical syndrome generally defined by an abrupt reduction in kidney function as evidenced by changes in laboratory values, serum creatinine (S_{cr}), blood urea nitrogen (BUN), and urine output. The consequences of AKI can be serious, especially in hospitalized patients, among whom complications and mortality are particularly high. Early recognition along with supportive therapy is the focus of management for those with established AKI, as there is no therapy that directly reverses the injury. Individuals at risk, such as those with history of chronic kidney disease (CKD), need to have their hemodynamic status carefully monitored and their exposure to nephrotoxins minimized. A thorough patient workup is often necessary and includes past medical and surgical history, medication use, physical examination, and multiple laboratory tests. Management goals include maintenance of blood pressure, fluid, and electrolyte homeostasis, all of which may be dramatically altered. Additional therapies designed to eliminate or minimize the insult that precipitated AKI include discontinuation of the offending drug (i.e., the nephrotoxin), aggressive hydration, maintenance of renal perfusion, and renal replacement therapy (RRT).

In this chapter, the definition, classification, epidemiology, and common etiologies of AKI are presented. Methods to recognize and assess the extent of kidney function loss are also discussed. Finally, preventive strategies for patients at risk and management approaches for those with established AKI are reviewed.

DEFINITION AND CLASSIFICATION OF ACUTE KIDNEY INJURY

1 Over the past 10 years, several efforts by a broad consensus of experts have been made to standardize the definition and classification of AKI. In 2004, the Acute Dialysis Quality Initiative (ADQI) group published a consensus-derived definition and classification system called the Risk, Injury, Failure, Loss of Kidney Function, and End-Stage Kidney Disease (RIFLE) classification.[1] In 2007, a modified version of RIFLE was developed by the Acute Kidney Injury Network (AKIN) and these criteria are presented in Table 28-1[2] (see Table 28-1 for an overview of all classification systems). Both classification systems are now widely accepted and have been validated to predict outcomes in thousands of patients

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Key Concepts summarize must-know information in each chapter

NEW TO THIS EDITION

- A section on personalized pharmacotherapy appears in most sections
- All diagnostic flow diagrams, treatment algorithms, dosing guideline recommendations, and monitoring approaches have been updated in full color to clearly distinguish treatment pathways
- New drug monitoring tables have been added
- Most of the disease-oriented chapters have incorporated evidence-based treatment guidelines when available, include ratings of the level of evidence to support the key therapeutic approaches
- Twenty-four online-only chapters are available at www.pharmacotherapyonline.com

