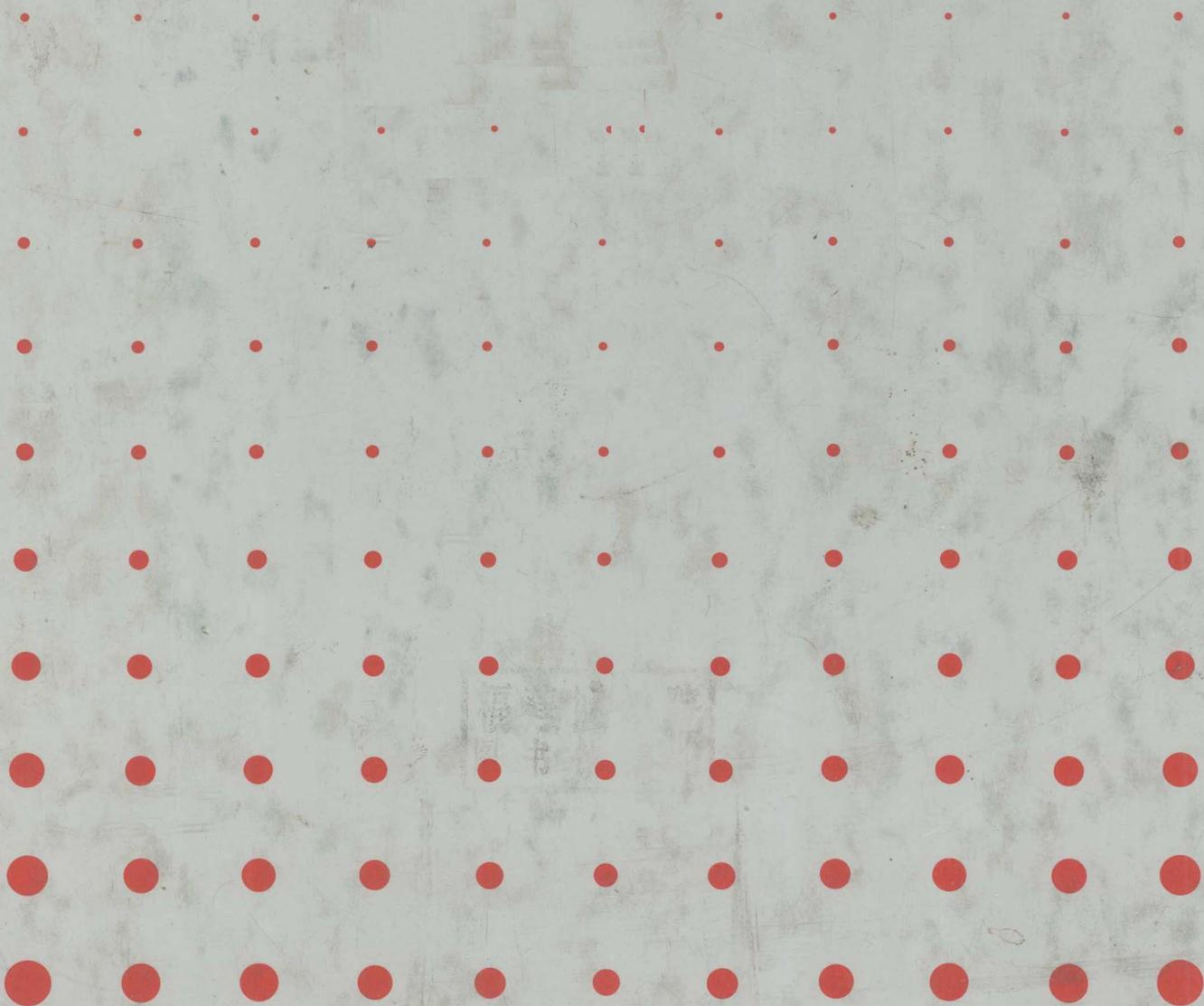

FIFTEENTH EDITION

PHARMACOLOGY
IN NURSING

HAHN · BARKIN · OESTREICH



PHARMACOLOGY

IN NURSING

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ANNE BURGESS HAHN

R.N., B.S.N., M.A. (Nursing), M.A. (Biological Sciences)

Associate Professor and Science Coordinator of Nursing, University of Bridgeport, Bridgeport, Connecticut; Consultant, Veterans Administration Medical Center, West Haven, Connecticut; Adjunct Faculty of Respiratory Therapy Program, University of Bridgeport, Bridgeport, Connecticut

ROBERT L. BARKIN

Pharm.B.S., M.B.A., R.Ph.

