Reading Material for
Dispensing Technique – II

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PREFACE

A two years post matric teaching program of Dispensing Technician for the students of Allied Health Sciences. The purpose of this reading material is to provide basic education to the students regarding Pharmaceutical sciences. This reading material attempts to give an introduction to the fundamental concepts of pharmacy with description about different aspects of a drug as well as a brief overview of different drugs used in various diseases.

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CHAPTER 1: PHARMACY AND PHARMACOLOGY

Drug

A drug may be defined as any substance that is used to diagnose, prevent or treat a disease.

The nature of drugs

Drugs in common use include

- Inorganic ions
- Non peptide organic molecules
- Small peptides and proteins
- Nucleic acids
- Lipids
- Carbohydrates

Some are found in plants or animals and others are partially or completely synthetic.

A. Size and Molecular Weight

Drugs vary in size from molecular weight (MW) 7 e.g. Lithium to over MW 50,000 e.g. Thrombolytic enzymes, antibodies, other proteins. Most drugs, however, have MWs between 100 and 1000.

B. Drug-Receptor Bonds

Drug receptors are the molecular components of the body with which drugs interact to bring about their effects.

- **Chemical Bonds:** Drugs bind to receptors with a variety of chemical bonds. These include very strong covalent bonds (which usually result in irreversible action), somewhat weaker electrostatic bonds (e.g. between a cation and an anion), and much weaker interactions (e.g. hydrogen, van der Waals, and hydrophobic bonds).
- **Agonist and Antagonist:** If drug-receptor binding results in activation of the receptor, the drug is termed an agonist; if inhibition results, the drug is considered an antagonist.

Nomenclature of drugs

A drug may have more than one name. Actually, most drugs have at least three names.

i. **Chemical Name:** This indicates the molecular structure. Many of these names are complex. This name describes the compound for chemists.

ii. **Official (Approved) Name:** It is usually the abbreviated form of the chemical name. This name is used in pharmacopoeia and chosen by official bodies.

iii. **Proprietary Name (Brand, Trade Name):** This is the name given by the company which markets the drug. It is the commercial property of a pharmaceutical company. It indicates a particular formulation of a particular substance by a particular manufacturer.

Since several companies market the same drug under different proprietary names, unnecessary confusion may arise. Whenever possible, drugs should be prescribed by their approved names.

Example: Chemical Name: Acetyl-p-aminophenol

Official Name: Paracetamol

Proprietary Name: Calpol, Panadol

Sources of drugs

Following are the sources of drugs

i. **Vegetable Sources (Plant Source):** This is the oldest source of drugs. All parts of the plants are used as drugs, such as leaves, seeds, flowers, roots, bark, etc.

Examples are: Belladonna leaves. Belladonna root, Cinchona bark, Digitalis leaves, Nux vomica seeds. Senna leaves, Senna fruit. Action of crude drugs is due to Active Principles contained in them, e.g. Belladonna contains atropine, opium contains morphine, cinchona contains quinine, digitalis contains digoxin.

ii. **Animal Sources:** Various organs and tissues of animals were used in the past without understanding their mechanism of action. Active principles of animal drugs are Proteins, Oil and Fats, Enzymes and Hormones.

At present Insulin and Sex Hormones are obtained from animal source.

iii. **Mineral Sources:** Metals, metalloids, non-metal substances and their compounds have been used as drugs. Mercury was one of the earliest drugs to be used for treatment of syphilis. At present iron is used for treatment of anemia and iodine for thyroid problems and as antiseptic.

iv. **Synthetic Sources:** These days drugs are prepared in pharmaceutical laboratories. They may be organic or inorganic or a combination of organic and inorganic compounds.

Chloroform, ether, nitrous oxide and chloral hydrate were the earliest synthetic drugs. Later on derivatives of active principles of crude drugs were prepared along with advancement in the knowledge of chemistry.

At present more than 90% of drugs used for treatment of patients are prepared synthetically. Antipyretics, sulphonamides, antihistamines, anticonvulsants, antianxiety agents are examples of such drugs.

v. **Microbiological Sources**: Antibiotic drugs which are very useful for treating infections have been prepared from bacteria and fungi. Penicillin was the first antibiotic to be discovered. Some vitamins have also been prepared from such sources.

Active principles of crude drugs

Following are the active principles of crude drugs

i. **Alkaloids:** These are active nitrogenous compounds. They are alkaline in nature and intensely bitter. Most of them are insoluble in water and are solids e.g. Belladonna contains atropine and hyoscine, Opium contains morphine.

ii. **Glycosides:** These substances are highly active and complex, containing carbon, hydrogen, and oxygen. They undergo hydrolysis by either acid or enzymes in the presence of water, leading to their division into sugar and non-sugar components. The non-sugar component, known as aglycone or genin, possesses pharmacological activity.

Examples of such compounds include digoxin, digitoxin, gitoxin, and gitalin.

iii. **Saponins**: They act as emulsifying agents as they are both water and fat soluble e.g. glycyrrhizin.

iv. **Fixed oils**: these are oils which are obtained from plants and animals. They are called fixed oils because they can't be distilled without being decomposed. They form soaps with alkalies. e.g. castor oil, olive oil.

v. **Volatile oils:** They are obtained from parts of plants like flowers, fruit, leaves. They are highly aromatic and slightly soluble in water. They contain liquid hydrocarbons or some contain oxidized hydrocarbons. e.g. menthol, thymol, camphor.

vi. **Fats:** A fat is a fixed oil which is solid at room temperature. These are natural esters of glycerol and fatty acids. All three OH groups of glycerol are esterified in fats therefore they are known as triglycerides.

vii. **Waxes:** These are esters of fatty acids with monohydric alcohol. They are used in preparation of ointments and other drugs used locally on skins. e.g. bees wax.

viii. **Gums:** They are exudation of plants and contain carbohydrates. They form viscous solution with water known as mucilage. Gums and mucilage are used for preparation of suspension and emulsion.

ix. **Resins:** They form resin soaps with alkalies which are used in preparation of emulsions and pills.

x. **Oleoresins:** They are formed when resins are dissolved in volatile oils.

xi. **Gum resin:** They are combination of gum and resin. Used in dentistry.

xii. **Balsams:** These are combination of resin with benzoic acid or cinnamic acid or both. Benzoin is applied on small superficial wounds and abrasions.

xiii. **Tannins:** These are non-nitrogenous compounds possessing astringent action on mucus membrane. Some are hydrolyzed to tannic acid. They are precipitated by metallic salts and alkaloids.

xiv. **Neutral principles:** These are active substances which do not belong to any special group. e.g. Santonin.

Dosage forms

Dosage forms are pharmaceutical products that typically involve combinations of active drug components and inert components. In addition, non-reusable materials, known as excipients, are used to solubilize, color, flavor, and fashion medicinal agents into effective and appealing dosage forms.

Classification of dosage forms:

Dosage forms can be classify according to

1. Physical forms
2. Route of administration

1. Solid
2. Semi solid
3. Liquid

A. Solid dosage forms:

1. Powders
2. Granules
3. Tablets
4. Capsules
5. Modified Release dosage forms

1. Powders

These are drugs or drug extracts that are dried, ground and converted into fine particles. They can be used orally, by dusting or as insufflations.

Oral powders:

They are intended to be suspended or dissolved in water or mixed with foods, for example, antacids and laxatives.

Dusting powders:

These are non-toxic preparations intended for local application, such as antiseptics. They can be formulated for use in the nose, eyes, and vagina.

Insufflations:

These products are introduced into a body cavity and insufflators are used to administer them.

2. Granules:

They consist of solid drug aggregates of powder particles often supply in single dose sachet. Some granules are placed on tongue and swallowed with water. Other are intended to be dissolved in water before taking.