Valuable tables encapsulate important information

TABLE 75-4 Topical Drugs Used in the Treatment of Open-Angle Glaucoma

Drug	Pharmacologic Properties	Common Brand Names	Dose Form	Strength (%)	Usual Dose[a]	Mechanism of Action
β-Adrenergic Blocking Agents						
Betaxolol	Relative β_1-selective	Generic	Solution	0.5	One drop twice a day	All reduce aqueous production of ciliary body
		Betoptic-S	Suspension	0.25	One drop twice a day	
Carteolol	Nonselective, intrinsic sympathomimetic activity	Generic	Solution	1	One drop twice a day	
Levobunolol	Nonselective	Betagan	Solution	0.25, 0.5	One drop twice a day	
Metipranolol	Nonselective	OptiPranolol	Solution	0.3	One drop twice a day	
Timolol	Nonselective	Timoptic, Betimol, Istalol	Solution	0.25, 0.5	One drop every day—one to two times a day	
		Timoptic-XE	Gelling solution	0.25, 0.5	One drop every day[a]	
Nonspecific Adrenergic Agonists						
Dipivefrin	Epinephrine prodrug	Propine	Solution	0.1	One drop twice a day	Increased aqueous humor outflow
α_2-Adrenergic Agonists						
Apraclonidine	Specific α_2-agonists	Iopidine	Solution	0.5, 1	One drop two to three times a day	Both reduce aqueous humor production; brimonidine known to also increase uveoscleral outflow; only brimonidine has primary indication
Brimonidine		Alphagan P	Solution	0.15, 0.1	One drop two to three times a day	
Cholinergic Agonists Direct Acting						
Carbachol	Irreversible	Carboptic, Isopto Carbachol	Solution	1.5, 3	One drop two to three times a day	All increase aqueous humor outflow through trabecular meshwork
Pilocarpine	Irreversible	Isopto Carpine, Pilocar	Solution	0.25, 0.5, 1, 2, 4, 6, 8, 10	One drop two to three times a day One drop four times a day	
		Pilopine HS	Gel	4	Every 24 hours at bedtime	
Cholinesterase Inhibitors						
Echothiophate		Phospholine Iodide	Solution	0.125	Once or twice a day	
Carbonic Anhydrase Inhibitors						
Topical						
Brinzolamide	Carbonic anhydrase type II inhibition	Azopt	Suspension	1	Two to three times a day	All reduce aqueous humor production of ciliary body
Dorzolamide		Trusopt Generic	Solution	2	Two to three times a day	
Systemic						
Acetazolamide		Generic	Tablet	125 mg, 250 mg	125–250 mg two to four times a day	
		Injection	500 mg/vial	250–500 mg		
		Diamox Sequels	Capsule	500 mg	500 mg twice a day	
Methazolamide		Generic	Tablet	25 mg, 50 mg	25–50 mg two to three times a day	
Prostaglandin Analogs						
Latanoprost	Prostanoid agonist	Xalatan	Solution	0.005	One drop every night	Increases aqueous uveoscleral outflow and to a lesser extent trabecular outflow
Bimatoprost	Prostamide agonist	Lumigan	Solution	0.01, 0.03	One drop every night	
Travoprost	Prostanoid agonist	Travatan Z	Solution	0.004	One drop every night	
Tafluprost	Prostanoid agonist	Zioptan	Preservative free solution	0.0015%	One drop every night	
Combinations						
Timolol–dorzolamide		Cosopt Generic	Solution	Timolol 0.5% dorzolamide 2%	One drop twice daily	
Timolol–brimonidine		Combigan	Solution	Timolol 0.5% brimonide 0.2%	One drop twice daily	
Brinzolamide–brimonidine		Simrinza		Brinzolamide 1% brimonidine 0.2%	One drop three times daily	

[a]Use of nasolacrimal occlusion will increase the number of patients successfully treated with longer dosage intervals.