Faculty, Department of Pharmacology, Rush Medical College;
Faculty, College of Pharmacy, University of Illinois;
Assistant Director of Pharmacy, Rush Presbyterian
St. Luke's Medical Center, Chicago, Illinois

SANDY JEANNE KLARMAN OESTREICH

R.N. C., B.S., M.S., Doctoral Candidate

Assistant Professor of Nursing, Adelphi University, Garden City, New York;
ANA-Certified Adult Health Nurse Practitioner, Community Health Program,
New Hyde Park, New York

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CONTRIBUTORS

ANDRES GOTH, M.D.

Professor and Chairman,
Department of Pharmacology, Southwestern Medical School,
University of Texas Health Science Center at Dallas,
Dallas, Texas

RITA LENHART, R.N., B.S., M.A.

Nursing Instructor, Veterans Administration Medical Center,
West Haven, Connecticut

KAY SEE-LASLEY, M.S., R.Ph.

Clinical Pharmacist Oncologist, Lawrence, Kansas

MARY ANNE TOLL, R.Ph.

Clinical Instructor, Department of Pharmacy,
University of Kansas Medical Center, Lawrence, Kansas

SARA J. WHITE, M.S.

Associate Director of Pharmacy, Department of Pharmacy,
University of Kansas Medical Center, Lawrence, Kansas

JAMES S. WOODS, Ph.D.

Program Leader, Epidemiology and Environmental Health Research Program,
Health and Population Study Center, Battelle Human Affairs Research Centers,
Seattle, Washington

BRUCE WOOLEY, Pharm.D.

University of Nebraska, Omaha, Nebraska

P R E F A C E

The reputation that *Pharmacology in Nursing* has gained over the years is a proud one. This textbook has served as an informative resource and guide to generations of nursing students learning the safe and therapeutic use of drugs in the care of patients. In order to keep pace with the constantly changing field of pharmacology, periodic revisions are required to introduce important new drugs and pharmacologic theories. This ensures a continually high level of contemporary information that provides a rational basis for intelligent application of modern drug therapy.

The fifteenth edition of *Pharmacology in Nursing* has undergone a significant revision. A major change includes the reorganization of the table of contents, whereby the chapters have been assembled into broad pharmacologic units. The units represent a more cohesive and consistent presentation of each major class of drugs. Accordingly, the chapters within a unit follow in a logical sequence so that the pharmacologic properties of a drug group are discussed in relation to their therapeutic effect on a specific organ system.

In addition, the reader will find that nearly every chapter has been extensively altered; most have been rewritten and a great deal of new material has been introduced. Current pharmacologic concepts and principles as well as descriptions of pharmacokinetic characteristics of the more important drugs have been incorporated. Two new chapters have been added—Chapter 5, “Assessment in Pharmacotherapeutics,” and Chapter 6, “Plans, Implementation, and Evaluation.” They deal with

the nursing process as an up-to-date tool for the safe and effective administration of drugs.

Also, this revision includes information on newly approved drugs and updates the new therapeutic uses of already established drugs. As an additional feature, we have inserted cross-references from one section of the book to another to direct the reader to the various properties and the multiple uses that may be associated with an individual agent.

Modern scientific advancements now presume knowledge of cell physiology as a basis for pharmacology. This involves the manner in which drugs alter the function of distinct cellular components in a disease process. For example, the response of specific receptors to various neurotransmitters and other chemicals, the role of $\text{Na}^+\text{-K}^+$ ATPase in the mechanism of action of digitalis glycosides, and the effect of antidysrhythmic agents on electrophysiologic properties of the cardiac cell are aspects of pharmacology that provide a deeper insight into *how* a specific drug alters a pathologic condition in a patient. Moreover, a focus on cellular function promotes progress toward an understanding of the mechanism of drug interactions. How drugs interact with each other has become a major clinical concern, and it is therefore essential that nurses become knowledgeable about this aspect of drug therapy.