3. Tablets:

It is a form of drug in which active forms are modulated or compressed into different shapes and sizes after mixing with sucrose, lactose, dextrose, or any other suitable diluents. This process also involves adding sufficient binding, closure and a polymer coating may be applied to Improve palatability, Make the tablet smoother & easier to swallow, Make it more resistant to environment and Extending its shelf life.

Tablets are commonly administered through oral, buccal, sublingual, rectal, and vaginal routes. Some tablets are chewable, and others are effervescent as well.

4. Capsules:

These are solid dosage form in which the drug is enclosed in a hard or soft soluble container, usually of a form of gelatin.

Their main types are:

1. Hard shelled: These are used for powder and dry ingredients.
2. Soft shelled: There are used for active ingredients that are dissolved or suspend in oil.

5. Modified Release dosage forms:

These forms provide either delayed or extended release of drugs. Most delayed-release products are enteric-coated tablets or capsules designed to pass through the stomach unaffected, releasing their medication in the distal part of the intestinal tract. Delayed-release products are used either to protect the substance from destruction by gastric juice or to prevent stomach distress. Extended-release products release their medication in a controlled manner at a prime rate, for a specific duration and location. So that to optimum therapeutic blood levels of the drug is maintained.

B. Semisolid dosage forms:

These are products of semisolid consistency applied to the skin or mucous membranes for therapeutic, protective, or cosmetic purposes.

These are:

1. Ointments
2. Cream
3. Suppository
4. Gel /jelly

5. Paste
6. Poultice
7. Aerosols
8. Transdermal drug delivery system.

Ointments:

An ointment is a homogeneous, viscous semisolid preparation intended for external application to the skin or mucous membrane. They are used as emollients or for applying active ingredients to the skin for protective therapeutic purposes and when a degree of occlusion is desired. The vehicle of an ointment is known as the ointment base. Different types of ointment bases are available, each serving specific purposes:

- Hydrocarbon bases e.g. hard paraffin, soft paraffin.
- Absorption bases e.g. bees wax, wool fat
- Water soluble bases: e.g. macrogols
- Emulsifying bases: e.g. emulsifying wax, vegetable oils, olive oil, coconut oil, peanut oil, almond oil.

Creams:

Cream is a semi-solid emulsion of oil and water, divided into two groups:

1. **Oil in water creams (O/W):** These creams are composed of small droplets of oil dispersed in a continuous aqueous (water) phase. They are more comfortable and cosmetically acceptable because they are less greasy and can be more easily washed off by water.

2. **Water in oil creams (W/O):** These creams are composed of small droplets of water dispersed in a continuous oil phase.

Suppository:

A suppository is a small solid medicated mass, usually cone-shaped, inserted into the rectum where it melts at body temperature. These may be used for local or systemic effects.

Gel/Jelly:

These are semi-solid forms where a liquid phase is confined within a 3D polymer matrix (made of natural or synthetic materials) with a high degree of physical or chemical cross-linking. They are used for medication, liberation, and various applications, such as carriers for spermicidal agents used intra-vaginally.

Pastes: Pastes are essentially ointments with a high percentage of insoluble solid added. They are less penetrating than ointments.

Poultice: A poultice is a soft and viscous preparation for external use applied to the skin while hot. These must retain heat for a considerable time because they are intended to provide warmth to inflamed parts.

Pressurized Dispensers/Aerosol Spray: Various pharmaceutical forms may be packaged in pressurized dispensers, known as aerosols. Surface sprays produce droplets of small diameter or greater.

Transdermal Patches: These are medicated adhesive patches placed on the skin to deliver a specific dose of medicine through the skin and into the bloodstream. An advantage of transdermal patches over other types is that they provide a controlled release of medicine to the patient.

C. Liquid dosage forms:

These are prepared by dissolving, suspending, or emulsifying active drugs in an aqueous or non-aqueous (e.g. ether,alcohol , glycerine) solvent .These dosage forms can be administered topically, orally or parentally.

Types are

1. Monophasic liquid dosage forms, It consists of a single liquid phase, there are no visible separate layers within liquid.
2. Biphasic liquid dosage forms. It consists of two phases that are immiscible. Liquids are separate from each other e.g. oil and water

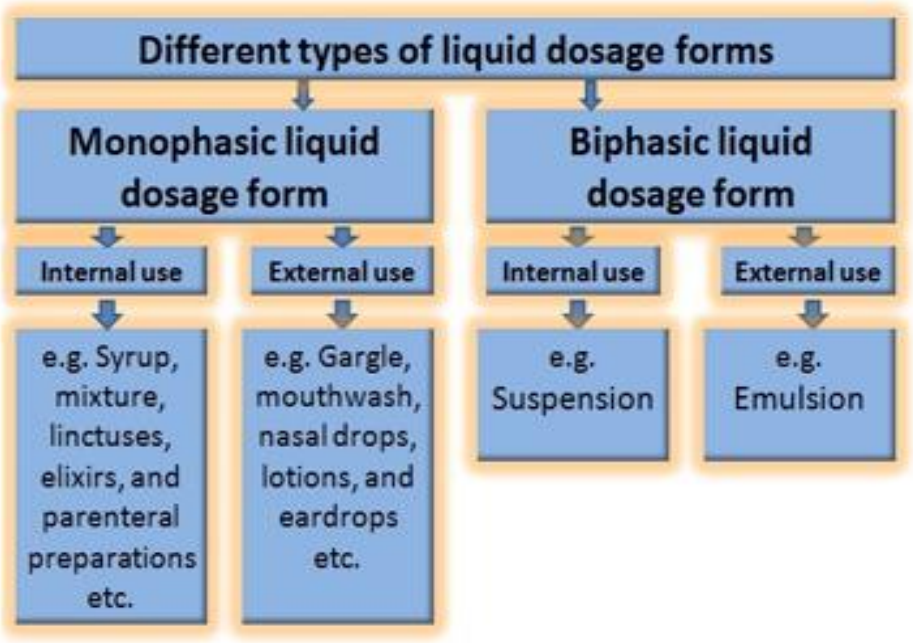

Fig. 1.1 different types of liquid dosage forms

These are classified as:-

1. Non sterile
2. Sterile

1. Non sterile liquids:

- Syrup
- Solution
- Suspensions
- Linctus
- Emulsions
- Elixir
- Liniments
- Gargles
- Enemas

Advantages

1. Better for patients with difficulty in swallowing.
2. Palatable.
3. Better choice for children & old age persons.
4. More flexibility in achieving the proper dose of a medicine.

Disadvantages

1. Shorter shelf life than other dosage forms.
2. Need special storage conditions.
3. Less stable.
4. Microbial contamination.

1. Non sterile liquids

Solution:

Solution is a homogeneous mixture which is prepared by dissolving a drug in a suitable solvent. Solutions are intended for topical, oral and parenteral administration.

Suspension:

A suspension is a heterogeneous mixture composed of relatively large, coarse particles dispersed in an aqueous vehicle. Suspensions may be used for topical administration. The internal phase (solid) is dispersed throughout the external phase (fluid) through mechanical agitation.

Emulsions:

An emulsion is a mixture of two or more liquids that are normally immiscible. In an emulsion, one liquid (dispersed phase) is mixed in the other liquid (continuous phase). The term "emulsion" comes from a Latin word meaning "to milk," as milk is an emulsion of fat and water, among its other components.

Emulsions are classified as

1. Oil in water emulsion
2. Water in oil emulsion

Emulsions are administration topically, orally & intramuscularly.

Syrup:

Syrup is a concentrated aqueous preparation of sugar or a sugar substitute, with or without flavoring agents and medicinal substances. Flavoring syrups are used to mask a bad taste, and they contain little or no alcohol.