1535 CHAPTER 75 Glaucoma

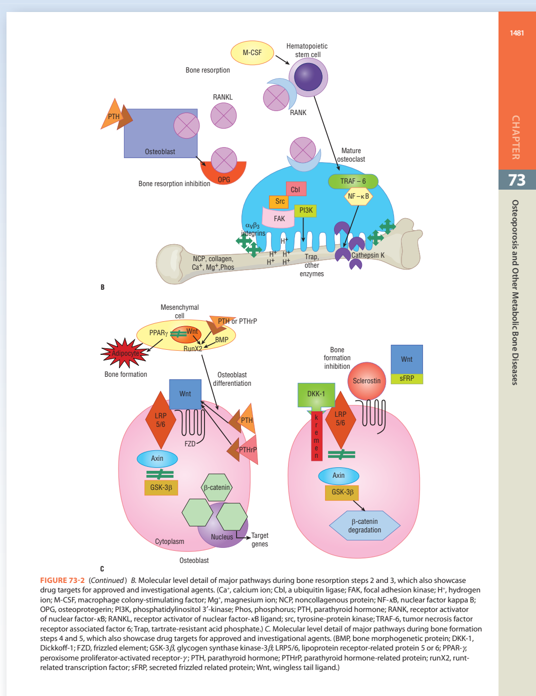

FIGURE 73-2 (Continued) B. Molecular level detail of major pathways during bone resorption steps 2 and 3, which also showcase drug targets for approved and investigational agents. (Ca+, calcium ion; Cbl, a ubiquitin ligase; FAK, focal adhesion kinase; H+, hydrogen ion; M-CSF, macrophage colony-stimulating factor; Mg+, magnesium ion; NCP, noncollagenous protein; NF-κB, nuclear factor kappa B; OPG, osteoprotegerin; PI3K, phosphatidylinositol 3'-kinase; Phos, phosphorus; PTH, parathyroid hormone; RANK, receptor activator of nuclear factor-κB; RANKL, receptor activator of nuclear factor-κB ligand; src, tyrosine-protein kinase; TRAF-6, tumor necrosis factor receptor associated factor 6; Trap, tartrate-resistant acid phosphatase.) C. Molecular level detail of major pathways during bone formation steps 4 and 5, which also showcase drug targets for approved and investigational agents. (BMP, bone morphogenetic protein; DKK-1, Dickkoff-1; FZD, frizzled element; GSK-3β glycogen synthase kinase-3β; LRP5/6, lipoprotein receptor-related protein 5 or 6; PPAR-γ, peroxisome proliferator-activated receptor-γ; PTH, parathyroid hormone; PTHrP, parathyroid hormone-related protein; runX2, runt-related transcription factor; sFRP, secreted frizzled related protein; Wnt, wingless tail ligand.)

Full-color illustrations enhance and clarify the text

Clinical Presentation tables summarize disease signs and symptoms

1341 CHAPTER 66 Erectile Dysfunction

CLINICAL PRESENTATION Erectile Dysfunction

General

- Men are affected emotionally in many different ways
- Depression
- Performance anxiety
- Marital difficulties and avoidance of sexual intimacy (patients are often brought to a physician by their partners)
- Nonadherence to medications patient believes are causing erectile dysfunction

Symptoms

- Erectile dysfunction or inability to have sexual intercourse

Signs

- If completing an International Index of Erectile Dysfunction survey, results are consistent with low satisfaction with the quality of erectile function
- Medical history may identify concurrent medical illnesses, past surgical procedures that interfere with good vascular flow to the penis or damage nerve function to the corpora, or mental disorders associated with decreased reception of sexual stimuli
- Medication history may reveal prescription or nonprescription medications that could cause erectile dysfunction
- Physical examination may reveal signs of hypogonadism (e.g., gynecomastia, small testicles, decreased body hair or beard, and decreased muscle mass), which may contribute to erectile dysfunction. The patient may have an abnormally curved penis when erect, decreased pulses in the pelvic region (suggesting impaired vascular flow to the penis), or decreased anal sphincter tone (suggesting impaired nerve function to the corpora). Men older than 50 years should undergo a digital rectal examination to determine whether an enlarged prostate is contributing to the patient's erectile dysfunction

Laboratory Tests

- If the patient has signs of hypogonadism and complains of decreased libido, a serum testosterone concentration may be below the normal range, which would be consistent with a hormonal cause of erectile dysfunction
- If the patient has an enlarged prostate noted on digital rectal examination, a blood sample for prostate-specific antigen should be obtained. If elevated, the patient should be evaluated for a prostate disorder, which could contribute to erectile dysfunction

A complete listing of the patient's prescription and nonprescription medications and dietary supplements should be reviewed by the clinician, who should identify drugs that may be contributing to erectile dysfunction. If possible, causative agents should be discontinued or the dose should be reduced.

A physical examination of the patient should include a check for hypogonadism (i.e., signs of gynecomastia, small testicles, and decreased beard or body hair). The penis should be evaluated for diseases associated with abnormal penile curvature (e.g., Peyronie's disease), which are associated with erectile dysfunction. Femoral and lower extremity pulses should be assessed to provide an indication of vascular supply to the genitals. Anal sphincter tone and other genital reflexes should be checked for the integrity of the nerve supply to the penis. A digital rectal examination in patients 50 years or older is needed to rule out benign prostatic hyperplasia, which may contribute to erectile dysfunction.

