**Notes on Pharmacology**

**BRANCHES OF PHARMACOLOGY**

 Though there are more branch with more and more scientific researches adding, most important divisions are as follows:

**1. Clinical pharmacology**

 The basic of pharmacology with added focus on the application of pharmacology, principles and methods in medical clinics and towards patient care and outcome.

**2. Neuro pharmacology**

 Effects of medication on central and peripheral nervous system functioning.

**3. Psycho pharmacology**

 Effects of medication on the psyche, observing change in behaviour of the body and mind and how molecular events are manifested in behavioural form.

**4. Pharmacogenetics :**

 Clinical testing of genetic variation that give rise to differing response to drug.

**5. Pharmacogenomics:**

 Application of genomic technologies to new drug discovery and further characterization of old drugs.

**6. Toxicology**

 Study of harmful or toxic effects of drugs, the adverse effects of any chemical substances in excess (including beneficial drug in small dose) and their molecular target and characterization.

**7. Pharmacometrics:**

 Study of metrics (measurements) in pharmacology is the study of qualitative and quantitative aspects of drug effects on lab animals. It deals with measurements of drugs.

**8.** **Posology:**

 We study how medicines are dosed. It also depends upon various factors like age, climate weight, sex and so on.

**9. Pharmacognosy:**

 A branch of pharmacology dealing with the composition, use and development of medicinal substance of biological origin and especially substance obtained from plants.

**10. Behavioural pharmacology:**

It also deals with psycho pharmacology and it is an interdisciplinary field which studies the behavioural effects of psycho-active drugs. It incorporates approaches and techniques from neuropharmacology, animal behaviour and behavioural neuroscience and is interested in the behavioural and neurological mechanism of action of psychoactive drugs. Another good of behavioural pharmacology is to develop animal behavioural model to screen chemical compound with therapeutic potential. People in this field called by behavioural pharmacologists typically use animals such as rabbits to study psychotherapeutic action of drugs such antipsychotics, anti-depressants, anxiolytics and drugs of abuse such as nicotine, cocaine and methamphetamine.

**11. Environmental pharmacology**

 It is a new discipline where focus is given to understand gene - environment interaction, drug- environment interaction, toxic- environment interaction. There is close collaboration between environment science and medicine in addressing these issued as health care itself can be a source / cause of environmental pollution or remediation. Human health and ecology is intimately related. Demand for more pharmaceutical products may place the population at risk by destruction of species. The entry of chemicals and drugs to aquatic ecosystem is of great concern today. In addition the production of illegal drugs, poison, toxins and carcinogens are polluting water. More and more biodegradable drugs are needed. This field is intimately related with eco survivability and public health.

**Classification of pharmacology based on action of drugs on organs and tissues**

1. Pharmacology of peripheral nervous system
2. Pharmacology of C.N.S
3. Pharmacology of cardio- vascular system
4. Pharmacology of endocrine system
5. Pharmacology of Haemopoietic system
6. Pharmacology of drugs acting on excretory system
7. Pharmacology of drugs acting on respiratory system
8. Autacoids (Like antihistamine)
9. Drugs acting on the gastro – intestinal system
10. Chemotherapy

**Historical developments in Pharmacology**

1. 2500 years ago – 17th century : Ancient Greece used willow leaves (contains salicylic acid)
2. 17th century – 18th century : Salicylic acid was found in the bark of willow tree
3. 1899: Beyer marketed aspirin (acetyl – salicylic acid)
4. 1970’s : The mechanism is known : inhibition of prostaglandin synthesis vie a cyclo- oxygenase (COX) enzyme.
5. Rudolf Buchhein (1820 – 1879) : Founder of experimental pharmacology.
6. Francois Magendie: Discovered strychnine in necessaries.
7. Oswald Schmiedeberg : Founder of modern pharmacology. **Doctor Oswald Schmiedeberg** (10 October 1838 – 12 July 1921) was a [Baltic German](https://www.bing.com/search?q=Baltic+Germans&filters=sid%3ab01b38af-9918-d8b9-3ce9-d7d68decf8ac&form=ENTLNK) pharmacologist. He is sometimes referred to as the **"Father of Modern Pharmacology.".**

**The Nobel Prize and history of pharmacology, Person and year of**

 Elie Metchnikoff, Panel Ehrlich (1908),

 Frederick Bunting, John Macleod (1923)- First antimicrobial drug (magic bullet). Isolation and discovery of insulin and its application in the treatment of diabetes.

