



Definition, Historical landmarks, & Scope of P'cology

Dr. Rupali A. Patil

Associate Professor & Head-Pharmacology


GES's Sir Dr. M. S. Gosavi College of Pharmaceutical Edu. & Res., Nashik

Definitions

- ▶ **Pharmacology** : The science of drugs (Greek: *Pharmacon*-drug; *logos*-discourse in)
- ▶ **Pharmacology** is the study of the therapeutic value and/or potential toxicity of chemical agents on biological systems.

In simple terms, it is study of all the aspects of drug.

 - ▶ It targets every aspect of the mechanisms for the chemical actions of both traditional and novel therapeutic agents.
 - ▶ Two important and interrelated areas are: pharmacodynamic and pharmacokinetics.
- ▶ **Pharmacodynamic** (Greek: *dynamis*-power) (what drug does with the body) are the study of the molecular, biochemical, and physiological effects of drugs on cellular systems and their mechanisms of action.
- ▶ **Pharmacokinetics** (Greek: *Kinesis*-movement) (what body does with the drug) deals with the absorption, distribution, and excretion of drugs.

- 
- **Pharmacotherapeutics** It is the application of pharmacological information together with knowledge of the disease for its prevention, mitigation or cure. Selection of the most appropriate drug, dosage and duration of treatment taking into account the stage of disease and the specific features of a patient are a part of pharmacotherapeutics.
 - **Clinical pharmacology** It is the scientific study of drugs (both old and new) in man . It includes pharmacodynamic and pharmacokinetic investigation in healthy volunteers as well as in patients. Evaluation of efficacy and safety of drugs and comparative trials with other forms of treatment; surveillance of patterns of drug use, adverse effects, etc. are also part of clinical pharmacology. The aim of clinical pharmacology is to generate data for optimum use of drugs and the practice of 'evidence based medicine'.
 - **Chemotherapy** It is the treatment of systemic infection/ malignancy with specific drugs that have selective toxicity for the infecting organism/malignant cell with no/minimal effects on the host cells.

Drugs in general, can thus be divided into:

Pharmacodynamic agents These are designed to have pharmacodynamic effects in the recipient.

Chemotherapeutic agents These are designed to inhibit/kill invading parasites/malignant cell, but have no/minimal pharmacodynamic effects in the recipient.

- **Toxicology** It is the study of poisonous effect of drugs and other chemicals (household, environmental pollutant, industrial, agricultural, homicidal) with emphasis on detection, prevention and treatment of poisonings. It also includes the study of adverse effects of drugs, since the same substance can be a drug or a poison, depending on the dose.

History of Pharmacology

- Knowledge of drugs and their uses in diseases are as old as history of mankind.
- Primitive men gather the knowledge of healing and medicines by observing the nature, noticing the animals while ill & personal experience after consuming plants & herbs as remedies.
- Ancient civilizations discovered that extracts from plants, animals, & minerals had medicinal effects on body tissue. These discoveries became the foundation of Pharmacology.
- Pharmacology in the present form is relatively recent branch about hundred years old.
- It is of intellectual interest to know how drugs are discovered and developed. Often in the past, this was based on folklore or intelligent observation (e.g. digitalis leaf, penicillin).
- Nowadays, new drugs are mostly developed by the organic chemist working with a Pharmacologist, increasingly from basic knowledge about key molecular targets.
- Usually some sort of biological screen is used to select among organic molecules for optimum pharmacological activity.

Historical developments in Pharmacology

- *PEN PSAO (2700 BC)* It was the great herbal Materia Medica written in China.
- *Kahun Papyrus (2000 BC)* is an oldest Egyptian document containing information about veterinary medicines & uterine diseases of women.
- *Ebers papyrus (1550 BC)* also an Egyptian document containing information about number of diseases & 829 prescription where castor oil, opium like drug are being used.
- *Hippocrates (460-375 BC)* A Greek Physician **“Father of Medicine”**. First person who recognized disease as abnormal reaction of body. He introduced use of metallic salts for the treatment of disease.
- *Theophrastus (380-287 BC)* a great philosopher called father of Pharmacognosy. He classified medicinal plants on the base of medicinal characteristics.
- *Dioscorides (AD 57)* a greek, produced one of the first Materia medica of approximately 500 plants & remedies.
- *Claudius Galen (AD 129–200)* first attempted to consider the theoretical background of pharmacology.
- *Paracelsus (1493–1541)* a Swiss scholar and alchemist, often considered **Grandfather of Pharmacology**. He introduces the use of chemicals for treatment of disease.
- *Valerius Cordus (1514-1544)* He compiled the first Pharmacopeia where he described techniques for the preparation of drugs.

