

PCTX 201  
Introduction to Pharmacology

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CHAPTER 1  
ORIENTATION TO PHARMACOLOGY

**Objectives:**

1. Definition of the four basic terms (*drug, pharmacology, clinical pharmacology, and therapeutics*) for the study of pharmacology.
2. Properties of an ideal drug.
3. Therapeutic objective of drug therapy.
4. Factors that determine how an individual will respond to a specific drug and dosage

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■ Four Basic Terms:

1. Drug: any chemical that can affect living processes
2. Pharmacology: the study of drugs and their interactions with living systems
  - Physical and chemical properties
  - Biochemical and physiological effects
  - Knowledge of the history, source, and use of drugs
  - Absorption, distribution, metabolism and excretion
3. Clinical Pharmacology: study of drugs in humans
4. Therapeutics: use of drugs to diagnose, prevent and treat illness (and/or pregnancy)= medical use of drugs

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**Definitions**

- Define **Living**
  - Respiration - energy formation
  - Metabolism- anabolism and catabolism
  - Reproduction- DNA replication and cell division
- **Cell types**
  - Eukaryotic cells:
    - A unicellular organism having a true nucleus and nuclear membrane
    - Contain ribosomes (80S), nucleus, mitochondria, ER, Golgi-bodies
  - Prokaryotic cells:
    - A unicellular organism lacking a true nucleus and nuclear membrane, have a single loop of double stranded DNA
    - Contain ribosomes (70S), NO mitochondria, nucleus, ER, Golgi-bodies
- **Viruses**
  - Contain NA (DNA or RNA not both), capsid, and no other organelles

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**Definition of Disease**

- Disease occurs when:
  - Enough cells become dysfunctional
  - Enough cells die and organ loses function
- Diseases can be due to:
  - Autoimmune
  - Prokaryotic: bacteria (cause disease 1° by toxin release, not by direct invasion into cells and killing of cells)
  - Viruses: cause disease 1° by lysis of infected cells
  - Chemicals- environment, pollution
  - Drugs- medicinal or otherwise

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**Properties of Ideal Drug**

- Effectiveness:
  - A drug that elicits the response it was meant to. It is the most important property. No effect=no justification of use (FDA approved with appropriate experiments).
- Safety:
  - *Pharmakon*= poison in Greek
  - Safe even at high concentrations and for long periods of administration (no such thing as a safe drug)
    - Reduced by proper administration (iv, ip, im, sc, etc...)
    - No habit forming aspects
    - No side effects

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Properties of Ideal Drug

- **Selectivity:**
  - One that elicits only the response for which it is given
  - Selective for specific reaction with no side effects (there is no such thing)
    - Drowsiness can be caused by antihistamines
    - Morning sickness, cramps, and depression can be caused by oral contraceptives
    - Constipation, urinary hesitance, and respiratory depression can be caused by morphine

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Additional Properties of Ideal Drug (*no drug is ideal!*)

- **1. Reversible action**
  - Effects be reversible, i.e., removal/subside w/i specific time (1/2 life is short but potent during that time)
  - Example: General Anesthetic; Contraceptives
- **2. Predictability**
  - Know how patient will respond
- **3. Ease of Administration**
  - Number of doses should be low and easy to administer
  - 1. increase compliance & 2. decrease errors
    - Diabetic patient: Multiple daily injection of insulin
    - Intravenous infusion

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Additional Properties of Ideal Drug (Continued)

- **4. Freedom from drug interactions**
  - Should not augment or decrease action of other drugs or have adverse combined effects
    - Respiratory depression caused by diazepam (valium), which is normally minimal, can greatly be intensified by alcohol.
    - Antibacterial effects of Tetracycline can be greatly reduced by taking iron or calcium supplements
- **5. Low Cost**
  - Easy to afford (especially with chronic illness)
    - Growth hormone (somatrem) costs between \$10,000 and \$20,000
    - Lifelong medication: hypertension, arthritis, diabetes

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Additional Properties of Ideal Drug  
(Continued)

- **6. Chemical Stability**
  - No lose of effectiveness with storage
- **7. Possession of a simple generic name**
  - Easy to remember and pronounce
    - Example: Viagra (sildenafil); Tylenol (acetaminophen)

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Because No Drug is Ideal.....

