



BERGERSEN

Pharmacology in nursing

Thirteenth
edition

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Thirteenth edition

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Preface

Drugs can be beneficial when used with wisdom but harmful when used with inadequate knowledge. This edition of *Pharmacology in Nursing* outlines current concepts of pharmacology and their relationship to clinical patient care. Included in the text are basic mechanisms of drug action, indications and contraindications for drug therapy, toxicity and side effects, and safe therapeutic dosage range. This information should provide the nurse practitioner or student with the means for ensuring rational and optimal drug therapy.

In this edition the following changes have been incorporated: (1) major revision of the chapters on drug legislation, respiratory system drugs, skeletal muscle relaxants, fluids and electrolytes, antimicrobial and antineoplastic drugs, endocrine hormones, and ophthalmic drugs; (2) dosage for children for many drugs approved for use in pediatrics; (3) inclusion of D.E.S.I. ratings (drug efficacy study by the Food and Drug Administration); and (4) expanded coverage of information on drug interactions, pharmacologic effects, and nursing care aspects.

Concern for prevention of teratogenic effects and more extensive research on the effects of drugs has led to the inclusion of a new chapter titled "Effects of Drugs on Human Sexuality, Fetal Development, and Nursing Infant." I wish

to thank Eleanor A. Schuster, R.N., D.N.S., Associate Professor of Nursing and Director of the Graduate Program, Department of Nursing, Wichita State University, Wichita, Kansas, for this timely contribution.

I also wish to thank my friend and colleague, Jurate Sakalys, Assistant Professor of Nursing, University of Colorado School of Nursing, for updating the chapter on drug abuse, which she originally wrote, as well as for revising the chapters on antimicrobial and antineoplastic drugs and pharmacodynamics. In addition, I wish to thank Patsy A. Perry, R.N., M.S., Assistant Professor of Medical-Surgical Nursing, University of Colorado School of Nursing, for the much needed revision on respiratory system drugs.

As in the previous edition, each chapter has been critically reviewed by Andres Goth, Professor of Pharmacology and Chairman of the Department, The University of Texas Southwestern Medical School, Dallas, Texas.

I also wish to express my deep gratitude and affection to Elsie Krug, from whom I inherited this textbook, and I extend my appreciation to the many students and educators of nurses who have used this book and contributed to its success.

Betty S. Bergersen



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CHAPTER 1

Orientation to pharmacology

Orientation to pharmacology
Drug information sources

ORIENTATION TO PHARMACOLOGY

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.

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. The nurse is 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 the knowledgeable, competent, and skilled nurse. The nurse who is knowledgeable about the drugs patients are receiving, who uses proper technique and precautions, who observes for and charts explicitly the drug effects, who keeps up to date by referring to authoritative sources (pharmacist, pharmacologist, professional literature), who questions a drug order that is unclear or that appears to contain an error, and who even refuses to administer a drug and intervenes to prevent others from administering a drug if there is reason to believe harm may come to the patient is safeguarding and protecting patients from drug-induced harm. The law in turn will protect the nurse from unfair litigation.

Drugs deserve the respect of the nurse, but

^{*}Murchison, I. A., and Nichols, T. S.: Legal foundations of nursing practice, New York, 1970, The Macmillan Company, pp. 189, 338, and 116.

that respect must be mingled with skepticism. Much remains to be learned about the actual mode of 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 life-long 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 subcellular, 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 doctor or even safe for the patient. Drugs change and will continue to change. Pharmacology books should become a permanent section of the nurse'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, doctors, instructors, supervisors, 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 are 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.

DRUG INFORMATION SOURCES

Nurses will find the following sources of drug information very useful in the study of pharmacology and in the practice of nursing involving drug therapy.

THE UNITED STATES DISPENSATORY

The twenty-seventh edition of the United States Dispensatory was edited by Arthur Osol, Robertson Pratt, and Alfonso R. Gennaro and published by J. B. Lippincott Co. (Philadelphia, 1973).