Historical landmarks

- **Francois Magendie (1783-1855)**, a French Physiologist laid down the dictum "Facts and facts alone are the basis of science." Experimental procedures with animals are the testing grounds for determination of drug action. He developed experiment to elucidate the physiological processes and action of drugs on the body.
- **Frederich Sertürner**, German Pharmacist's assistant, isolated morphine—the first pure drug—in 1805.
- **Claude Bernard (1813-1878)**, investigated the plant extract curare & proposed a site of action for this agent. Considered *Father of Experimental Medicine*.
- **Rudolph Buchheim (1820-1879)**. A German pharmacologist in 1847 established the first laboratory devoted to Experimental Pharmacology in the basement of his home in Dorpat which is known as the *Cradle of Experimental Pharmacology*.
- **Oswald Schmiedeberg (1838-1921)**. **Father of Pharmacology** in 1872 set up an Institute of Pharmacology in Strasbourg, France (Germany at that time).
- **J.N. Langley (1852-1925 & Sir Henry Dale (1875-1968)** pioneered Pharmacology in England, taking a physiological approach.
- **John J. Abel (1857-1938)** established the first chair of Pharmacology in the U.S.A. (U. Michigan, 1891) after training in Germany. Able went to Johns Hopkins in 1893, and trained many U.S. pharmacologists. He is known as "*The Father of American Pharmacology*". Co-founded the Journal of Pharmacology & Experimental Therapeutics in 1909.
- **L. Mayer Jones (1912-2002)** regarded as father of modern veterinary pharmacology. He authored first book of veterinary pharmacology therapeutics in 1954.

Approximate dates

>3000 BC

~1600 AD

~1800

~1900

~1970

2000

Therapeutics

Magical potions
Herbal remedies

Commerce

Apothecaries

Chemistry

Natural products

Chemical structure

Synthetic chemistry

Biomedical sciences

Pharmacology

Pathology

Physiology

Biochemistry

Molecular biology

Pharmaceutical industry



Synthetic drugs

Biopharmaceuticals

Pharmacology

Scope of Pharmacology

- It provides the rational basis for the therapeutic use of the drug.
- Before the establishment of this discipline, even though many remedies were used, but doctors were reluctant to apply scientific principles to therapeutics.
- In 1920s, many synthetic chemicals were first introduced & the modern Pharmaceutical companies began to develop.
- The ***Second World War*** was the impetus for accelerated research in Pharmacology (the war time antimalarial program) in the U.S., & introduced strong analytical & synthetic chemical approaches.
- Scientific understanding of drugs enables us to predict the pharmacological effect of a new chemical that will produce a specified therapeutic effect.
- The scope of Pharmacology has expanded greatly over the last decade to incorporate many new approaches such as Computer-assisted Drug Design, Genetic screens, Protein engineering & Use of Novel Drug Delivery Vehicles including Viruses & Artificial cells.

