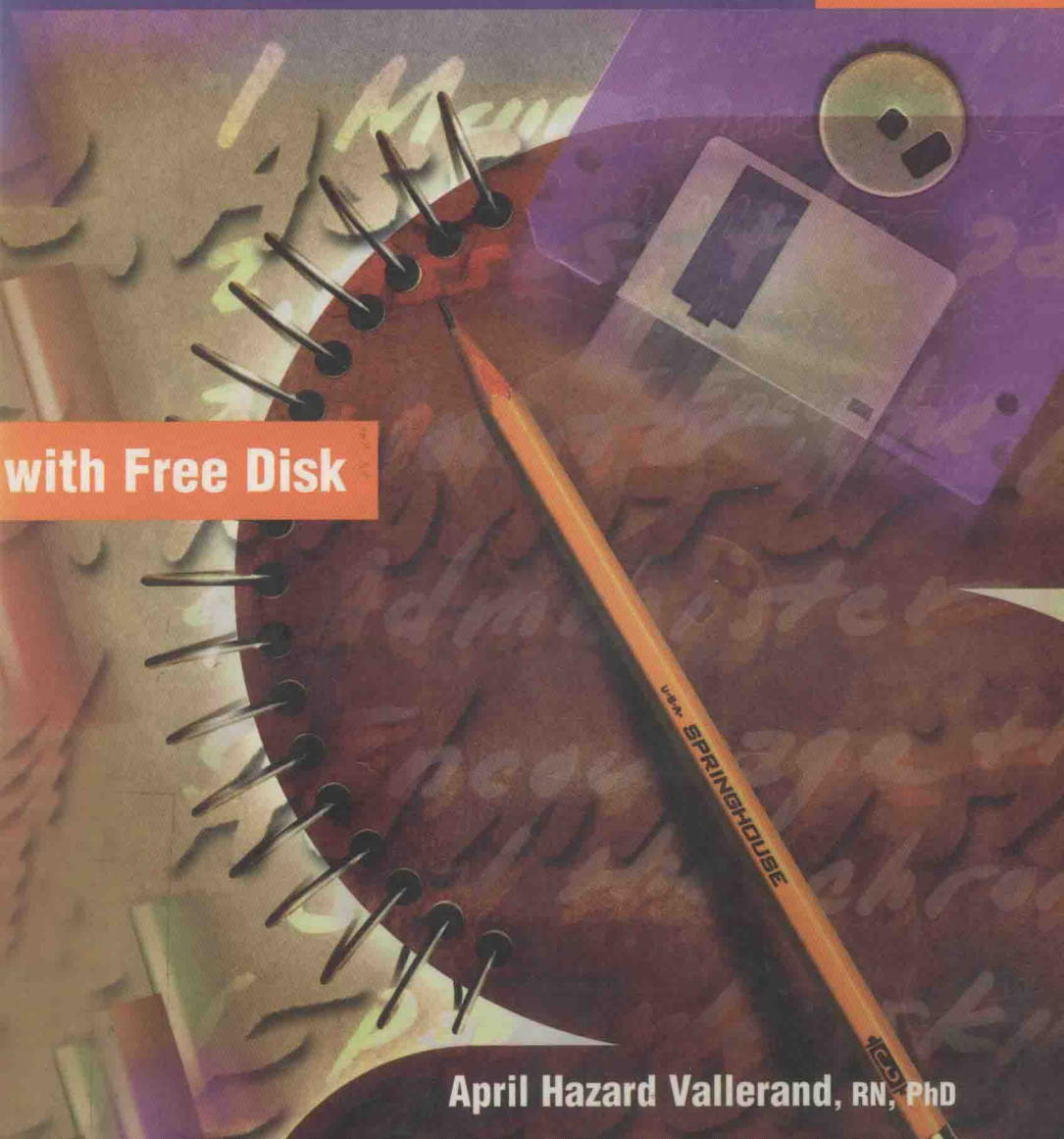
SPRINGHOUSE NOTES

The A+ Review Series

Nursing Pharmacology

Third Edition



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Nursing Pharmacology

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How to Use Springhouse Notes

Springhouse Notes is a multi-volume study guide series developed especially for nursing students. Each volume provides essential course material in an outline format, enabling the student to review information efficiently.