The Dispensatory is an encyclopedia containing comprehensive monographs on individual drugs and general survey articles on pharmacologic classes of drugs alphabetically arranged. The monographs contain descriptions, histories, actions, uses, and facts on toxicology and dosage for adults and children; they are documented by references to medical literature. Official, generic, trade, and chemical names are given in the monographs. The monographs contain drugs listed in *The Pharmacopeia of the United States of America*, *The National Formulary*, and the *British Pharmaceutical Codex* and drugs not listed in these official compendia. Official, generic (or nonproprietary), and trade (or proprietary) names are included in the general alphabetic index.

AMERICAN HOSPITAL FORMULARY SERVICE

The *American Hospital Formulary Service* is a drug monograph subscription service for the calendar year published by the American Society of Hospital Pharmacists, Washington, D.C. The monograph of each drug is entered under the generic name, giving common synonyms and trade names. Monographs are full and descriptive and emphasize rational therapeutic procedures. Classification is according to the pharmacologic ac-

tions of the individual agents. Each monograph includes a list of the dosage forms most commonly used in hospitals.

MODERN DRUG ENCYCLOPEDIA AND THERAPEUTIC INDEX

The *Modern Drug Encyclopedia*, thirteenth edition edited by Arthur J. Lewis and published by the Dun-Donnelley Corporation (New York, 1975), describes widely used prescription medications. Individual monographs are arranged alphabetically according to generic names. Information for each includes its manufacturer, pharmacologic classification, description, chemical name, trade name, action and uses, method of administration and dosage, cautions and contraindications, and forms and sizes supplied. The general alphabetic index includes both generic and trade names.

A.M.A. DRUG EVALUATIONS

The *A.M.A. Drug Evaluations* contains drug monographs organized according to therapeutic classifications. Each chapter begins with an overall discussion of the therapeutic category followed by brief evaluative monographs of individual drugs. Drugs evaluated include those listed in the official compendia, those that are dispensed exclusively or principally by prescription, those commonly administered, and those judged to be of particular importance to a therapeutic category. Evaluations are based on available and current evidence from scientific literature, unpublished data, and consultants and review committees. The monographs also contain uses, routes of administration, and dosages that may or may not be included in package inserts. Although the drug evaluations are compiled by the A.M.A. Department of Drugs this does not imply endorsement by the American Medical Association. Evaluations may be favorable, unfavorable, or a combination of both.

PHYSICIANS' DESK REFERENCE TO PHARMACEUTICAL SPECIALTIES AND BIOLOGICALS (P.D.R.)

P.D.R., published by Medical Economics, Inc. (Oradell, N.J.), contains an annual listing of drugs arranged in five sections. The pink sec-

tion is a comprehensive alphabetic listing of brand name products and a list of manufacturers with their products. The blue section is a therapeutic index. The yellow section is a drug, chemical, and pharmacologic index to drugs. The white section is a list of the major products of manufacturers, with information on composition, action, uses, administration, dosage, precautions, contraindications, and supply of each drug. A product identification section shows full-size color photographs of more than 1000 capsules and tablets.

UNLISTED DRUGS

Unlisted Drugs, published by Special Libraries Association (New York), lists new drugs found in literature or advertising when no entries are located for them in *Modern Drug Encyclopedia* or other standard sources. Entries are made for experimental compounds under their research numbers as well as for marketed products. Each entry includes a brief statement of composition, manufacturer, action, dosage, and source of information. This is a monthly publication with a cumulative index for volumes.

COMPENDIUM OF PHARMACEUTICALS AND SPECIALTIES (CANADA)

Compendium of Pharmaceuticals and Specialties (Canada), edited by G. N. Rotenberg and published by Canadian Pharmaceutical Association (Toronto), contains information on the most frequently used drugs available to Canadian pharmacists. The book contains monographs (entered under trade names) that provide descriptions, manufacturers' information, indication, instructions for administration, and dosage, as well as forms and sizes in which drugs are available. A product recognition section is included as an aid for quick visual identification of drug dosage forms. A list of manufacturers

with their products and a therapeutic index are included as well as a cross-reference index for nonproprietary names and chemical names of drugs. Drug schedules of the Food and Drugs Act and regulations issued by the Health Protection Branch, Ottawa, and the location of poison control centers in Canada are also included. This publication consists of three semiannual supplements, which are cumulative.