At the end of each chapter, a summary of nursing considerations and questions for study and review have been added to reinforce content and stimulate critical thinking. The bibliographic references have been updated. Most of the books and periodicals cited in the list are

generally available in the library so that the student will be encouraged to do additional reading.

Since nursing decisions are based on comprehension of pharmacologic concepts and principles, every effort has been made to provide this information. Throughout the book, emphasis has been placed on clinical application of drugs to ensure rational and optimal care of patients. Therefore, this edition will serve the clinical needs of both the student and the practitioner of nursing. However, we trust that the book also will be of value to students of other allied health sciences whose curriculum involves the study of pharmacology.

We wish to gratefully acknowledge the many people who were instrumental in the development of this revision. Particular thanks is extended to the editor who organized the vast amount of material into a consistent format, to

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Anne Burgess Hahn
Robert L. Barkin
Sandy Jeanne Klarman Oestreich

NOTE TO THE READER

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UNIT ONE

INTRODUCTORY ASPECTS OF PHARMACOLOGY

CHAPTER 1

Orientation to pharmacology

Historical origin and progress of pharmacology
Drug uses and mechanisms of action
Nursing scope and responsibilities
The nursing process as related to pharmacology
Goals of this text
Summary of nursing considerations

Medications are an essential part of patient care, and safe administration of drugs requires *sound* and *current* knowledge of their (1) mode of action, (2) side effects, (3) toxicity, (4) range of dosage, (5) rate and route of excretion, (6) individual differences in response, such as idiosyncratic or allergic reactions, and (7) interactions with other drugs. This knowledge can be obtained from textbooks and periodicals for health professionals, classroom lectures and discussions, and materials available in teaching laboratories. However, actual administration of drugs with careful observation of their effects in individuals and groups of patients will richly supplement and complement a student's knowledge of specific drugs.

There are several basic terms a nurse needs to know and understand to be properly oriented to pharmacology practice. The first is the word "pharmacology" itself.

Pharmacology is the study of the interaction between drugs and living systems. Branches of pharmacology include:

- 1 *Pharmacotherapeutics* (clinical pharmacology), which deals with the relative effects of drugs in the human system in specific applications
- 2 *Pharmacodynamics*, which deals with experimental science pertaining to theories of drug action
- 3 *Pharmacokinetics*, which is the study of a drug's alterations during its odyssey through the body as it is absorbed, distributed, bound to or localized in tissues, biotransformed, and excreted

- 4 *Pharmacogenetics*, which is the study of genetically induced drug responses that are often responsible for some "idiosyncratic" (unexplained) response

Chemotherapy is drug therapy to destroy or inhibit growth and reproduction of abnormal cells, such as cancer cells. This is the common use of the term, but it may also be applied to the treatment of infectious disease-causing organisms.

Drug is defined by the Food and Drug Administration (FDA) to be any substance for use in diagnosis, cure, mitigation (relief), treatment, or prevention of disease in humans or animals. This is the definition recognized by official standard-setters such as *The United States Pharmacopeia* and the *British Pharmacopoeia*. The terms "medication," "medicine," "medicament," and "medicinal" are used more or less synonymously with the term "drug."

Historical origin and progress of pharmacology

Historically the primitive person's belief that disease was caused by evil spirits inhabiting the body persisted throughout the Egyptian period of medicine until challenged by Hippocrates in 460 BC. This Greek priest-physician advanced the idea that disease resulted from natural causes and could only be understood

through study of natural laws. He believed in the body's recuperative powers and saw the physician's role in assisting the recuperative process. Called the Father of Medicine, Hippocrates influenced the sound principles that control the practice of medicine today. Building on the teachings and practice of Hippocrates, Galen (131 to 201 AD) established a system of medicine and pharmacy that made him the supreme authority for several hundred years.

The decline and fall of the Roman Empire marked the beginning of the medieval period (400 to 1580 AD). Germanic barbarians overran Western Europe and reverted to a medicine of folklore and tradition, similar to that of the Greeks before Hippocrates.

