Lecture 1: Introduction to Pharmacology

Objectives: Upon completion of this lecture, student will be able to answer the following questions:

1. Why a nursing student should learn pharmacology?
2. Define: Pharmacology, Clinical Pharmacology, Drug, Therapeutics
3. What are the Clinical applications of drugs?
4. What are the nature and sources of drugs?
5. What are the different types of drug therapies?
6. What are the different names assigned to drugs?
7. Classify drugs and define a prototypical drug.
8. Describe the properties of an ideal drug.
9. Explain the therapeutic objective of drug therapy.
10. What are factors that determine how an individual will respond to a specific drug and dosage.
11. Describe the main categories of drugs.
12. What are the Controlled Substances and Drug Schedules?
Why should a nursing student learn pharmacology?

- Pharmacology integrated into every step of the nursing process and it is the core of patient care.
- Without adequate understanding of drugs and their effects on the body, nurses are unable to meet their professional and legal responsibilities to their patients.
- Pharmacology helps the nurses to learn why, what, how, when, and where drugs are use in daily life.

The goals or objective of Studying Pharmacology

- By applying their knowledge of pharmacology, nurses well make a large contribution to achieving the therapeutic objective of drug therapy (maximum benefit and minimum harm).
- For the safe and accurate administration of medications, monitoring patients for therapeutic and adverse effects and providing education for patients who are taking these medications.
- Monitoring the overall patient care plan to prevent or limit the medication errors and adverse drug events. Nurses can minimize any harm associated with medications by carrying out this task with few, if any, errors.

- The professional nurse can routinely avoid medication errors and many serious adverse drug effects in patients by applying experience and knowledge of pharmacotherapy to clinical practice.

- Learning pharmacology is a gradual, continuous process that does not end with graduation.
Four Basic terms

- **Pharmacology**: The term *pharmacology* is derived from two Greek words:
  - *pharmakon*, the Greek word for “drugs, medicine or poison”; and
  - *logos*, the Greek word for “study or science”.
- Thus, pharmacology is most simply defined as
  - “the Study of Drugs or the Science of Drugs”
- **Pharmacology** “A branch of medical sciences that study drugs and their action on living organisms” by activating or inhibiting normal body processes (alter functions of living organisms).
- It also includes history, source, physicochemical properties, dosage forms, methods of administration, absorption, distribution, mechanism of action, biotransformation, excretion, clinical uses and adverse effects of drugs.
• **Clinical Pharmacology** is the study of drugs in human – includes patients as well as healthy volunteers (during new drug development).

• Clinical pharmacology addresses two key concerns: the drug’s effects on the body, and the body’s response to the drug.

• **Drug** – General term for any chemical substance or mixture of substances that can affect physiologic processes of a living organism.

  - Drugs can **stimulate** or **inhibit** normal cellular functions and activities; Drugs cannot add functions and activities to the body.
  - After a drug is administered, it is called a **medication**.
  - We will limit discussion to drugs that have therapeutic (medical or clinical) application rather than studying all drugs

• **Therapeutics**: is the branch of medicine concerned with the proper selection and use of drugs → the use of drugs to diagnose, prevent, and treat illness or disease.

  *(Therapeutics also known as Pharmacotherapy, Drug therapy – is the application of drugs for the purpose of prevention and the treatment of disease.)*
Medical or Clinical application of drug
(Therapeutic Application)

• The use or application of the drugs to diagnose, prevent, and treat illness or disease or to prevent pregnancy.

1) Diagnosis of the disease (investigation)
2) Prevention of disease (as prophylaxis)
3) Treatment of disease: treat signs, symptoms, and disease processes.
   a) To cure disease: that eliminates the disease, and the drug is withdrawn, e.g. as in bacterial and parasitic infection.
   b) Suppression of symptoms to avoid the effects of disease without attaining cure e.g. hypertension, diabetes mellitus, and asthma, or to control symptoms (pain, cough).
4) Prevention of pregnancy (contraceptive pill)
• Terms related the pharmacology

• Pharmacy:
• Pharmacokinetics:
• Pharmacodynamics:
• Toxicology:
• Chemotherapy:
• Pharmacopoeia: (دستور الأدوية)
• FDA:
• Essential Drugs:
Drug Sources

Natural drug sources and Synthetic drug source:

• **Plants**: Examples: digoxin from digitalis, morphine from *opium*, atropine from *atropa belladonna*, castor oil, etc.

• **Minerals**: Liquid paraffin, magnesium sulfate, kaolin, etc.

• **Animals**: Glandular products from animals are used, such as insulin and thyroid extract, heparin and antitoxin sera, etc.

• **Micro organisms**: (fungi, bacteria) such as Penicilllin a product of penicillium notatum.
Synthetic drug source:

- Laboratory synthesis - Aspirin, sulphonamides, paracetamol, meperidine, etc.

Today, however, laboratory researchers use traditional knowledge, along with chemical science, to develop synthetic drug sources.