Elixir:

An elixir is a clear, sweetened hydro-alcoholic solution intended for oral use. It is typically flavored to make it taste better. Elixirs are usually less sweet and less viscous than syrups. They may contain a small amount of ethanol or

sucrose, along with antimicrobial preservatives. However, elixirs are generally less effective than syrups in masking the taste of medicated substances.

Linctus:

Linctus is a liquid preparation prescribed to relieve cough. Typically, they contain a high proportion of syrup and glycerol, which have a soothing effect on throat membranes.

Liniments:

A liniment is a medicated topical preparation applied to the skin. Such preparations are also commonly referred to as balms. Unlike lotions, a liniment is applied with friction, meaning it is always rubbed on. Liniments are used topically to relieve pain and stiffness.

Gargles:

These are aqueous solutions used for the prevention or treatment of throat infections. They are typically prepared in a concentrated solution with directions for the patient to dilute it with warm water before use.

Mouth washes:

These are similar to gargles but are used for oral hygiene and to treat infections of gums and mouth.

Enema:

An enema is a procedure of introducing liquid into the rectum and colon through the anus. Evacuate enemas are used as bowel stimulants to treat constipation, and the volume of an evacuate enema may reach up to 2 liters. Barium enemas are used for diagnostic purposes.

Lotion: Lotions are liquid preparations applied to the skin or mucous membranes. Skin paints contain volatile solvents that evaporate quickly, leaving a dry film of prescribed medicine. Throat paints are more viscous due to a high glycerol content designed to prolong contact of medicine with the affected area.

2. Sterile liquids:

- Injectable
- Intravenous bolus dosage
- Drops

- **Sterile liquids**

Drops

Drops are solutions of highly potent drug substances these are prescribed in small quantity (10-30gram). The drops are used orally or externally in eyes, ear.

Routes of administration

Definition: Routes of administration refer to the paths by which a drug is introduced into the body. These can be

1. Enteral
2. Parenteral
3. Inhalation
4. Topical

1. Enteral Routes:

Definition: Enteral routes involve the administration of drugs through the gastrointestinal tract. The drug is typically absorbed through the mucous membranes of the mouth, stomach and intestines.

Common Enteral Routes:

Oral: Administration through the mouth. Examples include tablets, capsules, liquids, and powders.

Sublingual: Placing the drug under the tongue for absorption through the sublingual mucosa e.g. Nitroglycerine

Buccal: Placement of the drug between the cheek and gum for absorption through the buccal mucosa.

Rectal: Administration through the rectum using suppositories or enemas e.g glycerin suppository,

2. Parenteral routes:

Definition: Parenteral routes involve the administration of drugs outside the digestive tract, bypassing the gastrointestinal system. This is often done to achieve a more rapid and reliable onset of action. It is useful in emergency, in unconscious, non-cooperative and unable to retain by mouth patients

Common Parenteral Routes:

Intravenous (IV): Injection directly into a vein. This route allows for rapid and complete drug absorption. Small or large quantities may be given. It is used in emergency or drug is too irritating. I/V injection should be given carefully and slowly. For 10 ml at least 01 minute must be spent.This method is advantageous when a rapid onset of action is needed.

Intramuscular (IM): Injection into a muscle. Drug is injected deeply into a large muscle such as upper and outer quadrant of buttock, thigh and deltoid (in deltoid, vastus lateralis, or gluteal muscles). It provides a relatively rapid onset of action compared to oral administration. If Intramuscular injection is not given carefully a nerve or vein may be injured. Nodules or abscess may be formed if sterilization is not observed.

Subcutaneous (SC): Subcutaneous injections involve giving injections into the subcutaneous layer of the skin.This route is suitable for drugs that require a slower release into the bloodstream. These injections are highly effective for administering vaccines and certain medicines, such as insulin and adrenaline.

Intradermal (ID): Injection into the dermal layer of the skin. It is often used for diagnostic tests or certain vaccinations. For sensitivity tests such as before giving penicillin injection.

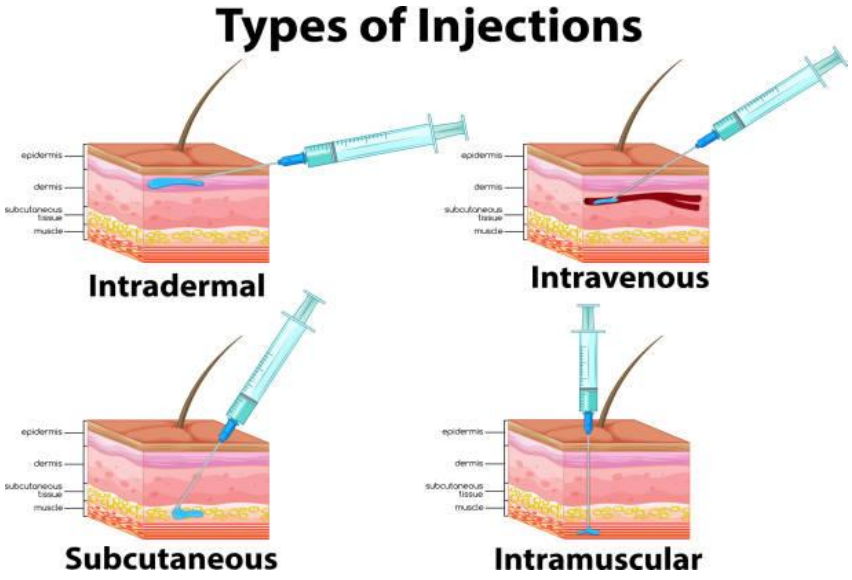

Fig. 1.2 Different types of injections

3. Inhalation route

Inhaler: Inhalers are solutions or suspensions of drugs in a mixture of inert propellants held under pressure in aerosol dispensers. The drug is released in the form of droplets with a diameter of 50 um or less from a container through a spring loaded valve incorporated in a metered-dose device. The patient then inhales the released drug through a mouthpiece. Inhalers are commonly used to treat various respiratory conditions.

Fig. 1.3 Inhaler

Nebulizer: A nebulizer is a device used to administer medication in the form of a mist into the airways. It is often employed in treating asthma and other respiratory conditions by converting a liquid medicine into vapors that can be inhaled. Nebulizers are usually reserved for serious cases of respiratory diseases.

Fig. 1.4 Nebulizer

4 .Topical route

1) Application to the skin
   Drug is placed on unbroken skin without massage or rubbing e.g pastes and plasters
2) Instillation
   Liquid drugs are poured in conjunctival sac, ear, nose or open wounds. Ointments and powders are applied also.
3) Insufflation
   Drug is distributed on the tissue surface to obtain local effect.
4) Irrigation
   Urinary bladder, vagina and urethra are irrigated by drugs.
5) Insertion
   Suppository, pessary are applied by it
6) Painting
   Drugs simply applied in the form of lotions on cutaneous or mucous membrane.

Pharmacopoeias

Pharmacopeias are authoritative compilations of drug information, standards and guidelines used by healthcare professionals and regulatory authorities.

In order to ensure the maintenance of the good standard of drugs, many countries of the world publish their own pharmacopoeias.

It is an official book published under legal authority of the Government of the country who appoint pharmacopoeia commission and its committees of experts to prepare pharmacopoeia and to revise it after every 5 years. In Pakistan**, British Pharmacopoeia (B.P)** is usually followed.

Other pharmacopoeias in use are:

- United States Pharmacopoeia (U.S.P)
- European Pharmacopoeia (E.P)
- International Pharmacopoeia (P.I)
- Pharmaceutical Codex (B.P.C)
- National Formulary (N.F)

Drugs listed in the Pharmacopoeias are called Official Drugs.

Incompatibilities

Incompatibility in pharmaceuticals is defined as a change that results in the formation of an undesirable product, which can impact the safety, efficacy, appearance and stability of the pharmaceutical product.