Selected laboratory tests should be obtained to identify the presence of underlying diseases that could cause erectile dysfunction. They include a fasting serum blood glucose and lipid profile. Serum testosterone levels should be checked in patients older than 50 years and in younger patients who complain of decreased libido and erectile dysfunction. At least two early morning serum testosterone levels on different days are needed to confirm the presence of hypogonadism.[17]

Finally, erectile dysfunction is a potential marker for arteriosclerosis. Therefore, older patients and those at intermediate and high risk for cardiovascular disease should undergo a cardiovascular risk assessment before starting on drug treatment for erectile dysfunction. By doing so, patients will be categorized into low-, intermediate-, or high-risk groups for cardiovascular morbidity related to sexual intercourse. Patients in the intermediate-risk group should undergo additional testing to reclassify them into the low- or high-risk group. The high-risk group should defer sexual activity. Patients in the low-risk group may start specific treatment for erectile dysfunction.[8,18–20]

TREATMENT
Erectile Dysfunction

Desired Outcomes

The goal of treatment is improvement in the quantity and quality of penile erections suitable for intercourse and considered satisfactory by the patient and his partner. Simple as this may sound, healthcare providers must ensure that patients and their partners have reasonable expectations for any therapies that are initiated. Furthermore, only patients with erectile dysfunction should be treated. Patients who have normal sexual function should not seek—or be encouraged to seek—treatment in an effort to enhance sexual function or enable increased activity. In addition, treatment should be well tolerated and be of reasonable cost.

General Approach to Treatment

3 The Third Princeton Consensus Conference is a widely accepted multidisciplinary approach to managing erectile dysfunction that maps out a stepwise treatment plan.[20–22] The first step in clinical management of erectile dysfunction is to identify and, if possible, reverse underlying causes. Risk factors for erectile dysfunction, including hypertension, coronary artery disease, dyslipidemia, diabetes mellitus, smoking, or chronic ethanol abuse, should be

- *Pharmacotherapy Casebook* provides the case studies students need to learn how to identify and resolve the drug therapy problems most likely encountered in real-world practice. This new edition is packed with patient cases and makes the ideal study companion to the 9th edition of DiPiro's *Pharmacotherapy: A Pathophysiologic Approach*.
- Online Learning Center is designed to benefit the student and faculty. Both learning objectives and self-assessment questions for each chapter are available online at www.accesspharmacy.com

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Foreword

This edition of *Pharmacotherapy: A Pathophysiologic Approach* comes at a time of unprecedented change in health care. While some would argue that the health care system has been slow to change, the environment of today is rapidly evolving. This requires that health care professionals, including pharmacists, are not only responsive and adaptive to change, but able to identify innovative strategies and new approaches to delivering care that contribute meaningfully to the transformation that is needed.

There are significant deficiencies in the way health care is delivered, including poor coordination, variation in quality, and an inability to integrate team-based approaches, all of which impact the quality of care provided to individuals and contribute to rising health care costs. This is especially true in caring for individuals and populations living with chronic disease, which is the leading cost driver in the U.S. health care system. This edition of *Pharmacotherapy: A Pathophysiologic Approach* will prepare future practitioners with the foundational knowledge critical in the management of these diseases.

Medications remain the most common and powerful of all health care interventions, yet are associated with serious harm. In 2011, more than 4 billion prescriptions were written annually in the U.S with prescription spending reaching nearly $320 billion. The adverse consequences of medication use are a major contributor to poor quality care and cost the health care industry billions of dollars each year. In 2007, hospital-based adverse drug events were estimated to be nearly 450,000 per year, with higher numbers in long-term care facilities (800,000), and the outpatient setting (550,000). While this imposes serious impact on the health of patients and the health care system as a whole, most troubling is that medication-related harm occurs at every step in the medication use process—manufacturing, purchasing, prescribing, dispensing, administering, and monitoring—and is largely preventable. It is not surprising that in a 2007 Institute of Medicine report, the appropriate use and management of drug therapy was acknowledged as a critical issue that must be addressed to improve national health care. This is important for the profession of pharmacy as we strive to position ourselves to contribute meaningfully to the delivery of high-quality patient care and play an integral role in transforming our health care system.