Presently majority of drugs are obtained synthetically

What are the Advantages of synthetic drugs?
• **Semi-synthetic drugs** researchers and drug developers can modify the molecular structure of naturally occurring substances – a slight change in the chemical structure makes the drug effective against different organisms. (e.g., many antibiotics – penicillin substrates, and first-, second-, third-, and fourth generation cephalosporins)

• **Biotechnology: Genetic engineering** – e.g., Human insulin, human growth hormone – a process of altering DNA, usually of bacteria, to produce a chemical to be used as a drug

• Out of all the above sources, majority of the drugs currently used in therapeutics are from synthetic source.

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• **Types of drug therapies**

* **Acute therapy**: drugs are used to sustain life or treat disease – stroke, heart attack.

* **Maintenance therapy**: drugs are used to prevent the progression of chronic diseases, such as hypertension, hyperlipidemia.

* **Supplemental/replacement therapy**: drugs supply substances not available to the body, such as insulin for diabetic clients, iron, and thyroid hormones.

* **Palliative therapy**: Drugs used to maintain comfort - high dose opioids for cancer patients,

* **Supportive therapy**: drug therapy that help to maintain body functions -- fluid and electrolytes, volume expanders

* **Prophylactic therapy**: drugs help to prevent illness and have scientific evidence to support their use – antibiotics before surgery

* **Empiric therapy**: drugs are used based on past experience with their actions rather than scientific evidence.
• **Drug Names**: There are three types of drug names:
  – The chemical name
  – The generic name
  – The trade name

• Individual drugs may have several different names, but the two that are most commonly used are the generic name and the trade or brand name. To avoid confusion, it is best to use a drug’s generic name because any one drug can have a number of trade names.
• **The Chemical name**: indicate the drug's chemical structure – is a scientific name that precisely describes its atomic and molecular structure. It is long, complex and inappropriate for everyday use. Example: N-acetyl-para-aminophenol

• **The Generic or Approved name (nonproprietary name)**
  **preferred use**: shortened form of chemical name – is an abbreviation of the chemical name but it is less complex. Each drug has only one generic name. Example: acetaminophen

• **The Trade name (brand name or proprietary name)**: Given name of how the drug will be marketed – created by the drug company that manufactures the drugs. Example: Panadol

• It is easy for nurses, physicians, consumers to recall but each drug has a large number of trade names.
• **Example:**
  • Chemical name: N-acetyl-paraaminophenol
  • Generic name, (nonproprietary): Acetaminophen or Paracetamol
  • Trade name, (proprietary): Tylenol® or Panadol®

• Chemical name: propionic acid
• Generic name: ibuprofen
• Trade name: Motrin®, Profen®
Drug Classifications and Prototypes

Drugs classified according to

- **Effects on particular body systems.** E.g., drugs affect CVS, GIT, CNS…

- **Therapeutic uses** – therapeutic classification is based on their therapeutic usefulness in treating particular diseases E.g., antidepressants, antihypertensives, anticoagulant, antihyperlipidemics, antidysrhythmias, antianginal, Antiemetic….

- **Mechanism of action** – how a drug produces its effect in the body. E.g.,
  - Diuretics treat hypertension by lowering plasma volume.
  - Calcium channel blockers treat hypertension by decreasing cardiac contractility.
PROTOTYPES

When classify drugs, it is common practice to select a single drug from a class and compare all other drugs with this representative drug.

✓ **Prototypes:** is the well-understood drug model with which other drugs in its representative class are compared.

✓ **Example**, morphine is the prototype of opioid analgesics; penicillin is the prototype of antibacterial drugs.

✓ By learning the characteristics of the prototype drug, you well predict the actions and adverse effects of other drugs in the same class.

✓ For example, by knowing the effects of penicillin V, students can extend this knowledge to the other drugs in the penicillin class of antibiotics.
Ideal Drug Properties (No drug is ideal!)

The most important characteristics that any drug can have are:

- **Effectiveness**: an effective drug is one that elicits the responses for which it is given. Effectiveness is the most important property that a drug can have. If a drug is not effective (does not do anything useful), there is no justification for giving it.

- **Safety**: a safe drug is a drug that cannot produce harmful effects – even if administered in very high doses and for a very long time. There is no such thing as a safe drug. All drugs have the ability to cause injury, especially with high doses and prolonged use. The chances of producing adverse effects can be reduced by proper drug selection and proper administration. However, the risk of adverse effects can be never eliminated. E.g., Opioid analgesics (e.g., morphine, meperidine), at high therapeutic doses, can cause potentially fatal respiratory depression.

- **Selectivity**: a selective drug is a drug that elicits only the response for which it is given. A selective drug would not produce adverse effects. There is no such thing as a selective drug: all drugs cause side effects. E.g., the drowsiness that can be caused by antihistamines.
ADDITIONAL PROPERTIES OF AN IDEAL DRUG (No drug is ideal!)

- Reversible action
- Predictability – know how patient will respond
- Ease of administration – number of doses low and easy to administer
- Freedom of drug interactions – should not augment or decrease action of other drugs or have adverse combined effects
- Low cost – easy to afford (especially with chronic illness)
- Chemical stability – no loss of effectiveness with storage
- Possession of simple generic name – easy to remember and pronounce

Consequently, medications are not ideal.