At the same time Christian religious orders developed whose members built monasteries that soon became repositories for all learning, including pharmacy and medicine. They aided the sick and needy with good food, rest, and medicinals from their monastery gardens.

The Arabs' interest in medicine, pharmacy, and chemistry was reflected in the hospitals and schools they built, the many new drugs they contributed and their formulation of the first set of drug standards.

Pharmacy came into its own during the sixteenth century. Valerius Cordus wrote the first pharmacopeia to be printed and authorized as an authoritative standard.

Paracelsus, professor of physics and surgery at Basel, denounced "humoral pathology" and substituted the idea that diseases were actual entities to be combated with specific remedies. He improved pharmacy and therapeutics for succeeding centuries, introducing new remedies and compounds and reducing the overdosing so prevalent in that period.

In the seventeenth and eighteenth centuries great progress was made in pharmacy and chemistry. The first London pharmacopeia appeared in 1618. Many preparations were introduced that are still in use today, including tincture of opium, coca, and ipecac. In 1785, Englishman William Withering introduced infusion of digitalis for heart disease. Edward Jenner made his first public inoculation with smallpox vaccine in 1796.

During the nineteenth century, pharmaceutical chemistry emerged as an important subdi-

vision of the highly specialized science of chemistry. Serturner's discovery of the alkaloid morphine in 1815 led to research on many vegetable drugs, resulting in discoveries of quinine, strychnine, atropine, codeine, and others. Ether and chloroform were first used as general anesthetics in the 1840s. The French *Codex* was the first of the important national pharmacopeias to be produced. Issued in 1818, it was followed by the United States' *Pharmacopeia* in 1820, that of Great Britain in 1864, and Germany's in 1872.

Accurate study of dosage became a reality in the nineteenth century, leading to the establishment of large-scale manufacturing plants for the production of drugs. Fewer drugs were prescribed, and knowledge of their expected action became more precise. Rational medicine had begun to replace empiricism.

Ehrlich's introduction in 1907 of salvarsan for syphilis and Banting's discovery of insulin for diabetes mellitus in 1922 constitute two early landmark events. The sulfonamides, penicillin, and other antibiotics revolutionized chemotherapy. The development of cortisone, first used in 1949, opened a new era in medical science. In 1955 and 1961, new poliomyelitis vaccines relieved humanity from another dread disease.

In the late 1950s, discovery that a chemical contraceptive taken by mouth could be a feasible approach to birth control had widespread effects on the per capita birth rate and sexual mores.

More recently, some of the most exciting research has turned up the existence of a whole new class of drugs that the body itself produces, such as interferon, enkephalins, endorphins, and endoxin (analogous to digoxin).

In the 1980s it is predicted that the most promising drug therapy research will be directed at drugs:

- 1 To reduce the nonfatal heart attack rate
- 2 That contain prostaglandins and prostacyclines for the treatment of diabetes, arthritis, coronary disease, ulcers, hypertension, and congenital heart malformations in infants
- 3 That will act to stimulate the immune system in immunosuppressed patients
- 4 That will be even broader spectrum antibiotics than those presently used

- 5 With greater antineoplastic action and less toxicity in the treatment of cancer
- 6 With antiviral activity for the treatment of herpes simplex, genital herpes, shingles, and hepatitis B
- 7 Like naturally occurring enkephalins and synthetic opiates that will not be addicting
- 8 To alleviate severe depression and many serious emotional disorders
- 9 To limit or reverse senility and failing memory

Two new general trends are emerging in health care related to pharmacology. First, people are becoming more concerned about the substances, including drugs, they ingest. The astute health care recipient now asks questions, and the person questioned is often a nurse. Second, the nurse is taking on greater responsibility in drug administration and drug therapy.