Patient-centered medical homes (PCMHs) and accountable care organizations (ACOs) are among the most promising approaches to delivering higher-quality, cost-effective care and present unique opportunities for improving drug therapy outcomes. Central to the PCMH is the patient having a personal physician and collaborative team to provide continuous and coordinated primary care that takes a whole person orientation. ACOs are healthcare organizations centered around the provision of coordinated care and characterized by a payment model that seeks to tie reimbursements to quality metrics and reductions in the total cost of care for a population of patients. PCMHs will require pharmacists to serve as integral members of the collaborative team, responsible for ensuring the safe, effective, and affordable use of medications. Likewise, the ACO model strives to improve quality and reduce total cost of care within health care organizations. Innovative and targeted strategies to improve drug therapy outcomes will be critical in any effort to improve total quality of care. Further, the ACO model provides a unique opportunity for pharmacy to demonstrate the true value-added proposition of pharmacists in health care, thereby informing payment reform and sustainability of clinical pharmacy services.

Numerous opportunities to transform health care delivery exist today; however, to ensure continued improvement of health and health care will require that health professions education be reengineered to better prepare students to meet the future needs of society. Education must be restructured to reduce the almost exclusive focus on the acquisition of knowledge and to place greater emphasis on the skills and behaviors that will be essential for students to survive in a rapidly changing health care environment. In pharmacy education, students must have an in-depth understanding of the foundations of pharmacy, the pharmaceutical sciences, and pharmacotherapy, but they must also be given ample opportunity to think critically, solve complex problems, communicate clearly, and work with others. Students must spend more time in real-world patient care settings and be immersed in complex systems of care, interacting with others to achieve shared goals and functioning in and leading teams toward improvement and change. In Flexner's 1910 report on medical education, he noted that just as scientists must inquire, analyze, identify solutions, and continually refine their approach toward discovery, so, too, must practitioners if they are to advance the practice of medicine and health care. To cultivate these "habits of mind," students must learn how to approach and solve complex problems through engagement in inquiry, discovery, and innovation rather than relying on memorization of facts. As schools of pharmacy move forward with new and innovative curricular designs as outlined in the 2011–2012 Argus Commission Report, authoritative textbooks like *Pharmacotherapy: A Pathophysiologic Approach* will become an important and integral part of student foundational learning.

Building a solid foundation and expertise that is deeply rooted in the pharmaceutical sciences and pharmacotherapy is critical to ensuring that pharmacists are well positioned to improve drug therapy outcomes. It is this unique expertise that differentiates us, as pharmacists, from any other profession. This edition of

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Pharmacotherapy: A Pathophysiologic Approach will equip pharmacy students and practitioners with the knowledge and perspective to be the health care professional most skilled in the provision of drug therapy management. As students and practitioners we must not lose sight of the opportunity we have to influence and shape health care delivery both now and in the future. Just as we take measureable steps to optimize and personalize one's drug therapy, so, too, must each of us take measureable steps toward transforming our health care system. These are unprecedented times of change and opportunity for the profession of pharmacy to shape the future of health care and improve drug therapy outcomes for patients and society.

Robert A. Blouin
Mary Roth McClurg

Foreword to the First Edition

Evidence of the maturity of a profession is not unlike that characterizing the maturity of an individual; a child's utterances and behavior typically reveal an unrealized potential for attainment, eventually, of those attributes characteristic of an appropriately confident, independently competent, socially responsible, sensitive, and productive member of society.

Within a period of perhaps 15 or 20 years, we have witnessed a profound maturation within the profession of pharmacy. The utterances of the profession, as projected in its literature, have evolved from mostly self-centered and self-serving issues of trade protection to a composite of expressed professional interests that prominently include responsible explorations of scientific/technological questions and ethical issues that promote the best interests of the clientele served by the profession. With the publication of *Pharmacotherapy: A Pathophysiologic Approach,* pharmacy's utterances bespeak a matured practitioner who is able to call upon unique knowledge and skills so as to function as an appropriately confident, independently competent pharmacotherapeutics expert.