No drug is safe, all drugs produce side effects. Drug responses may be difficult to predict and altered by drug interactions. Drug may be expensive, unstable, and hard to administer.
Because no drug is ideal … All members of the health care team must exercise care to promote therapeutic effects and minimize drug-induced harm … this to achieve the therapeutic objective.

**QUESTION??**

Therapeutic objective of drug therapy??
The therapeutic objective

The objective or a goal of drug therapy is to provide maximum benefit (beneficial effects) with minimum harm (adverse effects).

You, as a nurse have a critical responsibility in achieving the therapeutic objective.
• What are factors that determine how an individual will respond to a specific drug and dosage
Factors that determine the intensity of drug responses

1. Dosage size
2. Route
3. Timing

Administration

• medication errors
• patient compliance

Pharmacokinetics

• absorption
• distribution
• metabolism
• excretion

Pharmacodynamics

• drug-receptor interaction
• patient’s functional state
• placebo effects

Sources of individual variation

• physiological variables
• pathological variables
• genetic variables
• drug interactions

Determine how much of an administered dose gets to its sites of action.

Determine the nature & intensity of the response.

Important determinants of drug responses by health care providers.

minimize by give pts complete instruction about their medication and how to take it.
Drug categories

• Legal drugs are obtained either by a prescription or over the counter.

• **Prescription drugs** (largest category of drugs) are drugs obtained by a prescription – the patient must receive a written order from the licensed health care provider (person with the legal authority to write such a prescription). This person has an opportunity to examine the patient, determine a specific diagnosis and ordering the proper drug for the patient’s condition and by conveying the amount and frequency of drug to be dispensed.

• The prescription contains the name of the drug, the dosage, the method and times of administration, and the signature of the licensed health care provider prescribing the drug.
• **Nonprescription drugs** – Over-the-counter (OTC) drugs: are drugs obtained without a prescription (do not require a health care provider’s order)

• OTC drugs designated by the FDA to be safe, if patients carefully follow instructions included with the medication. If patients do not follow these guidelines, OTC drugs can have serious adverse effects.

• OTC drugs may be purchased in a variety of settings, such as a pharmacy, drugstore, or in the local supermarket. OTC drugs include those given for symptoms of the common cold, headaches, constipation, diarrhea, and upset stomach.

• Patients prefer to take OTC drugs for many reasons.

• They are obtained more easily. They are available in a variety of settings than are prescription drugs – do not require the patient to see a health care provider to write a prescription for the drug thus saving time and money.

• Patients often think they can effectively treat themselves and may believe that OTC medications do not have as many side effects as prescription medications

• Self-treatment is sometimes ineffectual, and the potential for harm may increase if the disease is allowed to progress.

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• What we main by Controlled Substances and Drug Schedules?

• Define: Drug abuse, Addiction, Dependence, Physical dependence, withdrawal syndrome

• Why are certain drugs placed in schedules?

• What does the nurse need to know when a scheduled drug is ordered?
Controlled Substances and Drug Schedules

• **Controlled substances**: substances have a potential for abuse and addiction or dependence and are categorized by U.S. Drug Enforcement Agency (DEA) into **5 Drug Schedules** (Schedule I – V) based on their therapeutic use and potential for abuse.

• Drugs in Schedule I have a high potential for abuse and no medically approved use. Drugs in Schedules II through V have progressively less abuse potential and are all medically approved.

• These schedules help to identify these controlled substances and regulate their prescription. The higher the abuse potential, the more restrictions are placed on the prescriber.
<table>
<thead>
<tr>
<th>Schedule</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Drugs that are not approved for medical use and have high abuse potentials: flunitrazepam, gamma hydroxybutyric acid (GHB), heroin, marijuana,</td>
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<tr>
<td>II</td>
<td>Drugs that are used medically and have high abuse potentials: opioid analgesics (e.g., codeine, hydromorphone, methadone, meperidine, morphine), central nervous system (CNS) stimulants (e.g., cocaine, methamphetamine), and barbiturate sedative-hypnotics (amobarbital, pentobarbital, secobarbital).</td>
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<tr>
<td>III</td>
<td>Drugs with less potential for abuse than those in Schedules I and II, but abuse may lead to psychological or physical dependence: androgens and anabolic steroids, ketamine, some CNS stimulants (e.g., benzphetamine).</td>
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<tr>
<td>IV</td>
<td>Drugs with some potential for abuse: benzodiazepines (e.g., diazepam, lorazepam, temazepam), other sedative-hypnotics (e.g., phenobarbital), and some prescription appetite suppressants (e.g., phentermine).</td>
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<tr>
<td>V</td>
<td>Products containing moderate amounts of controlled substances. They may be dispensed by the pharmacist without a physician’s prescription but with some restrictions regarding amount, record keeping, and other safeguards. (e.g., opioids preparation of antidiarrheal drugs, such as diphenoxylate and atropine (Lomotil) and antitussive drugs).</td>
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