Special features appear in every chapter to make information accessible and easy to remember. **Learning objectives** encourage the student to evaluate knowledge before and after study. **Chapter overview** highlights the chapter's major concepts. Within the outlined text, key points appear in color to facilitate a quick review of critical information. Key points may include cardinal signs and symptoms, current theories, important steps in a nursing procedure, critical assessment findings, crucial nursing interventions, or successful therapies and treatments. **Points to remember** summarize each chapter's major themes. **Study questions** then offer another opportunity to review material and assess knowledge gained before moving on to new information. **Critical thinking and application exercises** conclude each chapter, challenging students to expand on knowledge gained.

Other features appear throughout the book to facilitate learning: **Teaching tips** highlight key areas to address with patient teaching. **Clinical alerts** point out essential information on how to provide safe, effective care. **Decision trees** promote critical thinking. Difficult, frequently used, or sometimes misunderstood terms are indicated by SMALL CAPITAL LETTERS in the outline and defined in the glossary, Appendix A; answers to the study questions appear in Appendix B. Finally, a brand-new Windows-based software program (see diskette on inside back cover) poses 100 multiple-choice questions in random or sequential order to assess your knowledge.

The Springhouse Notes volumes are designed as learning tools, not as primary information sources. When read conscientiously as a supplement to class attendance and textbook reading, Springhouse Notes can enhance understanding and help improve test scores and final grades.

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CHAPTER

1

Fundamentals of Nursing Pharmacology

Learning objectives

After studying this chapter, you should be able to:

- Describe drug considerations in children, the elderly, and pregnant women.
- Discuss use of the nursing process with patients and families when administering medications.
- Describe how federal drug legislation has contributed to the safety of medications in the United States.
- Identify the pharmacokinetic and pharmacodynamic phases of drug action.
- Describe techniques for administering intramuscular, subcutaneous, and intradermal medications.
- Identify those patients at risk for drug toxicities.

Chapter overview

Safe administration of medications is complex: the nurse must understand the pharmacologic effects of drugs and be aware of the patient's current diagnoses, past medical history, laboratory studies, and patient teaching needs. This chapter begins by exploring two major concepts in pharmacology: pharmacokinetics — the movement of drugs into systemic circulation —

and pharmacodynamics — the mechanism by which drugs produce chemical and physiologic changes in the body. The chapter also provides guidelines for using the nursing process as a framework for administering medications, teaching patients and families, and evaluating pharmacologic effects. The nurse must also understand key drug concepts: therapeutic effects, adverse reactions, drug interactions, and toxic effects. Finally, the nurse needs to be aware of federal legislation and regulations governing the manufacture and sale of drugs and laws governing administration of controlled substances.

♦ I. Pharmacokinetics of drug action

A. General information
   1. PHARMACOKINETICS refers to the movement of drugs across body membranes to reach the target organ
   2. It involves four components: absorption, distribution, metabolism, and excretion
   3. Pharmacokinetics of a drug influences the determination of proper dosing schedules

B. Absorption
   1. This term refers to movement of a drug from its administration site through or across tissue into the systemic circulation
   2. The degree and rate of absorption depend on the administration route, the patient's age and physical condition and potential interactions with other drugs or food
   3. The degree and rate of absorption also depend on the drug's mechanism of absorption, such as passive transport (including diffusion, convective absorption, and carrier-mediated diffusion), active transport, or pinocytosis

C. Distribution
   1. This term refers to movement of a drug from the systemic circulation into the tissues
   2. Distribution may be affected by the BLOOD-BRAIN BARRIER, cardiac output, blood supply to target tissues, the degree of vessel constriction or dilation, and the degree to which the drug binds to plasma proteins such as albumin

D. Metabolism
   1. This term refers to the alteration of a drug to a more active or less active form, usually in the liver
   2. Metabolism may be affected by genetic factors, the patient's age and physical condition, and the drug itself (for example, the suitability of the metabolites for drug activity or the drug's lipid solubility)

E. Excretion
   1. This term refers to elimination of a drug from the circulation
   2. A drug may be excreted in various ways
      a. Most drugs are excreted by the kidney into the urine; into the bile, then the feces; by the lungs into exhaled air; or into breast milk
      b. Minor excretion routes include saliva, tears, and sweat

F. Dosing schedules
   1. Dosing schedules are determined by the drug's pharmacokinetic properties
   2. The following factors are considered when establishing dosing schedules
      a. *Onset of action:* the time when a drug's effects first become noticeable
      b. *Peak concentration level:* the maximum blood concentration level achieved through absorption: at this level most of the drug reaches the site of action and provides the therapeutic response
      c. *Duration of action:* length of time a drug acts on the body
      d. *Half-life:* the time required for a drug's plasma concentration to decrease by 50%