 Sir Henry Dole, Otto Locur (1936), Ernst Chain, Sir Alexander Flaming, Sir Howard Florey (1945).

 Edward Kendall, Tadeus Reichstein, Philip S. Hench (1950),

Danil Bart (1957). Julius Arulrod, Sir Bremond Katy, Ulf von Enlu (1970)

Earl Sutherland Jr. (1971)

Father of Indian Pharmacology – **Sri Ram Nath Chopra**. Sri Ram Nath Chopra is considered as “Father of Indian Pharmacology” since he was the first to establish a centre of study and research in pharmacology in India, at the Calcutta School of Tropical Medicine.
Name : Singh H. Sir Colonel Ram Nath Chopra

**Pre Christian Era:**

* Greek medicine is said to be the origin of modern medicine and therapeutics.
* Hippocrates (5th century B.C.) separated medicine from religion and was known as the father of medicine. He laid down certain principles on which modern medicine is built.
* According to Hippocrates the 4 elements of nature-water, fire, air and earth gave rise to the 4 humors of the body, blood, phlegm, yellow bile or urine and black bile. Any imbalance in one or more of these humors inflicted sufferings.
* Galen was a famous Greek physician who practised in Rome, Galenical drugs are pharmaceuticals compounded by mechanical means especially of vegetable material.

**Medicinal medicine:**

 Paracelsus introduced inorganic chemicals like mercury into medicine. He called this ‘latrochemistry’ or medicinal chemistry. He induced practitioners to use laudanum (an opium preparation), sulphur, iron, CuSO4, K2SO4, mercurial’s and tinctures and fluid extracts of various plants to treat diseases.

**Modern medicine**

* Buchheim, a Professor of Dorpat University who was known as the ‘Father of **Pharmacology’** set up the first laboratory to study pharmacology. He discarded many remedies for want of rational scientific action or explanation.
* By the middle of the 19th century modern medicine has seen only one effective weapon ie. small pox vaccine. In quick succession came the anaesthetics and antiseptics. In the last quarter the causative organism of malaria, plague etc. were identified.
* Beginning in the 20th century, the fresh wind of synthetic chemistry began to revolutionize the pharmaceutical industry and with it the science of pharmacology.
* New synthetic drugs such as barbiturates and local anaesthetics were introduced.
* The era of chemotherapy began with the discovery of arsenal compounds for the treatment of syphilis by Paul Ehrlich in 1909 (father of chemotherapy).
* Discovery of sulphonamides by Gerhard Domagk in 1935 and development of penicillin by Alexander Flemings.
* The addition of drugs to the therapeutic jungle is growing with rapid pace from the later half of the 20th century.
* Robert Furehgott, Louis Ignero, Murael (1998) recognised Nitric oxide as a signalling molecule in cardiovascular system.
* Alfred Gilman, Martin Redbell (1994) discovered G-protein and the role of them.

**Basic principles of pharmacology includes**

* Study of drugs – Action – Dosage
* Therapeutic uses (indications) – Adverse effects
* Pharmacology is directly linked to pathophysiology of a particular disease.

**Drug:**

 A substance that affects biological activity in a person. Drugs may be from natural source (animals, plants, microorganisms) or synthetic.