In 1987, the Board of Pharmaceutical Specialties (BPS), in denying the petition filed by the American College of Clinical Pharmacy (ACCP) to recognize "clinical pharmacy" as a specialty, conceded nonetheless that the petitioning party had documented in its petition a specialist who does in fact exist within the practice of pharmacy and whose expertise clearly can be extricated from the performance characteristics of those in general practice. A refiled petition from ACCP requests recognition of "pharmacotherapy" as a Specialty Area of Pharmacy Practice. While the BPS had issued no decision when this book went to press, it is difficult to comprehend the basis for a rejection of the second petition.

Within this book one will find the scientific foundation for the essential knowledge required of one who may aspire to specialty practice as a pharmacotherapist. As is the case with any such publication, its usefulness to the practitioner or the future practitioner is limited to providing such a foundation. To be socially and professionally responsible in practice, the pharmacotherapist's foundation must be continually supplemented and complemented by the flow of information appearing in the primary literature. Of course this is not unique to the general or specialty practice of pharmacy; it is essential to the fulfillment of obligations to clients in any occupation operating under the code of professional ethics.

Because of the growing complexity of pharmacotherapeutic agents, their dosing regimens, and techniques for delivery, pharmacy is obligated to produce, recognize, and remunerate specialty practitioners who can fulfill the profession's responsibilities to society for service expertise where the competence required in a particular case exceeds that of the general practitioner. It simply is a component of our covenant with society and is as important as any other facet of that relationship existing between a profession and those it serves.

The recognition by BPS of pharmacotherapy as an area of specialty practice in pharmacy will serve as an important statement by the profession that we have matured sufficiently to be competent and willing to take unprecedented responsibilities in the collaborative, pharmacotherapeutic management of patient-specific problems. It commits pharmacy to an intention that will not be uniformly or rapidly accepted within the established health care community. Nonetheless, this formal action places us on the road to an avowed goal, and acceptance will be gained as the pharmacotherapists proliferate and establish their importance in the provision of optimal, cost-effective drug therapy.

Suspecting that other professions in other times must have faced similar quests for recognition of their unique knowledge and skills I once searched the literature for an example that might parallel pharmacy's modern-day aspirations. Writing in the *Philadelphia Medical Journal,* May 27, 1899, D. H. Galloway, MD, reflected on the need for specialty training and practice in a field of medicine lacking such expertise at that time. In an article entitled "The Anesthetizer as a Speciality," Galloway commented:

> The anesthetizer will have to make his own place in medicine: the profession will not make a place for him, and not until he has demonstrated the value of his services will it concede him the position which the importance of his duties entitles him to occupy. He will be obliged to define his own rights, duties and privileges, and he must not expect that his own estimate of the importance of his position will be conceded without opposition. There are many surgeons who are unwilling to share either the credit or the emoluments of their work with anyone, and their opposition will be overcome only when they are shown that the importance of their work will not be lessened, but enhanced, by the increased safety and dispatch with which operations may be done. . . .

It has been my experience that, given the opportunity for one-on-one, collaborative practice with physicians and other health professionals, pharmacy practitioners who have been educated and trained to perform at the level of pharmacotherapeutics specialists almost invariably have convinced the former that "the importance of their work will not be lessened, but enhanced, by the increased safety and dispatch with which" individualized problems of drug therapy could be managed in collaboration with clinical pharmacy practitioners.

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It is fortuitous—the coinciding of the release of *Pharmacotherapy: A Pathophysiologic Approach* with ACCP's petitioning of BPS for recognition of the pharmacotherapy specialist. The utterances of a maturing profession as revealed in the contents of this book, and the intraprofessional recognition and acceptance of a higher level of responsibility in the safe, effective, and economical use of drugs and drug products, bode well for the future of the profession and for the improvement of patient care with drugs.

Charles A. Walton, PhD
San Antonio, Texas

Preface

With each edition of *Pharmacotherapy: A Pathophysiologic Approach* the pace of change in health care seems to accelerate, and this continues to be true for the 9th edition. At this time, pharmacists across the United States are actively contributing their expertise as integrated and virtual members of the new health care delivery models that are being implemented as part of the Affordable Care Act through accountable care organizations and patient-centered medical homes. These emerging care models have improved outcomes for Medicare and Medicaid beneficiaries and now are poised to affect the care of most individuals. Pharmacists throughout the world are recognizing their potential to improve access to affordable high-quality care in their country. As expectations and opportunities for pharmacists expand, the need for state-of-the-art, patient-centered education and training becomes more acute. The Editors and authors of PAPA continue to strive to make this text relevant to patient-focused pharmacists and other health care providers in this dynamic era.