Drug uses and mechanisms of action

Drugs are typically used for the diagnosis, cure, relief, treatment, or prevention of disease. A drug cannot directly repair diseased tissues or organs, it can only facilitate normal cellular function. All drugs act by inducing one or more of the following mechanisms:

- 1 Stimulation or depression of targeted cell activity
- 2 Replacement of deficient subsystems
- 3 Killing or weakening foreign invading organisms
- 4 Irritation

These mechanisms may produce intended therapeutic responses in the patient, which are called the "intended" or "primary" effect or "therapeutic" effect, or they may affect other areas of the body and give rise to what is called "side" and "toxic" effects. Sometimes these are intended, but most of the time they are not. Side and toxic effects may run the gamut from merely annoying but acceptable side effects to unacceptable effects such as coma or death. Prime responsibility for observing intended and side and toxic drug effects in patients usually rests with nurses.

Nursing scope and responsibilities

Drugs have the power to help or to harm. Nurses, along with physicians and clinical

pharmacists, are held legally responsible for safe and therapeutically effective drug administration. Nurses are liable for their actions and omissions and for those duties they delegate to others. They should know that they are personally responsible, legally, morally, and ethically, for every drug they administer or have administered, no matter who actually prescribed it. Nurses are not exonerated from responsibility when drugs are administered by medication technicians, pharmacy technicians, practical nurses, or even physicians. Indeed, all members of a health team may be held liable for a single injury to a patient. The continued increase in litigation against nurses and physicians indicates that society tolerates only a minimal margin of error in relation to human life. Claims have been brought against health professionals for drug errors that caused loss of life (*Norton v. Argonaut Insurance Co.*, the *Somera* case) and permanent injury (*Honeywell v. Rogers*).^{*} When claims against health professionals are supported with evidence that the conduct of one or more health professionals helped to bring about the loss or injury, those parties are held liable. The law, a legal and social norm, requires health professionals to be safe and competent practitioners and permits compensation to those harmed or injured.

However, the law is a protective force for knowledgeable, competent, and skilled nurses. Nurses who are knowledgeable about the drugs patients are receiving, who use proper technique and precautions, who observe for and chart explicitly the drug effects, who keep up-to-date by referring to authoritative sources (pharmacist, pharmacologist, professional literature), who question a drug order that is unclear or that appears to contain an error, and who even refuse to administer a drug and intervene to prevent others from administering a drug if there is reason to believe harm may come to the patient are safeguarding and protecting patients from drug-induced harm. The law in turn will protect such nurses from unfair litigation.

Drugs deserve the respect of nurses, but that respect must be mingled with skepticism. Much remains to be learned about the actual mode of

^{*}Murchison, I.A., and Nichols, T.S.: *Legal foundations of nursing practice*, New York, 1970, The Macmillan Co.

action as well as effects from prolonged use of many commonly prescribed drugs. Furthermore, there is increasing concern about drug-induced disease. Fortunately, drug therapy for most illnesses or for illness prevention is temporary. However, there are those diseases that require lifelong use of drugs to sustain life (such as insulin for diabetes mellitus) or prolonged use to maintain relatively normal physiologic or psychologic functioning.

Nurses are entrusted with potent and habit-forming drugs, and they must not abuse or misuse this trust. Used respectfully and intelligently, drugs are comforting and lifesaving. Used unwisely or with undue dependence, they can lead to irreparable tragedy. The nurse who combines diligent and intelligent observation with moral integrity and factual knowledge will be a safe and competent practitioner and a credit to the nursing profession.

Pharmacology is a challenging and interesting subject to study. It requires integrating knowledge from many different disciplines including anatomy and physiology, pathology, microbiology, organic chemistry and biochemistry, psychology, and sociology; thus, clinical drug therapy can be considered to be an applied science. The hundreds of drugs available would make the study of pharmacology formidable if they had to be studied as individual agents. Fortunately, drugs can be classified into a reasonable number of drug groups based on their chemical, pharmacologic, or therapeutic relatedness. Understanding the characteristic effects of a particular group of drugs at the sub-cellular, tissue, organ, or functional system level permits a student or practitioner to know a variety of facts about many drugs. An individual drug can then be studied according to those characteristics that differentiate it from other drugs within the same classification.

The doses of drugs and indications for use must not be regarded by the student as therapeutic dogma. New knowledge about drugs will be forthcoming from laboratory research and more scientific methods of clinical drug evaluation.