**Drugs may be prescribed to**

1. Promote healing
2. Cure diseases
3. Control or slow progression of disease
4. Prevent diseases
5. Decrease risk of complications.
6. Increase comfort level
7. Reduce excessive activity in the body (sedative)

**Drug effects:**

1. Therapeutic or desired action : Stimulate or inhibit cell function or block the effects of bio-chemicals in tissues.

Eg: Antihistamine

1. Physical or mechanical action : Eg: Laxative
2. Unwanted effects on the body

- Mild side effects (Antihistamine cause dry mouth)

- Dangerous or cause tissue damage or life threatening

Thalasamide :

 Analgesic used during World War II, causes abnormalities in foetus

**OTC (Over the Counter)**

 Drugs that an individual can purchase without a “note” from their doctor. Still recommended that a doctor be consulted when there are other medical conditions or prescription being taken.

**Prescription**

 The doctor writes the notes

**Adverse effects**

1. Hypersensitivity or allergic reactions
* Rash to anaphylaxis
* Patient should stop taking the drug and the physician should be contacted.
1. Idiosyncratic : Unusual or unexpected reactions to drugs

Eg: Excessive excitement after taking a sedative

1. Latrogenic effects : Negative effects on the body due to medication error, drug overdose, unusual responses.
2. Teratogenic effects : Harmful effect on the foetus leading to developmental defects.
3. Interactions : Drugs effect is modified by combining it with another drug, food, other substances like aspirin, antacids, alcohol.

**Synergism**

When the combination increases the effects of what has been taken (can be life threatening)

**Antagonism**

 When the combination of drugs decrease the effects. The presence of an antagonist prevents the patient from getting the effect of the drug. Required as antidote.

**Administration of drugs**

**Dosage**

 Amount of drug required to produce the specific desired effect in an adult. Usually expressed by weight or volume and time factor (number of times per day).

**1. Loading dose**

 A large first dose by injection to reach effective drug levels quickly.

 It is important to maintain effective dosage in blood level.

**Dosage is based on**

1. Absorption
2. Transport in the blood
3. Half life of the particular drug (More is not better, it is toxic)

Major routes for drug administration are oral, parenteral (injection), other methods like inhalation, Bronchodilator (absorption into blood), Topical, Rectal.

Some drugs may only be administered through parenteral route

Eg: Insulin would be destroyed be gastric enzymes if consumed.

**Generics names**

 Unique official simple name for a specific drug. It is considered easy to remember accurately and used in many circumstances.

**Trade names (Proprietary name or brand name)**

 A trade mark name assigned by a single manufacture.

Eg: Hydrocortinum

**FDA (Food and drug administration)**

 Regulates the production, labelling, distribution and other aspects of drug control.

**Placebo**

 Something used in clinical research, given to the control group. Lacks the active ingredient that is being tested in the study. Eg: It has no drug action, it is just given to provide mental relief to the patient (This is also used in cases where the patient’s psychology is that he gets cured only if he takes medicines).

**1. Pharmacology**

 It is the science of drugs which deals with interaction of exogenously administered chemical molecules with living system. It encompasses all aspects of knowledge about drugs, but most importantly those that are relevant to be effective and used for medicinal purpose.

 Pharmacology is the science which involves all aspects of action of drugs on the living system.

It is the study of the therapeutic value / potential toxicity of chemical agents on biological systems. It targets every aspects of the mechanism for the chemical action of both traditional and novel therapeutic agents.

**2. Pharmacodynamics**

 It includes physiological and biochemical effects and drugs and their mechanism of action at macromolecular / subcellular / organ system level. It is the study of low drugs action on the body while pharmacokinetics is the study of how the body acts on the drugs. Pharmacodynamic and pharmacokinetic aspects of action of chemical agent are applicable to all related areas of study, including toxicology and therapeutics.

**3. Pharmacokinetics**

 It refers to the movement of the drug in and alteration of the drug by the body including absorption, distribution, binding / localization / storage, biotransformation and elimination of the drug.

**4. Toxicology**

 It is the study of adverse of toxic effects of drugs and other chemical agents. It is concerned both with drugs and is used in the treatment of disease and chemicals that may present household, environment al or industrial hazards.

 Toxicology is the study of poisonous effect of drugs and other chemicals with emphasis on deletion, precaution and treatment of poisoning.