♦ II. Pharmacodynamics

A. Definition: mechanisms by which specific drugs produce biochemical and physiologic changes in the body

B. Pharmacodynamic events
   1. A given drug interacts with specific receptor sites
   2. It causes a general interaction with cell metabolism
   3. The cellular environment and function are altered to produce the desired response

C. Therapeutic effect
   1. Therapeutic effect refers to a drug's ability to produce a desired effect
   2. Factors affecting response to a drug include body size, weight, sex, route, medical condition, and psychological factors
   3. A loading dose refers to administration of one or more doses at the onset of therapy to quickly reach the therapeutic blood level and thereby hasten a therapeutic effect; commonly, the loading dose is larger than the maintenance dose
   4. Drug efficacy refers to a drug's maximal effectiveness
   5. Measures of drug efficacy include vital signs, body weight, and easing of symptoms that the drug is expected to relieve; the nurse can document efficacy using these parameters

6. Therapeutic drug levels may be monitored to individualize drug dosage, to evaluate toxicity, and to monitor compliance

♦ III. Adverse reactions

A. General information
1. This term refers to unwanted or potentially harmful effects of a drug
2. Adverse reactions range from mild responses that disappear upon discontinuing the drug to debilitating, potentially chronic or life-threatening problems
   a. Adverse reactions may be dosage-related; careful prescription and administration may prevent such reactions
   b. Some adverse reactions are inseparable from the drug's intended effect
   c. Adverse reactions may be related to patient sensitivity; such reactions may be unpredictable

B. Classifications of adverse reactions
1. Dose-related reactions may be reactions to the drug's primary effect such as bleeding from anticoagulants or a secondary effect such as drowsiness after taking antihistamines
2. Sensitivity-related reactions occur when a patient is hypersensitive or allergic to a drug or one of its components
   a. In hypersensitivity or allergic reactions, a sensitized patient is exposed to a drug that elicits an antigen-antibody reaction
   b. Reactions may be immediate, resulting in anaphylaxis or urticaria or delayed, as in serum sickness
3. Toxicity occurs when drug levels exceed the therapeutic range and may cause additional adverse effects
   a. Toxicity may develop due to overdosage caused by failure to consider hepatic impairment, renal function, or the patient's age; toxicity may also result from patient's or family member's failure to understand therapy
   b. Dosage modification may be necessary if toxic effects occur
   c. For many drugs, established therapeutic blood levels help to monitor for therapeutic effect and prevent toxicity
4. IDIOSYNCRASY refers to an unexpected or peculiar response to a drug; for example, diphenhydramine (Benadryl) may cause hyperexcitability in children
5. Other adverse reactions also may occur
   a. A patient may develop blood dyscrasias, nephrotoxicity, or hepatic toxicity
   b. Carcinogenicity, teratogenicity, photosensitivity and disease related effects should also be considered

♦ IV. Interactions

A. General information
1. Interactions cause the therapeutic effect of a drug to be modified
2. A drug's therapeutic effect may be altered by other drugs, food, or the environment; for example, taking monoamine oxidase inhibitors with tyramine-containing foods such as aged cheese or beer may lead to hypertensive crisis
3. Contraindications warn against drug use in patients with specific conditions, patients in a specific age-group, or patients who are taking another, potentially incompatible drug.
4. Categories of interactions include incompatibilities, pharmacokinetic interactions, and pharmacodynamic interactions

B. Incompatibilities
1. Incompatibilities are chemical or physical reactions between two or more drugs
2. An incompatibility may have a therapeutic benefit (a drug antagonist)
3. Incompatibilities may occur when preparing I.V. admixtures, administering medications in I.V. bolus or piggyback, or mixing medications in a syringe

C. Pharmacokinetic interactions
1. Absorption may be affected by changes in stomach pH
2. Many drugs bound to plasma protein may compete for binding sites; as drugs displace one another from binding sites, more of the displaced drug circulates and toxicity may occur
3. Administration of drugs may be coordinated to enhance or inhibit excretion; for example, probenecid may be administered with penicillin to delay renal excretion and prolong the antibiotic's effect

D. Pharmacodynamic interactions
1. In an additive effect, combining two or more drugs causes an effect equal to the sum of their separate effects; for example, aspirin and codeine may be combined to relieve pain
2. In synergism, combining two or more drugs causes an effect greater than the sum of their separate effects
3. A type of synergism, potentiation occurs when one of two or more drugs are combined and one of the drugs exerts an action greater than if it was given alone
4. In an antagonistic effect, combining two or more drugs produces an effect less than the sum of their separate effects (a drug antidote works by an antagonistic effect)