- Physical incompatibilities
- Chemical incompatibilities
- Therapeutic incompatibilities

Physical Incompatibilities: Physical incompatibilities occur when two or more substances are combined, resulting in a physical change and the formation of an unacceptable product. This can lead to changes in color, odor, taste, viscosity, and morphology. Physical incompatibility is also referred to as pharmaceutical incompatibility. Various manifestations of physical incompatibility include:

- **Insolubility:** Prescribed agents being insoluble in the vehicle.
- **Immiscibility:** Two or more liquids being immiscible.

- **Precipitation:** Occurs when a solvent is insoluble when added to a solution.
- **Liquefaction:** Solids mixed in a dry state undergo liquefaction.

Chemical Incompatibilities: Chemical incompatibilities involve reactions between substances, leading to changes in the chemical properties of a pharmaceutical dosage form. This can result in the formation of toxic or inactive products. Reactions may include pH changes, oxidation-reduction reactions, acid-base hydrolysis, and complex formation, manifesting as precipitation, effervescence, decomposition, color change, or explosion.

Therapeutic Incompatibility: Therapeutic incompatibility occurs when two or more drugs are administered simultaneously. For example, antibiotics like chloramphenicol and penicillin may exhibit incompatibility, with chloramphenicol antagonizing penicillin's antibacterial effects. This highlights the importance of proper sequencing in drug administration.

Mechanisms of therapeutic incompatibility are divided into two groups:

- **Pharmacokinetic:** Involves the effects of one drug on another in terms of absorption, distribution, metabolism, and excretion.
- **Pharmacodynamics:** Relates to the pharmacological activity of interacting drugs, including synergism, antagonism, altered cellular transport, and effects on receptor sites.

Therapeutic incompatibility can occur due to reasons such as errors in dosage, wrong dose or dosage form, contra-indicated drugs, synergistic and antagonistic drug interactions.

Prescribing Contra-Indicated Drugs: Certain drugs may be contra-indicated in specific diseases or patients allergic to them. For instance, penicillin and sulfur drugs are contra-indicated in patients with allergies.

Prescribing Synergistic or Antagonistic Drugs: Synergism occurs when two drugs prescribed together increase each other's activity, while antagonism occurs when two drugs decrease each other's activity. Proper consideration of drug interactions is essential for safe and effective prescribing.

Weights and measures (Metric and Imperial Systems) with symbols and their conversions

WEIGHTS, MEASURES & ABBREVIATIONS

Metrology: It is the science of weights & measures. Two different systems are used

1. Metric system
2. Imperial system

Imperial system: It is used as a subsidiary system in England and some other countries. It has two sub-systems: a. Avoirdupois system

b. Apothecary system

In both the avoirdupois and apothecary systems the volume is minim (m) and unit of weight is grain (gr)

Avoirdupois System: The Avoirdupois system is a subsidiary system in England, and its units are outlined below:

- **Unit of Weight: Grain (gr)**
  - 437.5 Grains = 1 solid Ounce (oz)
  - 16 Ounces (oz) = 1 Pound (lb)
  - 1 Pound (lb avoir) = 7000 grains
- **Unit of Volume: Minims (m)**
  - 60 Minims = 1 Fluid drachm
  - 8 Fluid Drachms = 1 Fluid Ounce
  - 480 Minims = 1 Fluid Ounce

Apothecary System: The Apothecary system is a subsidiary system in America, and its units are outlined below:

Note: Regarding weights, the two systems, Apothecary system and Avoirdupois system differ.

Avoirdupois ounce is equivalent to 437.5 grains whereas apothecary ounce has 480 grains. Moreover, avoirdupois pound contains 7000 grains whereas apothecary pound has only 5760 grains.

- **Unit of Weight: Grain (gr)**
  - 20 Grain = 1 Scruple (℈)
  - 3 Scruples = 1 Drachm (ʒ)
  - 8 Drachms = 1 solid Ounce
  - 480 Grains = 1 Solid ounce
  - 12 Solid ounces = 1 Pound (lb apoth)
  - 1 Pound (lb apoth) = 5760 grains
- **Unit of Volume: Minim (m)**
  - 60 Minims = 1 Fluid Drachm (fl. ʒ)
  - 8 Fluid Drachms = 1 Fluid Ounce
  - 480 Minims = 1 Fluid Ounce
  - 16 Fluid Ounces = 1 pint (pt. or O)
  - 8 Pints = 1 Gallon (Gal)

Advantages of Metric VS Imperial System:

Metric System:

- **Sound Basis:** The Metric system has a solid foundation and is scientifically established.
- **Fine Weights:** It allows for the measurement of very fine weights with precision.
- **Interrelated Values:** Values between various compartments in the Metric system are interrelated.

Imperial System:

- **Fluid Ounce and Grain Discrepancy:** In the Imperial system, 1 minim of water is not equal to 1 grain due to the following:

1 Fluid ounce = 480 minims
1 Solid ounce = 437.5 grains
1 grain = 480 / 437.5 = 1.1 minims (This discrepancy requires multiplying grains by 1.1 during calculations for percentage solutions to obtain accurate readings).

Metric System Overview:

- **Universal and Scientific:** The Metric system is considered universal and the most scientific.

- **Units:**

Length: Meter (m)
Volume: Liter (L)
Weight: Gram (g)

- **Multiples of Ten:**

Deca: 10 times
Hecta: 100 times
Kilo: 1000 times
Mega: 1000,000 times
Deci: 1/10th
Centi: 1/100th
Milli: 1/1000th
Micro: 1/1000,000th

Meter (m): It is a unit of length. It is the distance between 2 engraved marks on a platinum iridium bar stored at the international bureau of weights & measures measured at 4 degree Celsius & 760 mmHg. Presently, meter is defined in terms of wavelength of a certain line in the spectrum of krypton 86 isotope.

Kilogram (kg): It is the unit of weight. 1 kg is the weight of 1 liter of water at its temperature of maximum density i.e. 4 degree Celsius & 760 mmHg.

1kg=1000grams

1g= 1000mg

1mg= 1000 micro grams (mcg)

Liter (L): It is the unit of volume. It is the amount of distilled water contained in a platinum tube 1 dm^3 at 4 degree Celsius & 760 mmHg

1liter= 1000ml

1Kl= 1000liters

Medicines and solutions used in medical practice in Pakistan and many other countries are still being measured both in Metric and Imperial Systems (although Metric System has been adopted officially).

EQUIVALENTS OF METRIC AND IMPERIAL SYSTEMS

Some of the equivalents are given below:

• **1 Gram = 15 Grains**
• **1 Milliliter = 16.9 Minims**
• **1 Liter = 1.76 Pints**
• **1 Pint = 568.25 Milliliters**
• **1 Meter = 39.37 Inches**
• **1 Inch = 2.54 Centimeters**

However, for practical purposes some equivalents are given in round figures:

• **1 Grain = 60 Milligrams / 0.065 Grams**
• **1 Kilogram = 2.2 Pounds**
• **1 Fluid Ounce = 30 Milliliters**
• **1 Milliliter = 20 Drops**
• **1 Minim = 1 Drop**

House Hold Measures

• **1 Tea spoon full = 5 ml**
• **1 Dessert spoon full = 8 ml**
• **1 Table spoon full = 15 ml**
• **1 Tea cup full = 120 ml**
• **1 Tumbler full = 240 ml**
• **1 Quart (qt) = 1000 ml**

Conversion of one System to other

During dispensing one must be able to convert measures of Imperial System to Metric System and vice versa. If the basic tables and certain important key equivalent are known, it is usually not difficult to convert to any needed number.