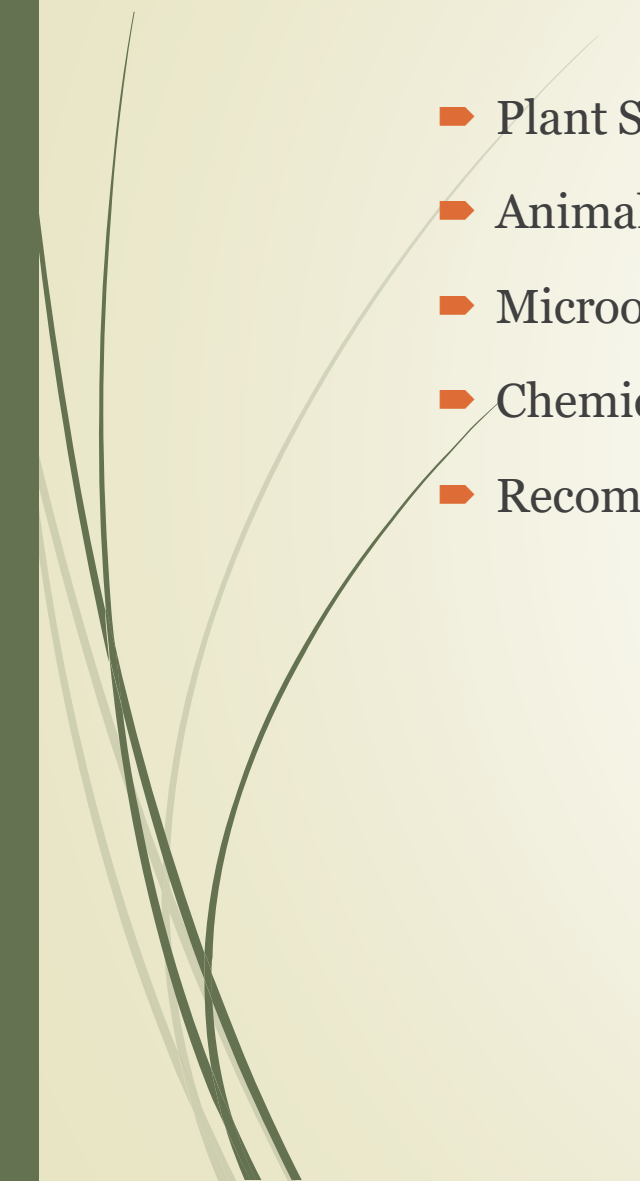
- 
- ▶ **Drug** (French: *Droque*- a dry herb) It is the *single active chemical entity present in a medicine that is used for diagnosis, prevention, treatment/cure of a disease.*
 - ▶ **WHO** : “Any substance or product that is used or intended to be used to modify or explore the physiological system or pathological state for the benefit of the recipient”
- 

Nature of drugs

- ▶ All drugs are chemical entities with simple or complex molecules.
- ▶ Majority: organic compounds
 - ▶ Weakly acidic (aspirin, penicillin)/weakly basic (morphine, chloroquine /nonelectrolytes (alcohol, diethyl-ether).
 - ▶ Most are solids: e.g. paracetamol, propranolol, furosemide, ampicillin, etc.,
 - ▶ Some liquids: ethanol, glyceryl trinitrate, propofol, castor oil
 - ▶ Few Gaseous: nitrous oxide
- ▶ Some purely inorganic: lithium carbonate, ferrous sulfate, magnesium hydroxide, etc.
- ▶ Molecular weight
 - ▶ Majority of drugs: range of 100- 1000 D
 - ▶ Molecules <100D: No sufficiently specific features - shape, size, configuration, chirality, distribution of charges, etc. to selectively bind to only one/ few closely related target biomolecules, to the exclusion of others.
 - ▶ Larger molecules than 1000 D: do not readily pass through membranes/barriers in the body to reach the target sites in various tissues/cells.
 - ▶ Few drugs are as small as lithium ion (7D), and some like heparin (10-20 KD), gonadotropins (>30 KD), enzymes, proteins, antibodies (>50 KD) are much bigger.
 - ▶ Bulky molecule drugs have to be administered parenterally.
- ▶ Drugs : Xenobiotics.
 - ▶ Many endogenous chemicals: hormones, autacoids, metabolites and nutrients are also used as drugs.



Sources of Drugs

- Plant Sources
 - Animal Sources
 - Microorganism
 - Chemicals
 - Recombinant DNA Technology
- 

A) Plant Sources-

- ▶ **Alkaloids** – Atropine (*Atropa belladonna*)
Morphine (*Papaver somniferum*)
- ▶ **Glycosides**- Digoxin (*Digitalis purpurea*)
- ▶ **Oils**-
 - ▶ Essential oil (Volatile oil)-leaves & Flower : eg. clove oil, peppermint, eucalyptus
 - ▶ Fixed oil- seeds : eg. ground nut, coconut, castor, olive oil
 - ▶ Mineral oil : eg. liquid paraffin, hard & soft paraffin
- ▶ **Gum**- excretory products (gum acacia)
- ▶ **Resins** - Tolu balsam (cough mix)
- ▶ **Tannins** - catechu



B) Animal Sources

- 1) **Hormones** : Insulin (Pork-Porcine), (Beef-Bovine)
- 2) **Vaccines**: Polio, Anti-rabies
- 3) **Sera**: ATS (Anti-tetanus Serum)
- 4) **Vitamins**: Vit B12 from Liver extract

C) Microorganism: Antibiotics


D) Minerals: iron salts, calcium salts, lithium carbonate, magnesium/ aluminium hydroxide, iodine.