♦ V. Drug legislation in the United States

A. Federal Food, Drug, and Cosmetic Act (FFDCA) of 1906
   1. This law empowered the federal government to enforce standards set by the UNITED STATES PHARMACOPEIA and the NATIONAL FORMULARY
   2. It required that drugs meet standards of strength and purity
   3. It also required that the type and amount of narcotic be listed on the label of opiate mixtures
   4. In 1912, the Sherley Amendment to the FFDCA increased federal involvement in drug control by prohibiting drug companies from using fraudulent therapeutic claims

B. Harrison narcotic act of 1914
   1. This act legally defines the term narcotic and regulates manufacture, import, sale, and use of cocaine and opiates
   2. Revisions to the Harrison narcotic act regulate use of marijuana and synthetic opiates

C. Food, Drug, and Cosmetic Act of 1938
   1. This act requires drugs and drug products be tested for harmful effects
   2. It requires that drug labels and literature be complete and accurate, stating the dose, manufacturer's name and address, names and amounts of potentially harmful ingredients, a warning if the drug might be habit-forming, directions for use, and contraindications
   3. The act also states that medical devices must be safe and effective and that cosmetics must be safe

D. Durham-Humphrey Amendment of 1952
   1. This amendment distinguishes between prescription and over-the-counter medications
   2. It states that a prescription for narcotics, hypnotics, habit-forming drugs, and potentially harmful drugs can be refilled only with a new prescription, and requires that the label state this fact

E. Kefauver-Harris Amendment of 1962
   1. This amendment gives the Food and Drug Administration (FDA) additional control over drug safety
   2. It allows the FDA to evaluate the testing methods of drug manufacturers
   3. It requires manufacturers to prove that a drug is effective, not just nontoxic

F. Controlled Substances Act or Comprehensive Drug Abuse Prevention Act of 1970
   1. This act groups controlled substances (such as narcotics, tranquilizers, barbiturates, and amphetamines) into five categories (schedules) based on a drug's potential for abuse and medical effectiveness
   2. It limits the number of prescription refills for controlled substances (for examples of representative controlled drugs, see Appendix C, pages 284 and 285)

G. Drug regulation reform of 1978 seeks to speed the release of drugs to the public by expediting FDA investigation

H. Orphan Drug Act of 1983 provides incentives to drug manufacturers to produce drugs for less common disorders

I. Drug price competition and patent time restoration act of 1984
   1. This act makes it possible for generic versions of bioequivalent equals to be marketed without duplicating clinical trials
   2. It also grants longer patent protection to companies introducing new drugs

♦ VI. Controlled substances

A. General Information
   1. Controlled substances are groups of drugs that have potential for abuse or physical and psychological dependence
   2. Proper handling of controlled substances is essential; violations may result in suspension of your nursing license

B. Schedule I
   1. Schedule I drugs carry the highest risk for abuse.
   2. These drugs are not acceptable for prescription use; they may be available for investigational use
   3. This schedule includes cannabinols such as marijuana and hallucinogens such as LSD, heroin, and mescaline

C. Schedule II
   1. Schedule II drugs carry high potential for abuse and may lead to physical and psychological dependence.
   2. This group includes certain barbiturates, narcotics, and stimulants.
   3. Prescriptions may not be refilled

D. Schedule III
   1. Schedule III drugs carry a lesser abuse potential than schedules I and II
   2. This group includes barbiturates such as butabarbital, narcotics in combination with other drugs, stimulants, androgens, anabolic steroids, and paregoric

E. Schedule IV
   1. Schedule IV drugs carry a low abuse potential, with psychological dependence more common than physical dependence
   2. This group includes benzodiazepines, propoxyphene (Darvon), and chlordiazepoxide (Librium)

F. Schedule V
   1. Schedule V drugs carry the least abuse potential
   2. Most drugs in this class have a small amount of narcotic combined with an antitussive or antidiarrheal

◆ VII. Nursing process in medication administration

A. Assessment
   1. Determine whether the patient has any food or drug allergies
   2. Find out which prescription and nonprescription medications the patient currently takes, the frequency, the purpose of each medication for this patient, and whether adverse effects have occurred
   3. Obtain a nursing history
   4. Perform a physical examination; pay particular attention to body systems that may be affected by current or newly prescribed medications