More commonly used equivalents should be memorized. These are given below:

1 Kilogram = 2.2 Pounds
1 Gram = 15 Grains
1 Milligram = 1/60 Grain
1 Grain = 60 Milligrams
1 Milliliter = 16.9 Minims
1 Fluid Drachm = 4 Milliliters
1 Fluid Ounce = 30 Milliliters
1 Pint = 0.5 Liter
1 Gallon = 4 Liters

DECIMAL MULTIPLES AND FRACTIONS

Factor	Prefix	symbol
10^{-12}	Pico	p
10^{-9}	Nano	n
10^{-6}	Micro	µ
10^{-3}	Milli	m
10^{-2}	Centi	c
10^{-1}	Deci	d
10^{1}	Deca	da
10^{2}	Hecto	h
10^{3}	Kilo	k
10^{6}	Mega	M
10^{9}	Giga	G
10^{12}	Tera	T

TEMPERATURE

To measure temperature, Centigrade and Fahrenheit scales are used. To convert Fahrenheit into Centigrade degrees, subtract 32 then multiply by 5/9.

Example: Convert 212º Fahrenheit to centigrade.

212ºF = (212-32) x 5/9 =180 x 5/9 = 100ºC

Some of the Fahrenheit = Centigrade equivalents are given below:

Fahrenheitº - Centrigradeº:
32 - Zero
96.8 - 36.0
97.7 - 36.5
98.6 - 37.0
99.5 - 37.5
100.4 - 38.0
101.3 - 38.5
102.2 - 39.0
103.1 - 39.5
104.0 - 40.0
212.0 - 100.0

EXAMPLES

- **Convert 2.5 grams into microgram:**

1gram	=1000 milligrams
2.5 grams	= 2.5 x 1000 = 2500 milligrams
1 milligram	= 1000 micrograms
2500 milligrams	=2500x1000=25,00,000micrograms
	= 25,00,000 micrograms

- **Convert 14,00,000 micrograms into grams:**

1000 micrograms	= 1 milligram
14,00,000 micrograms	=14,00,000/1000=1400milligrams
1000 milligrams	= 1 gram
1400 milligrams	= 1400/1000= 1.4 grams
	=1.4 grams

- **How many- 65 mg capsules can be made from 52 G of a drug?**

1 gram	= 1000 milligrams
52 grams	= 52x 1000=52000milligrams

Quantity of drug which can be made =65mg

No. of capsules which can be made
= 52000/65=800
= 800 capsules

- **Convert 50 grams into grains:**

1	gram	= 15 grains
50 grams		= 50x 15= 750 grains
50 grams		=750 grains

- **Convert 50 grains into grams**

1	gram	= 15 grains

50 grains = 50/15=3.3 grains

50 grains = 3.3 grams

- **How many grains are in 4 ounce (avoirdupois)?**

1 ounce (avoir) = 437.5 grains

4 ounce (avoir) =4x 437.5 =1750 grains

4 ounce (avoir) = 1750 grains

- **Convert 2 ounce (apothecary) into grains**

1 ounce (apoth) = 480 grains

2 ounce (apoth) = 480x2 =960grains 2 ounce = 960 grains

- **Convent 1 pound (apothecary) into grams**

1 pound (apoth) = 12 ounce(apoth)
1 ounce (apoth) = 180 grains
1 pound (apoth) = 12x 480= 5760 grains
Now 1 gram = 15 grains
5760 grains = 5760/15 =384 grams
1 pound = 384 grams

- **Convent 2200 minims into fluid ounces**

1 fluid ounce = 480 minims

2200 minims	=2200/480= 4 fl ounce and 280 minims
1 fluid drachm	= 60 minims
280 minims	= 280/60 = 4 fl drachm and 280 minims
2200 minims	= 4 fl ounce 4 fl drachm and 40 minims

- **Convert 4 fl ounce into millilitres:**

1 fl ounce	=180 minims
4 fl ounce	= 4x 480 = 1920 minims
1 millilitres	= 16.9 minims
1920 minims	=1920/16.9 =113.61 millilitres
4 fl ounce	= 113.61 millilitres

ABBREVIATIONS

Abbreviation	Explanation	Abbreviation	Explanation
ā	before	PO	by mouth
ac	before meals	PR	per rectum
agit	shake, stir	prn	when needed
Aq	water	q	every
Aq dest	distilled water	qam, om	every morning
bid	twice a day	qd (do not use)	every day (write "daily")
c̄	with	qh, q1h	every hour
cap	capsule	q2h, q3h, etc	every 2 hours, every 3 hours, etc
D5W, D_5W	dextrose 5% in water	qhs	every night at bedtime
dil	dissolve dilute	qid	four times a day
disp, dis	dispense	qod (do not use)	every other day
elix	elixir	qs	sufficient quantity
ext	extract	rept, repet	may be repeated
g	gram	Rx	take
gr	grain	s̄	without
gtt	drops	SC, SQ	subcutaneous
h	hour	sid (veterinary)	once a day

h	hour	sid (veterinary)	once a day
hs	at bedtime	Sig, S	label
IA	intra-arterial	sos	if needed
IM	intramuscular	s̄s̄, ss	one-half
IV	intravenous	stat	at once
IVPB	IV piggyback	sup, supp	suppository
kg	kilogram	susp	suspension
mcg, µg (do not use)	microgram (always write out "microgram")	tab	tablet
mEq, meq	milliequivalent	tbsp, T (do not use)	tablespoon (always write out "15 mL")
mg	milligram	tid	three times a day
no	number	Tr, tinct	tincture
non rep	do not repeat	tsp (do not use)	teaspoon (always write out "5 mL")
OD	right eye	U (do not use)	units (always write out "units")
OS, OL	left eye	vag	vaginal
OTC	over-the-counter	i, ii, iii, iv, etc	one, two, three, four, etc
OU	both eyes	ʒ (do not use)	dram (in fluid measure 3.7 mL)
p̄	after	℥ (do not use)	ounce (in fluid measure 29.6 mL)
pc	after meals		

Abbreviation	Meaning
Ad	upto

Ad lib	**At pleasure**
Add	**To add**
Mist	**mixture**
Noct	**At night**
Od	**Once a day**
Omn her	**Every hour**
Per diem	**Per day**
Pulv	**powder**
Oz	**ounce**
TDS	**Three times a day**

Compounding and dispensing of pharmaceutical preparations.

Drug compounding: Drug compounding is often regarded as the process of combining, mixing, or altering ingredients to create a medication tailored to the needs of an individual patient.

The compounding process involves the preparation, mixing, and combining of pharmaceutical ingredients to create a medication tailored to a patient's specific needs. Here are the general steps involved in pharmaceutical compounding:

General Steps in the Compounding Process

Preparation phase:

- Receiving and checking for completeness and authenticity of the recipe.
- Clarifying with the doctor or patient about any missing information.
- Calculating drug dosages and checking for drug interactions.
- Calculating the amount of drugs and excipients to be used.
- Maintaining proper hygiene and the cleanliness of the compounding area.

Compounding phase:

- Dispensing all the necessary ingredients.
- Careful review of the ingredients.
- Compounding based on the appropriate technique.

Final Phase:

- Checking for indication, weight variation, and homogeneity of formulation made.
- Logging of information in compounding books.
- Labelling of the prepared drug.
- Cleaning of both compounding and storage areas.

- Giving (dispensing) medication to patient.

Drug dispensing: The dispensing process involves preparing and providing prescribed medications to patients. Here are the general steps involved in the dispensing of medication:

General dispensing procedure

- Wear a freshly laundered overall coat. It should be spotless and clean.

- Provide yourself with clean glass-cloth and a duster or sponge. It is used for cleaning the dispensing area. • Work in a clean and tidy manner. Don't accumulate stock bottles and equipment in the working area.
- Read the prescription carefully.
- If necessary, find the formula of preparation in an appropriate source of information (official books: BP, USP etc.)
- Check the doses of internal preparations
- Confirm that there are no incompatibilities in the preparation or between different preparations on the prescription.
- Look up the storage conditions for the preparation.
- Check the calculations.
- Collect the correct container and closure.
- Write the main label and collect any special labels that are required.
- Make the preparation, pack it in container.
- Check the labels and fix them to container.
- Check the finished preparation.