- **Because no drug is ideal.....**
  - No medications are not ideal
  - No drug is safe
  - All drugs produce side effects
  - Drug responses may be difficult to predict
  - Drugs may be expensive
  - Drugs may be hard to administer
- **All members of health care team must exercise care to promote therapeutic effects and minimize drug induced harm**

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Therapeutic Objective

***To provide maximum benefit  
with minimum harm***

Factors that determine Intensity of Response

- Administration- dosage size and route
- Pharmacokinetic processes
- Pharmacodynamics
- Individual Variations

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## Therapeutic Objective

### 1. Administration- dosage size and route

- Because of errors in administration routes and dosage and at wrong time there are many discrepancies in what patient gets and could cause more harm than good
- Errors could be made by pharmacists, physicians, or nurses
- Should give patients complete instruction about their medication and how to take it

### 2. Pharmacokinetic processes

- Determines how much of an administered dose gets to its sites of action
  - 1) drug absorption
  - 2) drug distribution
  - 3) drug metabolism
  - 4) drug excretion

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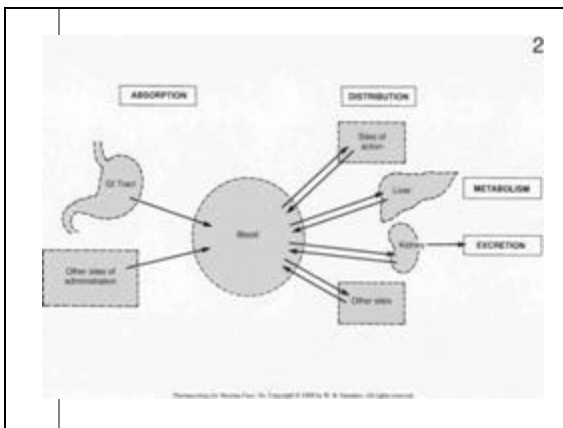
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## Therapeutic Objective (continued)

### 3. Pharmacodynamics

- Once a drug has reached its site of action, pharmacodynamic processes determine the type of response and intensity
- Drug must first bind to its specific target site at (**RECEPTOR**) that may be a chemical, a protein on a cell or in blood or tissue spaces, or on a bacteria or virus (i.e., heparin, antibody, leukotriene receptor (new), penicillin, etc...)
  - Followed by a sequence of events that result in response (inhibition of clotting, inhibition of peptidoglycan synthesis, inhibition of inflammation, blocking of virus, etc...).
  - Functional state of the patient is also important - Tolerance to morphine will cause less of a response & placebo effects may help determine response

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## Therapeutic Objective (continued)

### 4. Sources of individual variation

- Each patient is unique in ability to respond and to how they each respond, but formation of "IDEAL DRUG" will lessen this variation
  - Age- very important factor
  - Sex- due to hormonal differences
  - Weight - less effective and longer lasting in obese individuals (storage in fat)
  - Kidney & liver functions - elimination of drug
  - Genetic variables - tolerance, allergy (though not always genetic)

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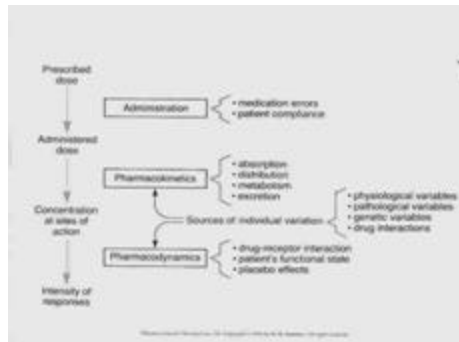
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## Factors that determine the intensity of drug response



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## Summary

- To promote desired effects and minimize adverse effects, we need to understand
  - Pharmacokinetics
  - Pharmacodynamics
  - In addition
    - Sources of individual variation in drug response

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**Key Points**

- The most important properties of an ideal drug are: effectiveness, safety, and selectivity.
- If the drug is not effective, it should not be used.
- There is no such drug as safe drug: all drugs can cause harm.
- There is no such thing as selective drug: all drugs can cause side effects.
- The objective of drug therapy is to provide maximum benefit within minimum harm.
- Because all patients are unique, drug therapy must be tailored to each individual.

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Chapter 2  
**Application of Pharmacology  
in Nursing Practice**

**Objectives**

- **Nurse's responsibility regarding the administration of prescribed medications.**
- **nurse's role as a patient advocate.**
- **Seven aspects that nurses should consider to best meet patient needs regarding medication administration.**
- **Nurse's role as patient educator to provide maximum benefit with least harm.**

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**Nursing Responsibilities Regarding Drugs**

- **Nurse's "Five Rights of Drug Administration"**
  - Use the RIGHT drug
  - Give to the RIGHT patient
  - Give the RIGHT dose
  - Give by the RIGHT route
  - Give at the RIGHT time
- **Must also be ready to respond to interaction between drug and patient (i.e., must be aware of drug REACTIONS and SIDE EFFECTS)**

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Nurse must have knowledge of...