**5. Drug**

 It is the single active chemical entity present in a medicine that is / used for diagnosis, prevention, treatment / cure of a disease. Drug is any substance or product that is used or is intended to be used to modify or restore physiological systems or pathological status for the benefit of the recipient (As per WHO)

 Drug is any chemical agent except food that is used to promote or safeguard the health of human beings or animals or fishes. It is also defined as any substance or product that is used or intended to be used to modify of restoration of physiological systems or pathological status for the benefit of the recipient.

**6. Pharmacotherapeutics**

It is the application of pharmacological information together with the knowledge of the disease for its prevention, mitigation or cure. It is also the science of application of drug in the precaution, control and treatment of diseases. It comprises of 2 distinct classification namely

1. Empirical pharmacotherapeutics . Here It is not easy to elicit definite pharmacological reason for drug action. Nevertheless a specific drug is effectively used to cure human disease.
2. Rational pharmacotherapeutics : Here critical selection of drugs exclusively on the basis of scientific explanation that may be accepted globally.

**7. Clinical pharmacology**

 It is the scientific study of drugs in man, animals or fishes.

**8. Chemotherapy**

 It is the treatment of systemic infection or malignancy with specific drugs that have selective toxicity for the infection organism / malignant cell with no / minimal effect on the host cell.

**9. Pharmacometrics**

 **Pharmacometrics** can be defined as that branch of science concerned with mathematical models of biology, pharmacology, disease, and physiology used to describe and quantify interactions between xenobiotics and patients (human and non-human), including beneficial effects and adverse effects. It is the branch of pharmacology dealing specifically with screening, computation, quantitation as well as qualitation and evolution of drug substances.

**10. Immuno Pharmacology**

 It is the specific branch of pharmacology that critically deals with various immunological aspects of drug action and immunotherapy and administration of preferred antibodies for passive immunization (serum or gamma-globulin).

**11. Pharmacy**

 It is the science that deals with the preparation, formulation, manufacture, standardization, preservation and dispensing of drugs. The term pharmacy is also used to indicate the place where the medicines are dispensed or sold.

**12. Pharmacognosy**

 Study of the sources of drug. It also deals with the physical and chemical properties of drugs.

**13. Materia medica**

Materia medica is a Latin term for the body of collected knowledge about the therapeutic properties of any substance used for healing. The term derives from the title of a work by the Ancient Greek physician **Pedanius Dioscorides** in the 1st century AD, De materia medica, 'On medical material'. The term materia medica was used from the period of the Roman Empire until the 20th century, but has now been generally replaced in medical education contexts by the term pharmacology.

 A subject that was concerned with pharmacy, posology, pharmacognosy and indications for therapeutic use of drugs.

**Drugs related terms**

**1. Over the Counter drug (OTC)**

These are those preparation that can be sold without any prescription because they can be adequately labelled for layman use.

**2. Prescription drugs**

 These are drugs that can be used only on the order of an licensed veterinarian, physician, dentist, surgeon based on a prescription. They are also known as legal drugs.

**3. Essential drugs**

 There are agents that satisfy the health care needs of majority of population. They should therefore be available at all times in adequate amounts and in appropriate dosage form.

**4. Pro-drugs:**

These are drugs that are inactive or have a low order of activity in the form administered and are metabolized to the active form in the body.

**5. Hard drugs**

 These are drugs used for non medical purposes that are liable to disable the individual seriously as a functioning member of the society by inducing severe psychological and / physical dependence. Eg: Heroine

**6. Soft drugs (page 8)**

 These are drugs used for non medical purposes that are less dependence producing, there may be psychological dependence but not physical dependence except with heavy dose. Eg: Amphetamines

**7. Nootropic drugs**

These are the drugs that affect the intellect (brain). These drugs are claimed to enhance learning, increase brain resistance to stress including hypoxia and stimulate brain metabolism especially in senile patients. Eg : Piracetam.

**Orphan drugs**

 These are drugs or biological products useful for diagnosis or treatment / prevention of a rare disease condition for which there is no reasonable expectation that the cost of developing and marketing it will be recovered from the sales of that drug

Eg: Acetyl cys-----------

 There drugs may be life saving for some patients but are not commercially available.