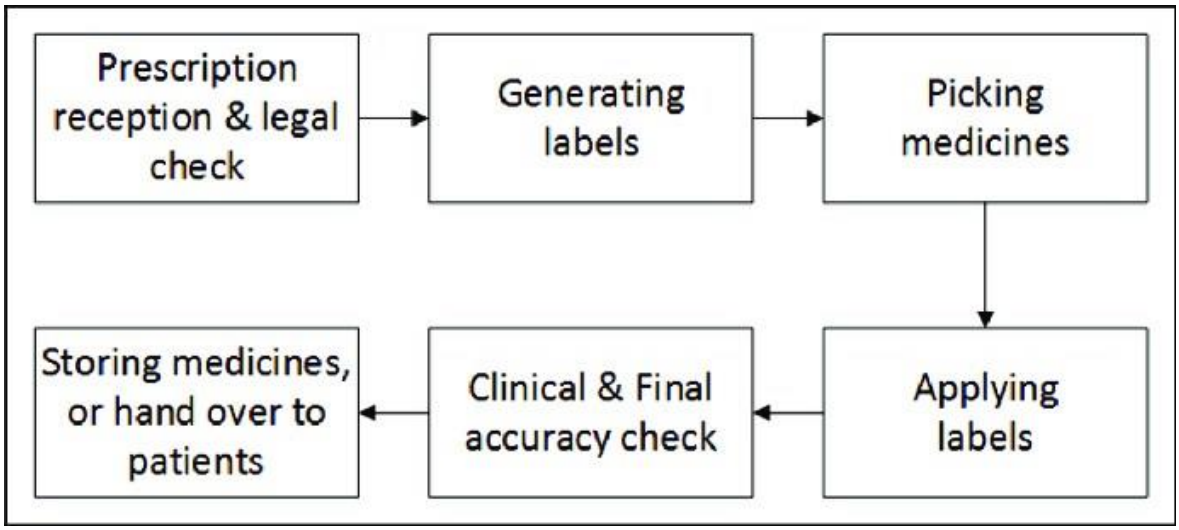

Figure 1.5 General Dispensing Procedure

Calculations of percentage solution

Many prescriptions received at the pharmacy specify the amounts of active ingredients as percentage strengths rather than measurable weights or volumes. The physician understands that achieving the desired therapeutic effect involves using each active ingredient at a particular percentage strength.

Instead of the physician manually calculating the quantity of each ingredient for the prescription, they simply specify the desired percentage strength for each ingredient and rely on the pharmacy to compute the actual amounts based on these percentages. Torsion balances lack percentage weights, and graduates lack percentage graduations. Therefore, we must convert the percentage values on the prescription into measurable quantities, either in grams for weighing or milliliters for measuring.

Percent strength: It represents the number of grams contained in 100 mL of product and is very useful in pharmacy calculations.

The following units express percent based on the nature of the ingredient:

Percent Weight in Volume (w/v): Is the number of grams in 100 mL of solution and is expressed as %w/v. Powdered substances suspended in a liquid vehicle would be calculated as w/v.

Example: A 10 % (w/v) potassium chloride (KCL) elixir would contain 10 grams of potassium chloride in every 100 milliliters of KCL elixir.

Percent Volume in Volume (v/v): Is the number of milliliters in 100 mL of solution and is expressed as %v/v. A liquid component in a liquid preparation would be calculated on a v/v basis.

Example: A 70% (v/v) alcoholic solution would contain 70 milliliters of alcohol in every 100 ml of solution.

Percent weight in weight (w/w): Is the number of grams in 100 grams of solution and is expressed as %w/w. Powdered substances mixed with a solid or semisolid (ointments) would be calculated as w/w.

Example: A 5% (w/w) boric acid ointment would contain 5 grams of boric acid in each 100 grams of boric acid ointment.

Prescription and its parts

A prescription is a written order from a licensed healthcare provider to a pharmacist, instructing the dispensing of a specific medication to a patient. Here are the key parts of a prescription:

Prescriber information

- Doctor name
- Qualification
- Clinic address
- Telephone Number

1. Patient information

- Name
- Age
- Sex
- Address

2. Date

3. Superscription: 'R_X' abbreviation of Latin word Recipe means "Take Thou" or "you take".

4. Inscription:

Main body or principle part of prescription.

It includes:

1. Name of drug
2. Dosage
3. Concentration

5. Subscription: "Instructions to pharmacist from the prescriber."

It includes;

- Dosage form
- Required or no. of doses dispensed by pharmacist
- Duration of treatment
  e.g., 1 Tab. × TDS for 7days

Signa: Represented as 'Sig' derived from Latin word Signa which means instruction to the patient regarding the use of drugs.

Signature of doctor, post and PMDC Registration number

Points to Remember:

- It is preferable to write the generic names of the drugs
- Metric system is used.
- Should be written legibly, complete & concise on a composed paper.
- There should not be any incompatibility.

EXAMPLE

ACUTE LVF: (Acute left ventricular Failure / Pulmonary Edema)

Dr ABC
Qualification
Hospital Name
Address Hospital / Clinic
Contact number of hospital/doctor
Date ----------

Pateint name : Mr XYZ
Age 55 years, Male
Resident of ----------

Diagnosis; Acute LVF

Rx

1. Inj. Furosemide 40mg
   I/V × stat
2. Oxygen Inhalation 6 liters/min
3. Inj. morphine 10 mg
   I/V × stat

Signa/ Instructions / Note:- (Not mandatory)
Patient must be in propped up position

Dr ABC
Post : MO ICU.
PMDC No. 12345

How to read a prescription

Reading a prescription correctly is crucial to ensure that the right medication is dispensed and taken by the patient. Here's a guide on how to read a prescription:

- **Patient Information:** Check the top of the prescription for the patient's information, including their name, date of birth, and sometimes address. Ensure it matches the patient in question.
- **Prescriber Information:** Identify the prescriber's information, including their name, credentials, and contact details. This information helps in case there are questions or clarifications needed.
- **Date of Prescription:** Note the date when the prescription was written. Some medications or dosages may change over time, so the date is essential for accuracy.
- **Superscription (Rx Symbol):** The "Rx" symbol, often seen at the beginning of the prescription, stands for the Latin word "recipe," meaning "take." It indicates that the document is a prescription.
- **Medication Name:** Identify the name of the medication. It may be a brand name or a generic name. If it's a generic name, it might be followed by the strength (e.g., 500 mg) or dosage form (e.g., tablets).
- **Dosage Instructions:** Look for instructions on how to take the medication. This includes the dosage (amount of medication), frequency (how often to take it), and route (how to take it, e.g., orally).
- **Duration of Treatment:** The prescription may indicate how long the patient should take the medication. It could be a specific number of days or weeks or a statement such as "as directed."
- **Special Instructions:** Check for any special instructions, such as taking the medication with food, avoiding certain activities, or any other specific guidance provided by the prescriber.
- **Refills:** If applicable, note the number of refills allowed. Some prescriptions are for a one-time use, while others can be refilled multiple times.
- **Signature of the Prescriber:** Look for the prescriber's signature. A prescription is a legal document, and the prescriber's signature confirms the order.
- **Pharmacy Information:** Note the name, address, and contact information of the pharmacy where the prescription can be filled. If the prescription is electronic, this information may be stored in the pharmacy's system.

Always follow the instructions on the prescription exactly as written. If anything is unclear or if there are concerns, it's essential to consult with the prescribing healthcare provider or a pharmacist for clarification.