- Patient history and drug usage
- What medications are appropriate and be aware of drug interactions ( cooperation between doctor, pharmacist and nurse a must)
- Drug actions and look for abnormal effects
- How to be a patient advocate- check for mistakes on part of doctor or pharmacist!!
  - Do NOT blindly follow Dr's orders-- THINK and respond to errors [ do not be intimidated]

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**Application of Pharmacology in Patient Care**

- Two major areas where you can apply your knowledge of pharmacology: patient care and patient education:
  1. Pre-administration Assessment
  2. Dosage and Administration
  3. Evaluating and Promoting Therapeutic Effects
  4. Minimizing adverse effects
  5. Minimizing adverse interactions
  6. Making PRN Decision
  7. Managing Toxicity

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**Patient Care**

- **1. Pre-administration Assessment**
  - a ) Collecting baseline data to evaluate therapeutic and adverse responses (e.g., get blood pressure data and cell counts to use to determine whether drugs are effective)
  - b ) Identifying high-risk patients (e.g., liver/kidney dysfunction, genetic factors, allergies, pregnancy, old age and extreme youth)
  - c) Assessing the patient's capacity for self-care (can they follow directions on their own)
- First two assessments are drug specific & last assessment is for any patient and drug

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**Patient Care  
(continued)**

- **2. Drug and Dosage Administration**
- Drugs may have more than one indication, i.e. each may have more than one action depending upon dosage
  - Aspirin is given in low doses to relieve pain & high doses to suppress inflammation (arthritis)
- Drugs can be administered by different routes and dosage depends on route given
  - Oral doses are usually larger than injected doses (sc, im, ip, iv) and may be fatal if given by incorrect route (morphine)
- Certain iv drugs can cause local injury if intravenous line becomes extravasated and Nurse must monitor this.

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**Patient Care  
(continued)**

Guidelines to help ensure correct administration

- **Read medication order carefully - verify**
- **Verify the identity of patient with drug order**
- **Read medication label & verify**
  - Drug itself
  - Amount of drug (per tablet, per volume)
  - Verify suitability for administration by intended route
- **Verify dosage calculations**
- **Use special handling if drug requires**
- **DO NOT ADMINISTER ANY DRUG IF YOU DO NOT UNDERSTAND THE REASON FOR ITS USE**

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**Patient Care  
(continued)**

- **3. Evaluating and Promoting Therapeutic Effects**
- Is the drug doing the right thing? Evaluation criteria
  - Must know rationale for treatment and the nature and time course of desired response
    - If do not have this then cannot make judgment of progress
  - If desired response do not occur then must act quickly
    - Give alternative therapy
    - Even if patient gains beneficial responses, must be aware of what drug is supposed to do, because it still might end up badly.
    - Example: Nifedipine: given for hypertension & angina pectoris: when given to treat hypertension should monitor for reduction in blood pressure: if used for treatment of angina, need to monitor for reduction in chest pain

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Patient Care (continued)  
 Promote Compliance and Implement Non-Drug Measures

- **Drugs must be taken correctly**
  - Wrong dose
  - Wrong route
  - Wrong time.....can not produce maximum benefit
- **Educate patients to how to self medicate with specific instructions**
  - If elderly must also give instructions to another responsible party (elderly might not like this!)
- **Implement Non-drug measures to enhance drug effects**
  - Breathing exercises, biofeedback, emotional support (for asthma); exercise, physical therapy, rest (arthritis); weight reduction, stop smoking, and sodium restriction (hypertension).
  - Must evaluate individual patient for specific needs

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**Patient Care (continued)**

- **4. Minimize Adverse Effects**
  - Example: Gastric erosion by aspirin; sedation by antihistamines; hypoglycemia by insulin; excessive fluid loss by diuretics.
- **Know patient history**
  - Understand disease and treatment and what drug is supposed to do (again, do not give drug blindly!!)
  - Identify high risk patient
  - Educate patient
  - Know adverse effects of drug and educate patient to these

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**Patient Care (continued)**

- **5. Minimize Adverse Interactions**
  - Oral contraceptives to protect against pregnancy can be reduced by concurrent therapy with Phenobarbital (an anti-seizure drug)
  - Risk of thromboembolism from oral contraceptives can be increased by smoking cigarettes.
- **Know drug interactions with other medications**
  - This is important part of patient history
  - Ask patients to avoid OTC drugs that can interact with prescribed medications.