E) Synthetic Chemicals: Synthetic glucocorticoids, benzodiazepines, thiazides.

E) Recombinant DNA Tech: Human Insulin, hGH, interferons, erythropoietin etc.



Classification of Drugs

- ▶ Site of action
 - ▶ Chemical Structure
 - ▶ Mechanism of Action
 - ▶ Ionization of Drugs
 - ▶ Therapeutic Uses
 - ▶ Anatomical Therapeutics Classification (ATC)
- 

Essential medicines (drugs)

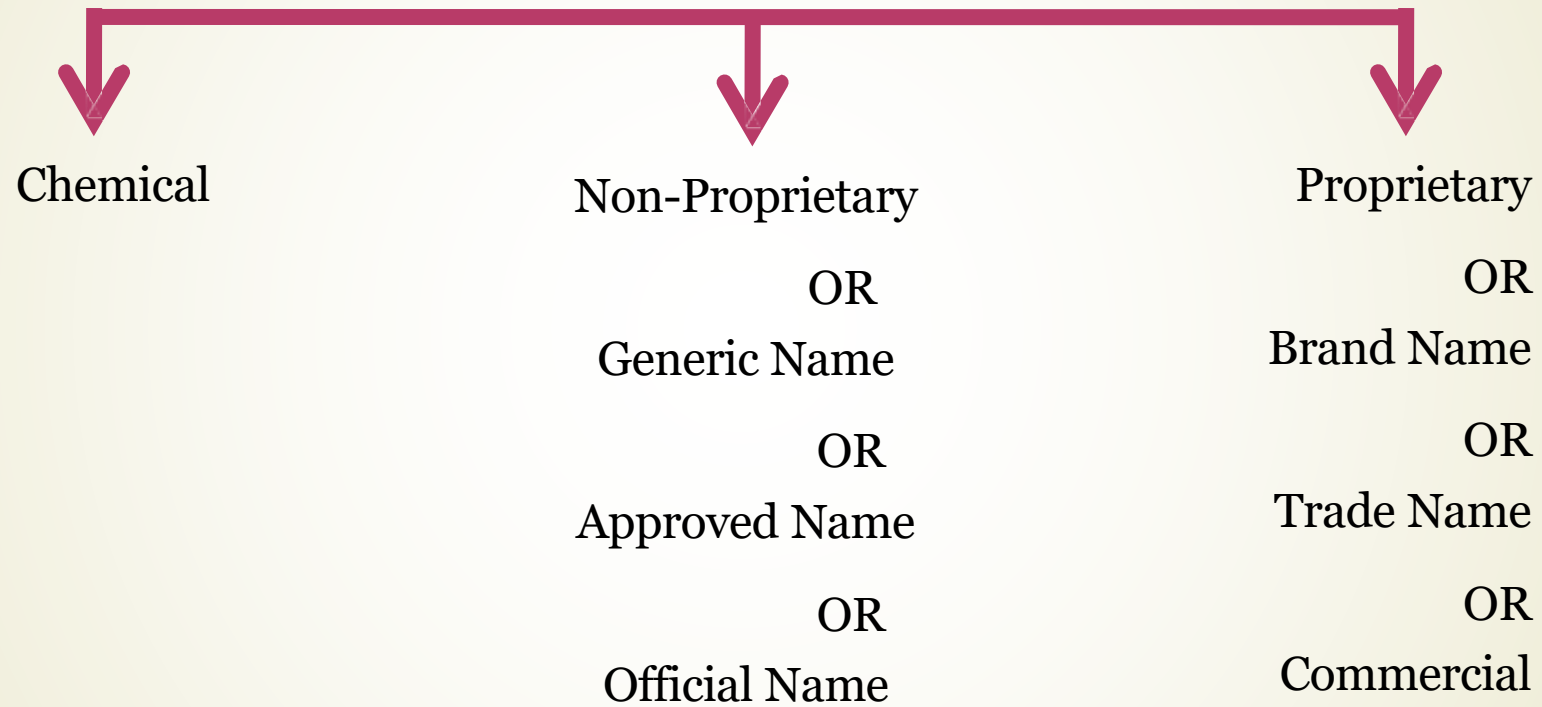
- ▶ **WHO's Definition:** Medicines that satisfy the priority healthcare needs of the population. They are selected with due regard to public health relevance, evidence on efficacy and safety, & comparative cost effectiveness.
- ▶ Intended to be available within the context of functioning health systems at all times and in adequate amounts, in appropriate dosage forms, with assured quality & adequate information, & at a price the individual & the community can afford.
- ▶ **1977:** 1st *Model List of Essential Drugs* along with their dosage forms and strengths by WHO
- ▶ **2017:** 20th list with 433 medicines, including 25 FDCs.
- ▶ **1996:** *National Essential Drugs List in India*
- ▶ *Revised in 2011*
- ▶ **2015:** *National List of Essential Medicines with 376 medicines, including 20 FDCs*
 - ▶ At Primary, Secondary & Tertiary levels