The constant advances in the field of drug therapy, the almost daily appearance of new drugs or new preparations of old drugs on the

market and in the hospital, are a challenge to both the student and the graduate nurse to be students always. An examination passed and an R.N. acquired are no lasting guarantees of sufficient knowledge in the field of drugs to make a nurse helpful to the physician or even safe for the patient. Drugs change and will continue to change. Pharmacology books should become a permanent section of the nurse's and agency's library, and year by year as new editions or new books appear the library must be brought up-to-date. In addition, the official current literature on drugs must be followed carefully, since new drugs are slow in making their way into more permanent literature. For the nurse working in a hospital or health service, physicians, instructors, inservice educators, and pharmacists will be on hand to help. In a more isolated practice, greater personal effort will be required to keep abreast of current practices. In any case, a sustained interest in pharmacology will help to keep the nurse well informed about drugs.

Of primary importance is the understanding that learning is an active process and that learning does not take place without activity. Thus clinical experience with drugs is invaluable, for it enables the student to:

- 1 Note those drugs most commonly used to treat certain diseases or specific signs and symptoms
- 2 Note the frequency with which certain drugs are administered
- 3 Observe the degree of effectiveness between specific drugs for relieving particular signs and symptoms
- 4 Witness the individual differences in patients' reactions to a specific drug
- 5 Relate knowledge obtained from authoritative sources with real-life situations

Regardless of what subject matter is to be learned, reasoning and the ability to analyze and synthesize information and prerequisites to understanding. These cognitive skills, along with perceptual skills, permit an individual to see meaningful relationships, make comparisons, and determine significance, all of which are essential for sound decision making. The development of cognitive, perceptual, and manual skills is the foundation for professional competence.

The nursing process as related to pharmacology

There are many types of people and roles involved in teaching and planning with and for sick people. But only nurses "take care of" sick people.* True enough, basic human needs are the proper domain of nursing. The *nursing process* is a method for identifying patients' nursing needs and problems and for working toward alleviating them. It is a systematic guide through the maze of data about the patient. It points the way to rational nursing actions and evaluation of them. High-quality nursing care has always been characterized by this approach—only the name is new.

The nursing process has four steps: (1) assessment of data, (2) planning, (3) implementation, and (4) evaluation. In regard to drug therapy, nurses must *assess* the medication needs of the patient and their station to provide optimal therapy and an ample supply of drugs to be used when needed. Much of nurses' daily routines revolve around these varying activities. The *plan of action* includes ordering drugs from the pharmacy and goal-setting concerning a patient's medication administration and monitoring.

The *implementation* of the goals previously set involves the actual nursing care given to the patient and followthrough to make certain drugs are administered appropriately.

The final step, which is perhaps the most important, is the *evaluation* of the effectiveness previous activities to assure that the goals for the patient were met. Each time the evaluation process takes place, nurses' knowledge bases increase and, likewise, their professional value. The nursing process as it relates to pharmacology will be discussed in greater detail in Unit two: The Role of Pharmacology in the Nursing Process.

Goals of this text

The intent of this text is to provide a useful orientation to nursing pharmacology and therapeutics by presenting healthy attitudes and a

*Genrose Alfano, Director of Nursing, Loeb Center for Nursing, Bronx, N.Y.

practical approach to drug therapy in many settings.

The first part of the text gives basic information concerning general principles, theories, and facts about all drugs and how they are given. Practical information is presented on how the nursing process is integrated with pharmacology giving general principles of action to facilitate a student nurse's learning in both the academic and the clinical environments. The rest of the book provides drug information related to specific body systems and clinical indications giving specific nursing implications and considerations relative to each. Thus this book can be used as a text and as a reference in nursing pharmacology.

Summary of nursing considerations

Safe, therapeutically effective drug administration is a major responsibility of the nurses, dependent on sound, current knowledge of medications and careful monitoring of their effects on patients. Ongoing laboratory and clinical research modifies and enlarges available drug information, necessitating continued effort to keep one's knowledge up-to-date. The mode of action of many commonly prescribed drugs, effects of their prolonged use, and the possibility of drug-induced disease are yet to be completely understood. There are many sources of current drug information, but even the most diligent student of these sources requires clinical experience to develop competence in drug administration. Few, if any, areas of nursing demand more intelligence, integrity, and factual knowledge.

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