B. Nursing diagnosis
   1. Develop a nursing diagnosis consisting of a problem and its etiology
   2. Begin by addressing problems that pose immediate threats to the patient's health
   3. Common nursing diagnoses include:
      a. Knowledge deficit
      b. Risk for injury
      c. Ineffective management of therapeutic regimen
      d. Noncompliance

C. Planning
   1. Develop outcomes using the nursing diagnosis; if possible, obtain input from the patient and family
   2. Use these goals as outcome criteria for evaluation

D. Implementation
   1. Follow the five rights of drug administration at all times
      a. Verify the medication order for the right drug
         (1) Ensure that the medication order is properly composed and includes the patient's full name, drug name, dosage form, dose amount, administration route, time schedule, prescriber's signature, and date and time of order
         (2) Check the medication order against the drug label three times

(3) Be aware of the reason why the patient is receiving this specific drug at this time

b. Check the order and medication supplied to ensure the right route

(1) Drugs can be administered orally (by mouth or through a gastric tube), parenterally (by intradermal, subcutaneous, intramuscular, or intravenous injection), topically, otically, ophthalmically, and via the mucous membranes (by sublingual, buccal, vaginal, or rectal route or inhaled)

(2) Be aware of the routes available for the specified drug

c. Perform dosage calculation to ensure the right dose

(1) Use a ratio and proportion to arrive at the ordered dose

(2) For example: A nurse must administer Demerol 75 mg I.M. taken from a 1-cc vial containing 100 mg of Demerol; the ratio reads 75 mg is to X cc as 100 mg is to 1 cc; the equation reads as follows:

$$\frac{75 \text{ mg}}{\text{X cc}} :: \frac{100 \text{ mg}}{1 \text{ cc}}$$

Solve for X:

$$\text{X} = \frac{75}{100} \text{ or } \text{X} = 0.75 \text{ cc}$$

(3) Alternately, the nurse may use the desired/on hand × cc's method (for example, 75/100 × 1 cc = 0.75 cc)

d. Verify the frequency of dosage with the medication order to ensure the right time

e. Confirm the patient's identity by checking the patient's armband

2. Administer medication as prescribed, according to the manufacturer's instructions
3. Monitor the patient for therapeutic effects; regularly evaluate the SERUM DRUG LEVEL and results of relevant laboratory tests
4. Evaluate the patient for adverse reactions; notify the doctor if adverse reactions occur and intervene as necessary
5. Provide patient teaching essential to proper medication administration; include family members in patient teaching (for specific teaching tips, see *Patient teaching and medication therapy,* page 10)
6. Consider legal aspects associated with drug therapy

CLINICAL ALERT

a. Make sure that there is a complete medication order

b. Question any order when handwriting is difficult to read, the drug's use in the patient's condition is questionable, dosages are unclear, or if drug incompatibilities or interactions may occur

7. Consider ethical principles when dealing with medication errors, fetuses, and investigational protocols

TEACHING TIPS

Patient teaching and medication therapy

Be sure to include the following topics in your teaching plan for the patient receiving medication therapy.

- Name of medication
- Purpose of medication
- How and when to take medication; what to do about missed doses
- How to monitor medication's effectiveness (for example, monitoring blood glucose when taking a hypoglycemic agent)
- Drugs that may interact with the prescribed medication
- Any required dietary changes, including use of alcohol
- Possible adverse effects and what to do if these occur
- Signs and symptoms to bring to the doctor's attention
- Required follow-up procedures

E. Evaluation
   1. Appropriate evaluation statements include:
      a. The patient obtains expected effects of the prescribed medication
      b. The patient avoids adverse effects or interactions with other drugs, foods, or alcohol
      c. The patient demonstrates an understanding of information taught
      d. The patient complies with the therapeutic regimen (if the patient does not comply, determine reasons for noncompliance)
      e. Therapeutic drug levels are maintained
   2. Based on patient evaluation, modify outcomes and interventions, as needed

♦ VIII. Special populations

A. Pediatric considerations
   1. Usually, pediatric dosing is based on milligram of drug per kilogram of body weight or body surface area expressed as milligrams per square meter
   2. Neonates have larger percentage of total body water, decreased protein levels, and less fat, which may result in reduced plasma levels of water soluble drugs and less storage
   3. Immaturity of the liver and kidneys in the pediatric population may delay metabolism and excretion

CLINICAL ALERT

B. Geriatric considerations
   1. Elderly patients absorb, distribute, and eliminate drugs less efficiently
   2. Multiple disorders, such as cardiac disease, renal disease, hepatic disturbances, or diabetes, may alter drug action and excretion