PACKAGE BROCHURES

Before marketing a new drug product, the manufacturer develops a concise description of the product, indications and precautions in clinical use, guidance for dosage, known adverse actions, and other pertinent pharmacologic information. Federal law requires that a brochure accompany each package of the product, and because this is construed as labeling, the brochure must be approved by the Food and Drug Administration.

THE MEDICAL LETTER

The Medical Letter, a semimonthly periodical published by Drug and Therapeutic Information, Inc. (New York), contains independent brief comments on newly released drug products and related topics by a board of competent authorities who call freely upon specialists in various fields. The letters contain data on drug action and comparative clinical efficacy. They have the advantage of presenting a timely and critical summation of current status in the early phase of promotion of a drug. However, these drug appraisals are tentative.

CLINICAL PHARMACOLOGY AND THERAPEUTICS

Clinical Pharmacology and Therapeutics, a bi-monthly periodical published by The C. V. Mosby Co. (St. Louis), contains reports of stud-

ies of new drugs, reviews of present knowledge of classes of drugs or advances in therapy of various disorders, and abstracts of reports of adverse reactions to drugs appearing in the world literature. It also contains a section on drug-induced diseases.

DRUGS OF CHOICE 1976-1977

Drugs of Choice 1976-1977, edited by Walter Modell and published by The C. V. Mosby Co. (St. Louis, 1976), is revised every 2 years and contains contributions from outstanding specialists who express their opinions of the drugs in current use in their own fields of specialization. The book is designed to provide clear, concise, and practical answers to questions of drugs of choice for actual therapeutic problems. An alphabetically arranged index of drugs in common use is also included.

JOURNALS

Other important sources of drug information are the various nursing, pharmacy, medical, and allied health journals. In addition to the *American Journal of Nursing*, *Nursing '76*, *Nursing Digest*, and *RN* the following prominent periodicals are usually available in medical and health reference libraries:

Pharmacy journals

Journal of the American Pharmaceutical Association
American Journal of Hospital Pharmacy
American Druggist
Pharmacy Times
Drug Topics

Medical journals

Journal of the American Medical Association
New England Journal of Medicine
Postgraduate Medicine
British Medical Journal

CHAPTER 2

History of materia medica

Ancient period

Medieval period

Sixteenth century

Seventeenth century

Eighteenth century

Nineteenth century

Twentieth century

The story of materia medica is as old as the story of man, for sickness has been man's heritage from the beginning of time and the search for ways and means to combat disease has been one of his earliest and most persistent activities. Early man's first experiments in dealing with disease were suggested by the belief common to all primitive people that the world in which they lived teemed with invisible spirits, some of whom were good and some bad. Whatever puzzled man in nature was attributed to these supernatural agencies, and it followed that disease was at first thought to be an evil spirit or the work of such a spirit. If this supposition were true, the logical treatment was to placate the invader by burnt offerings or to frighten it away by resorting to hideous noises or by administering foul-tasting substances. These measures were designed to make the body an uncomfortable habitat for the spirit. The search for obnoxious materials led man to experiment with herbs of the field and the forest, and as the knowledge gained from experience increased, the rudiments of materia medica were assembled. These intuitive efforts of man led to some valuable discoveries. Primitive peoples in separate countries knew the properties of the most fatal arrow poisons, such as curare, veratrine, and ouabain, as

well as the virtues of drugs like opium. Centuries ago the Indians of Peru discovered the value of cinchona bark for the treatment and prevention of malaria, and the natives of Brazil knew the worth of ipecac for amebic dysentery. The victims of leprosy in the Far East believed that they received relief by rubbing their wounds with chaulmoogra oil, and for some time chaulmoogra oil was used in the treatment of this disease. The Indians of America used arbutus for rheumatism; lobelia for coughs and colds; wild sage tea, goldenseal, and flowering dogwood for fevers; elders, wild cherry, and sumac for colds and quinsies; inhalations of pennyroyal for headache; sassafras leaves for wounds and felons; and the roots of sassafras for cooling and purifying the blood.