Basic knowledge of important commonly used drugs

Classification of drugs

Classification is defined as the action or process of classifying something. There are different ways of classifying drugs. Some are mentioned below

- **According to the organ system of the body**
    - e.g. respiratory system, cardiovascular system etc.
- **According to their main therapeutic use**
    - e.g. Anti-diabetic drugs, anti-hypertensive drugs etc.
- **On the basis of their chemical structure**
    - e.g. Steroids, alkaloids etc.
    -

Official Drugs, Unofficial Drugs and Nonofficial Drugs

Official Drug: An official drug is included in pharmacopoeia or in national formulary or in recognized books like pharmacopoeia, national formulary or pharmaceutical codex, e.g., quinine, morphine, codeine, paracetamol are included in BP (British pharmacopoeia).

Unofficial Drug: An unofficial, a drug that was recognized earlier in the pharmacopoeia but deleted from the current issue due to severe toxic effects on humans, e.g., sucralfate (hyperacidity), mercurial compounds (diuretics), benzoic acid (preservative).

Nonofficial Drug: A drug that did not appear in either of the official books may be called non-official. Non-official drug compounds may be published in current journals having proven clinical value, but information about their side effects is not yet known, e.g., curcumine (sinusitis).

Preparations and Doses

Preparations:

Definition: Preparations of a drug refer to the specific forms in which drugs are made available for administration.

Types of Preparations:

i Solid Preparations: Tablets, capsules, powders.
ii Liquid Preparations: Solutions, suspensions, syrups.
iii Semi-solid Preparations: Creams, ointments, gels.
iv Other Preparations: Injections, patches, suppositories.

Dose:

Definition: Dose refer to the quantity of a drug administered at a given time. Doses are typically specified in terms of mass (e.g., milligrams), volume (e.g., milliliters), or other appropriate units.

Types of Doses:

i. **Single Dose:** Administered once at a specific time.
ii. **Maintenance Dose:** Regular doses to maintain a therapeutic level in the body.
iii. **Loading Dose:** Initial higher dose to quickly reach therapeutic levels.
iv. **Cumulative Dose:** Total amount of drug administered over a period.

Uses of Drugs

- **Therapeutic Purposes:** Drugs are primarily used to treat or manage various medical conditions. This includes relieving symptoms, curing diseases, preventing diseases or maintaining health.

- **Palliative Care:** Some drugs are used to alleviate pain, discomfort, or other symptoms without necessarily curing the underlying condition.

- **Preventive Medicine:** Certain drugs are used for prophylaxis, preventing the onset of diseases, especially in individuals at risk.

Contraindications

Definition: A specific situation in which a medicine or surgical procedure should not be used because it will be harmful to the person.

Examples: Contraindications can include allergies to the drug, interactions with other medications, specific medical conditions (e.g., pregnancy, liver or kidney diseases) or age-related factors.

Toxic Effects of Drugs

Definition: Toxic effects refer to harmful, adverse reactions that may occur when drugs are used, often in excessive amounts or inappropriately.

Types of Toxic Effects:

- **Dose-Dependent (Predictable) Toxicity:** Occurs when the toxic effect is directly related to the dose administered. For example, overdose leading to liver damage with acetaminophen. These are of two types
  a. **Due to excessive activity of the drug:** When a drug is very active in the body, it can cause some problems. This can happen with drugs that affect the central nervous system (like making you feel sleepy), drugs that affect the heart, drugs that lower blood pressure, and drugs that lower blood sugar.

     Everyone is at risk of having these problems if they take too much of the drug. But some people are more likely to have issues, like those with kidney or liver problems, or those who are very young or very old.

  b. **Withdrawal symptoms after discontinuation of treatment:** Withdrawal symptoms refer to a set of physical and/or psychological reactions that occur when a person abruptly stops or significantly reduces the intake of a drug to which the body has developed dependence.

     For example, if you stop taking a certain kind of medicine that helps with pain, or if you stop taking sleeping pills or drugs that people can get addicted to, you might feel unwell. Another example is stopping corticosteroid therapy suddenly can cause a crisis.

- **Idiosyncratic (Unpredictable) Toxicity:** Unpredictable reactions that are not dose-dependent and may be influenced by individual genetic factors.

a. **Allergic Reactions:** Immune system-mediated responses that can range from mild allergic reactions to severe anaphylaxis. It is a common adverse effect.

b. **Genetic factors:** Some people may have special reactions to certain drugs because of their genes. This means that their bodies are different in a way that makes the medicine cause more harm to them than to others. For example, there's a condition called glucose-6-phosphate dehydrogenase deficiency. If someone has this condition and they take a medicine for malaria called primaquine or certain antibiotics called sulphonamides, they might develop a type of anemia (a blood problem) that happens quickly and is severe. Another example is when someone has a specific genetic issue related to a substance called pseudocholinesterase. If a person with this genetic issue takes a muscle relaxant drug called suxamethonium, they might not be able to use it properly. This can lead to long-lasting muscle paralysis and difficulty breathing and even death.

Idiosyncracy

Sometimes, people might have strange and unexpected reactions to certain medicines, and we call this "idiosyncrasy." It means that the response to a drug is unusual and can't be easily explained or predicted in a specific person.

For example, if someone takes a medicine called Chloramphenicol, which is used to treat infections, they might have a rare and severe reaction called aplastic anemia, where the body doesn't produce enough blood cells.

Drug Act

In many countries worldwide, the manufacturing, distribution, sale, import, and export of drugs are regulated by Drug Acts and corresponding rules. Before the formation of Pakistan, the Drug Act of 1940 and its rules were applied in India, and these regulations continued to be relevant in Pakistan for an extended period.

In 1972, the Generic Drug Act was implemented, requiring drugs to be marketed using Generic Names (internationally approved names based on the chemical structure of drugs) rather than Trade Names (proprietary, patent names). Both Generic and Trade names have their advantages and disadvantages.

The Generic Drugs Act was later replaced by the DRUGS ACT of 1976, which is currently in effect in Pakistan. It is crucial for members of the medical profession to comprehend the implications of this act and avoid any violations during the execution of their professional duties.

To ensure the production and sale of standard drugs, the government has appointed Drug Inspectors. These inspectors are responsible for taking drug samples and sending them to Drugs Testing Laboratories for analysis. In cases where drugs do not meet the required quality standards, the inspectors file a case against the offender in the Drugs Court established by the government. If found guilty, the offender faces punishment under the Drugs Act of 1976.
Given below are definitions of some commonly used terms regarding drugs as given in the Drug Act.

- **Drug** is a substance or a mixture of substances that is manufactured, sold, stored, offered for sale or represented for internal or external use in the treatment, mitigation, prevention or diagnosis of disease in human beings or animals. Surgical ligatures, sutures, bandages, absorbent cotton, disinfectants, adhesive plasters, gelatin capsules and antiseptic solutions are also included amongst drugs for the purpose of Drugs Act 1976.

- **Adulterated Drug** means a drug which consists in whole or in part of any filthy, putrid or decomposed substance or which contains any foreign matter or which has been manufactured, packed or held under unsanitary condition whereby it may have been contaminated with dirt, filth or any other foreign matter or whereby it may have been rendered injurious to health, or it has been mixed with any substance so as to reduce its quality or strength.

- **Counterfeit Drug** means a drug the label or outer packing of which is an imitation of, or resembles or so nearly resembles as to be calculated to deceive the label or outer packing of a drug of another manufacturer.
- **Misbranded Drug** means a drug which is not labelled in the prescribed manner or the label or container of which bears any statement, design or device which makes any false claim for the drug.

- **Spurious Drug** means drug which does not contain the active ingredient of the drug which it claims to be or claims to be the product of a manufacturer, place or country whereas it is not truly such product or bears the name of a company but that company is factious or does not exist.

- **Substandard Drug** means a drug which is not of the standard quality in accordance with the prescribed specifications or those given in the most recent edition of publications such as Pakistan Pharmacopoeia, British Pharmacopoeia, British Pharmaceutical Codex, United States Pharmacopoeia.