Essential drugs/medicines

WHO's *Criteria*.....

- Adequate data on its efficacy & safety should be available from clinical studies.
- It should be available in a form in which quality, including bioavailability, & stability on storage can be assured.
- Choice should depend upon pattern of prevalent diseases; availability of facilities & trained personnel; financial resources; genetic, demographic & environmental factors.
- If 2/ more similar medicines: choice should be made on the basis of their relative efficacy, safety, quality, price & availability. *Cost-benefit ratio should be a major consideration.*
- Choice may also be influenced by comparative pharmacokinetic properties & local facilities for manufacture & storage.
- Most essential medicines should be single compounds. Fixed ratio combination products should be included only when dosage of each ingredient meets the requirements of a defined population group, & when the combination has a proven advantage in therapeutic effect, safety, adherence or in decreasing the emergence of drug resistance.
- Selection should be a continuous process considering the changing priorities for public health action, epidemiological conditions as well as availability of better medicines/formulations & progress in pharmacological knowledge.
- Recent development: to select essential medicines based on rationally developed treatment guidelines.

Nomenclature of Drugs



Some examples of Chemical, Generic, Brand Names

Chemical Name	Generic Name/ Non-Proprietary Name	Brand Name/ Proprietary Name
Acetyl Salicylic Acid	Aspirin	Disprin
Acetaminophen	Paracetamol	Crocin, Calpol, Metacin
Aminobenzyl Penicillin	Ampicillin	Roscillin



Generic/Non-Proprietary Name

- ▶ Given by **USAN** Council (**United States Adopted Name**)
- ▶ **Advantages**
 - ▶ World-wide acceptance, name remains the same in all countries.
 - ▶ Usually have similar suffix in a group.
 - ▶ Economical than Branded/Proprietary Medicines.
- ▶ **Disadvantages**
 - ▶ Naming of Fixed Dose Combinations.



- **Brand Name/Proprietary Name**

- Name given by Pharmaceutical company for commercial purpose.

- **Advantages**

- The consistency or Pharmacokinetics or efficacy does not change with same brand.

- Single brand name for a Medicine with multiple ingredients.

- Bioavailability remains same where a patient is maintained on a particular brand.

- **Disadvantages**

- Branded Medicines are costlier.

- Multiple brands for a same Medicine.



➤ Drug Categories

- Prescription Drugs
- OTC (Over The Counter) Non-Prescription Drugs
- **Orphan drugs:** Drugs or biological products for diagnosis/treatment/ prevention of a rare disease or condition or a more common disease (endemic only in resource poor countries or areas) for which there is no reasonable expectation that the cost of developing and marketing it will be recovered from the sales of that drug.
 - As per Orphan Drug Amendment (1983) Act of USA, a rare disease/ condition is one that affects less than 0.2 million people in the USA.
 - Ex. Azacitidine, Bevacizumab, Bortezomib, Busulfan, Carboprost, Clofazimine, Colchicine, Fomivirsen, Nilotinib, Paromomycin, Rifaximin, Rituximab, Sodium stibogluconate, Sodium thiosulfate, ThioTEPA



THANK YOU!!!