As medical lore accumulated, there appeared individuals who demonstrated a special talent for herb-doctoring, bone-setting, and crude surgery and who employed it as a means of earning a livelihood. They were either the wisewomen who sought by their art to lessen the hardships and dangers of childbirth or certain men of superior intelligence and cunning who, appreciating the credulity of the rank and file, made use of incantations and charms in their therapeutics and established themselves in the community in the

role of priest and physician. These nature healers soon perceived not only what substances were good and what were harmful but that a number of poisons were also remedies under certain conditions. This drug and poison lore was the beginning of *materia medica* and medicine.

ANCIENT PERIOD

EGYPT

The oldest phase of medicine is the Egyptian. The main sources of data are the medical papyri, the most important of which is the Ebers papyrus, written in the sixteenth century B.C. It is a scroll 22 yards long and about 12 inches wide that contains a collection of prescriptions and formulas covering a wide range of uses. Included among them are many invocations and conjuring forms for driving away disease, as well as specific recipes, calling in many instances for drugs that are in common use today, for example, aloes, castor oil, figs, vinegar, turpentine, opium, wormwood, peppermint, and squill.

As the inclusion of invocations and charms in the prescriptions would imply, medicine was closely allied with religion, as it was to remain for many centuries. The doctors were all priests paid out of the royal treasury, but they were allowed to take fees also.

GREECE

The pharmaceutical history of Greece begins with legends regarding gods and goddesses. The reputed activities of these mythical characters are so inextricably woven with the authentic doings of real men and women that it is often hard to determine where legend ends and history begins. The story goes, however, that Chiron, the centaur, originated the pharmaceutical art and imparted his valuable knowledge to Asclepius, son of Apollo. Asclepius, with the aid of his daughters Hygeia and Panacea, in turn taught mortals the art of healing, but he became so successful in combating disease that he incurred the wrath of the god of the underworld, because he was diminishing too greatly the number of shades received in Hades. Zeus destroyed Asclepius with a thunderbolt, but upon the intercession of Apollo, Zeus deified him as

the god of healing. His mortal followers in time made up the organized guild of physicians called Asclepiades. They built temples in his honor in which they practiced their art and increased their knowledge of healing. These temples were situated in hills or mountains, usually near mineral springs, and were managed by trained priests. Hence they were virtually sanatoriums or hospitals for the sick. The patient was received by the physician priests and, after spiritual purification by prayers and sacrifice, was further cleansed by a bath from the mineral springs, catharsis, massage, and inunction and encouraged with medicated wines and soft music to sleep and to dream. The priest then interpreted the dream as a message from Morpheus and offered medical advice accordingly. If the treatment was a success and the patient recovered, a votive tablet giving the history of the case and the treatment was hung in the temple where anyone who wished might consult it. In this way, a considerable body of empirical knowledge was assembled and these Temples of Health took on some of the characteristics of a medical school. The most celebrated ones were at Cnidus and Cos.

The most famous representative of the Asclepiades was Hippocrates, who was born in the Island of Cos, 460 B.C., of a long line of priest physicians and who was reputed by popular tradition to be the seventeenth in direct descent from Asclepius. Hippocrates pursued his early studies at Cos and Cnidus but later came under the influence of the great thinkers and philosophers of the period and soon began to apply their scientific and ethical ideas to medicine. He denounced the belief in the supernatural origin of disease and the use of charms, incantations, and other superstitious devices of priestcraft. He substituted the doctrine that disease resulted from natural causes and that knowledge of it would be gained only through the study of the natural laws. He taught the use of the senses in collecting data for diagnosis and the use of inductive reasoning in arriving at diagnostic conclusions.

His therapeutic measures were decidedly modern. He believed that the body has great power to recuperate and that the role of the phy-