The 9th edition of *Pharmacotherapy: A Pathophysiologic Approach* is the product of the editorial team's reflection on what are the core pathophysiological and therapeutic elements that students and young practioners need. As a result, we have streamlined the offerings in this edition and placed a portion of the foundational chapters on the web to make them accessible to a broader audience. Most importantly, each chapter of the book has been revised and updated to reflect the latest in evidence-based information and recommendations. We trust that you will find that this edition balances the need for accurate, thorough, and unbiased information about the treatment of diseases by presenting concise illustrative analyses of the multiplicity of therapeutic options.

With each edition, the editors recommit to our founding precepts:

- Advance the quality of patient care through evidence-based medication therapy management based on sound pharmacotherapeutic principles.
- Enhance the health of our communities by incorporating contemporary health promotion and disease-prevention strategies in our practice environments.
- Motivate young practitioners to enhance the breadth, depth, and quality of care they provide to their patients.
- Challenge established pharmacists and other primary-care providers to learn new concepts and refine their understanding of the pathophysiologic tenets that undergird the development of individualized therapeutic regimens.
- Present the pharmacy and health care communities with innovative patient assessment, triage, and pharmacotherapy management skills.

The ninth edition builds on and expands the foundation of previous editions. Most of the disease-oriented chapters have incorporated updated evidence-based treatment guidelines that include, when available, ratings of the level of evidence to support the key therapeutic approaches. Also, in this edition new features have been added:

- Most chapters have a section on personalized pharmacotherapy.
- The diagnostic flow diagrams, treatment algorithms, dosing guideline recommendations, and monitoring approaches that were present in the last edition have been revised with color codes to clearly distinguish treatment pathways.
- The Drug Dosing tables have been reformatted for clarity and consistency.
- New Drug Monitoring tables have been added.

The text's digital home, Access Pharmacy (www.accesspharmacy.com), has become the primary access point for many in the United States and around the world. Users of Access Pharmacy will find many features to enhance their learning and information retrieval. Thoughtful and provocative updates to PAPA chapters are added as new information mandates to keep our readers relevant in these times of rapid advancements. Also, the site has many new features such as education guides, Goodman & Gilman's animations, virtual cases, and many other textbooks. As in previous editions, the text coordinates well with *Pharmacotherapy: A Patient-focused Approach*, which includes in-depth patient cases with questions and answers.

Twenty-four chapters of this edition are being published online and are available to all users in the Online Learning Center at www.pharmacotherapyonline.com The chapters chosen for online publication include seven, which describe and critique the available means to assess major organ system function, and five, which characterize the adverse effects of drugs on organ systems. They join the 12 foundational chapters, which provide overviews of pharmacy skills in medication safety, pharmacokinetics, and pharmacogenetics, and patient-centered considerations such as health literacy, cultural competency, pediatrics, and geriatrics; finally, there are three chapters that address public health, clinical toxicology, and emergency preparedness. The Online Learning Center continues to provide unique features designed to benefit students, practitioners, and faculty around the world. The site includes learning objectives and self-assessment questions for each chapter. In closing, we acknowledge the many hours that *Pharmacotherapy's* more than 300 authors contributed to this

labor of love. Without their devotion to the cause of improved pharmacotherapy and dedication in maintaining the accuracy, clarity, and relevance of their chapters, this text would unquestionably not be possible. In addition, we thank Michael Weitz, Brian Kearns, and James Shanahan and their colleagues at McGraw-Hill for their consistent support of the *Pharmacotherapy* family of resources, insights into trends in publishing and higher education, and the critical attention to detail so necessary in pharmacotherapy.

The Editors
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