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**Patient Care  
(continued)**

- **6. PRN Decisions**
- PRN order (*pro re nata* = as needed or as occasion arises)
  - nurse has discretion regarding how much drug to give and when to give it
  - Most common for sleeping aids
- *Better your knowledge of Pharmacology, better your PRN decision*

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**Patient Care  
(continued)**

**7. Patient Education**

In most cases, it is the the responsibility of the nurse to educate patients about medication. In your role as educator, you must give the patient the following information:

- Drug name and therapeutic category (e.g. penicillin= antibiotic) - give generic name and trade name
- Dosage size
- Dosing schedule (PRN not fixed)-what to do if missed?
- Route and technique of administration taught
- Expected therapeutic response and when it should develop
- Non drug measures to enhance therapeutic responses

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**Patient Care  
(continued)**

- **Patient Education (contd..)**
- Duration of treatment
- Method of drug storage
- Symptoms of major adverse effects, and measures to minimize discomfort and harm
- Major adverse drug-drug and drug-food interactions (along with Pharmacist)
- Whom to contact in the event of therapeutic failure, severe adverse reactions, or severe adverse interactions

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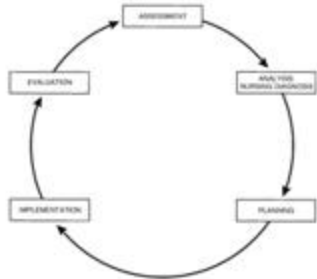
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**Application of the Nursing Process in Drug Therapy**



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**Application of the Nursing Process in Drug Therapy**

Objectives of the drug therapy:

*To produce maximum benefit with minimum harm*

Having reviewed the nursing process, let's discuss the process of drug therapy

- 1. Pre-administration Assessment
- 2. Analysis and Nursing Diagnoses
- 3. Planning
- 4. Implementation
- 5. Evaluation

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**Application of the Nursing Process in Drug Therapy**

Steps in the nursing process are -

- 1. Assessment
  - Assessment consists of collecting data about the patient to establish a foundation for subsequent steps in the process
  - Methods of data collection:
    - patient interview
    - medical and drug-use histories
    - physical examination
    - observation, and
    - lab tests.

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**Adverse drug effects**

<u>Drug</u>	<u>Adverse effect</u>	<u>Nursing diagnosis</u>
Aspirin	Gastric erosion	Pain related to gastric-erosion
Bethanechol	Stimulation of GI smooth muscles	Increased bowel motility
Clonidine	Impotence	Sexual dysfunction
Furosemide	excessive urine	Fluid volume deficit
Glucocorticoids	Thinning of skin	Impaired skin integrity
Bitroglycerine	Hypotension	Potential for injury related to dizziness
Propranolol	Bradycardia	Decreased cardiac output
Warfarin	Spontaneous bleeding	Potential for injury related to bleeding

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**Application of the Nursing Process in Drug Therapy**

**Steps in the nursing process are -**

- **2. Analysis**
  - Analysis the data to determine actual and potential health problems (physiologic, psychologic, or sociologic)
  - Nursing diagnosis: you see the patient first
  - Nursing diagnosis consists of 2 statements: (1) a statement of patient's actual and potential health problem, (2) a statement of the problem's probable cause or risk factors
  - E.g. " non-compliance with the prescribed regimen (problem) related to inability to self-administer medication (cause)"

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**Application of the Nursing Process in Drug Therapy**

**Steps in the nursing process are (contd..)**

- **3. Planning**
  - Determine specific intervention directed at solving or preventing the problems identified in analysis
  - Tailor individualized plan for each patient
  - During planning - define goals, set priorities, identify nursing interventions, and establish criteria for evaluating success

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**Application of the Nursing Process in Drug Therapy**

**Steps in the nursing process are (contd..)**

- **4. Implementation**
  - Begins with carrying out the interventions identified during planning
  - Some interventions are collaborative (requires physician's order); some are independent
  - Completes with observation and recording the outcome of the treatment
- **5. Evaluation**
  - Determination of the degree to which treatment has been successful

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**KEY POINTS**

- Application of the nursing process in drug therapy is directed at individual treatment: to achieve maximum benefit with minimum harm
- The goal of pre-administration assessment is to gather data needed for
  - Evaluation of therapeutic and adverse effects; Identification of high-risk patients; Assessment of the patient's capacity for self care
- The analysis and diagnosis phase of treatment is directed at
  - Judging the appropriateness of the prescribed therapy; Identifying potential health problems; Characterizing the patient's capacity for self care

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**KEY POINTS**

- Planning is directed at
  - Defining goals; Establishing priorities; Establishing criteria for evaluation
- The objectives of evaluation
  - To evaluate therapeutic response; Adverse reactions and interactions; Patient's compliance; Patient's satisfaction with treatment.

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## Key Points

- Nursing responsibilities with regard to drugs extend far beyond the 5 rights of drugs administration.
- You are the patient's last line of defense against medication errors.
- Your knowledge of pharmacology has a wide variety of practical applications in patient care and patient education.
- By applying your knowledge of pharmacology, you will make a large contribution to achieving the therapeutic objective of maximum benefit with minimum harm

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