- **Expiry Date of Drug** means the date stated on the label of a drug after which the drug is not expected to retain its claimed efficacy, safety, quality, potency or after which it is not permissible to sell the drug.

- **Pakistan National Formulary (P.N.F.)**: Federal Ministry of Health, Government of Pakistan registers drugs (both manufactured in Pakistan or imported from abroad) for marketing in the country. The registered drugs are published in Pakistan National Formulary (P.N.F.)

- **Medical and Dental Ordinance**

  Pakistan Medical and Dental Council Ordinance, 1962 was enacted to consolidate the law relating to the registration of medical practitioners and dentists and reconstitute the Medical and Dental Council in Pakistan in order to establish a uniform minimum standard of basic and higher qualifications in medicine and dentistry.

Prohibition of Medical Practice Ordinance

Allopathic System (Prevention of Misuse) Ordinance, 1962 was enacted to prevent the misuse of the allopathic system of medicine and to provide for matters connected therewith. The Ordinance prescribes the prohibition of the use of the word “doctor” and its variations; the use of medical degrees or diplomas; performing surgical operations by unqualified persons; for prescribing certain drugs; and restriction on the sale of patent and proprietary medicines.

Storage of Medicines/Equipment/Instruments

Proper storage of medicines, equipment and instruments is crucial to maintaining their efficacy, safety and integrity. Here are key points to consider for the storage of medicines, equipment, and instruments:

Medicines

- **Temperature Control:** Store medications at the temperature recommended by the manufacturer. Some may require refrigeration, while others need room temperature.
- **Humidity Control:** Keep medicines away from excessive humidity, as moisture can affect their stability.
- **Light Exposure:** Protect medications from direct sunlight or excessive light exposure, as some drugs are sensitive to light.
- **Separation of Products:** Store different medications separately to prevent cross-contamination or reactions between substances.
- **Storage Conditions:** Follow specific storage instructions on the medication's packaging, considering factors such as upright positioning, airtight containers, etc.
- **Expiry Dates:** Regularly check and monitor expiration dates, removing and properly disposing of expired medications.
- **Security:** Secure medicines to prevent unauthorized access, especially for controlled substances.

Equipment

- **Clean and Dry Environment:** Store equipment in a clean and dry environment to prevent corrosion and damage.
- **Proper Ventilation:** Ensure proper ventilation to prevent the buildup of dust or contaminants on equipment surfaces.
- **Organization:** Organize equipment systematically for easy accessibility and to prevent damage during handling.
- **Secure Storage:** Store sensitive or delicate equipment in secure cabinets or designated areas to prevent accidental damage.
- **Calibration:** Regularly calibrate and maintain equipment according to manufacturer guidelines to ensure accuracy.
- **Protection from Elements:** Protect equipment from extreme temperatures, direct sunlight, and other environmental elements.
- **Instruments Sterile Storage:** For sterile instruments, store them in a way that maintains their sterility until use. This may include using sterile wraps or containers.
- **Drying:** Ensure that instruments are thoroughly dried before storage to prevent corrosion.

- **Sharp Objects:** Store sharp instruments in a manner that protects both the instruments and individuals handling them.
- **Regular Inspection:** Regularly inspect instruments for signs of wear, damage, or malfunction and address any issues promptly.
- **Proper Shelving:** Use appropriate shelving and storage solutions to prevent instruments from overcrowding, which can lead to damage.
- **Labeling:** Clearly label storage areas for instruments, indicating the types of instruments stored and any special handling instructions.

By adhering to proper storage practices, healthcare facilities can ensure the effectiveness, safety, and longevity of medicines, equipment, and instruments, contributing to the overall quality of patient care.

Validity of drugs

The term **"validity"** in the context of drugs typically refers to the period during which a drug is considered safe and effective for use.

Expiry date: The expiry date, also known as the expiration date, is the date until which the drug manufacturer guarantees the full potency and safety of the medication.

To ensure validity of drugs regular stock rotation and regular monitoring of expiry dates should be done.

Stock taking

Stock taking, also known as inventory or stock counting, is the process of physically counting and recording the quantities of goods or items held in a business or organization at a specific point in time. It is a crucial aspect of inventory management and is conducted for various purposes, including maintaining accurate records, preventing stock outs or overstock situations, and assessing the financial health of the organization.

CHAPTER 2:
DRUGS USED IN DIFFERENT DISEASES
Drugs acting on Autonomic Nervous System (ANS)
Basic Concepts of ANS

The Autonomic Nervous System (ANS) is the functional division of the nervous system that is responsible for automatic and unconscious functions in the body e.g. control of heart rate and blood pressure, digestion and respiratory rate.

Its 2 major subdivisions are the Parasympathetic and the Sympathetic. The Enteric Nervous System (ENS) is a semi-autonomous part of the ANS located in the gastrointestinal tract.

Parasympathetic Nervous System

The part of the autonomic nervous system that originates from the cranial nerves and sacral part of the spinal cord.

- **Function:** Promotes "rest and digest" activities, conserving energy and facilitating recovery.
- **Effects:** Slows heart rate, constricts pupils, stimulates digestion, and promotes relaxation.

Sympathetic Nervous System

The part of the autonomic nervous system that originates in the thoracic and lumbar parts of the spinal cord.

- **Function:** Prepares the body for "fight or flight" responses during stress or emergencies.
- **Effects:** Increases heart rate, dilates pupils, inhibits digestion, releases adrenaline, and redirects blood flow to muscles.

Receptors of Autonomic Nervous System

The receptors of the autonomic nervous system (ANS) are specific proteins located on target cells that respond to neurotransmitters released by the sympathetic and parasympathetic nervous systems.

The two main types of receptors are cholinergic receptors (for the parasympathetic system) and adrenergic receptors (for the sympathetic system).

Receptors of Parasympathetic Nervous System (PNS):

Cholinergic receptors are receptors that respond to the neurotransmitter acetylcholine. These receptors are broadly categorized into two main types:

- Muscarinic receptors
- Nicotinic receptors

They are found in various tissues and organs throughout the body, and their activation leads to different physiological effects. Here's an overview of the location and effects of cholinergic receptors:

1. **Muscarinic Receptors:**
    - **Location:**

- Muscarinic receptors are primarily found on the effector organs innervated by the parasympathetic nervous system (rest and digest system).
- They are also present in some tissues innervated by the sympathetic nervous system, sweat glands, and certain parts of the central nervous system.
- Muscarinic receptors are G protein-coupled receptors.
- There are five subtypes of muscarinic receptors: M1, M2, M3, M4, and M5.
- **Effects:**
- **Heart (M2 receptors):** Activation of M2 receptors on the heart leads to a decrease in heart rate and a decrease in the force of contraction.
- **Smooth muscle (M3 receptors):** Activation of M3 receptors in smooth muscle, such as in the gastrointestinal tract and bronchi, leads to contraction.
- **Glands (M3 receptors):** Muscarinic receptors on gland cells stimulate the secretion of saliva, tears, and other digestive fluids.
- **Eye (M3 receptors):** Activation of M3 receptors in the eye's circular muscle causes constriction of the pupil (miosis) and accommodation for near vision.

2. **Nicotinic Receptors:** □

Location:

- Nicotinic receptors are found at the synapses between preganglionic and postganglionic neurons in both the sympathetic and parasympathetic divisions of the autonomic nervous system.
- They are also present in the neuromuscular junction, where motor neurons synapse with skeletal muscle fibers.
- Nicotinic receptors are ionotropic receptors, allowing the passage of ions when activated.
- **Effects:**
- **Autonomic ganglia (preganglionic receptors):** Activation of nicotinic receptors in autonomic ganglia leads to the transmission of signals from preganglionic to postganglionic neurons in both the sympathetic and parasympathetic systems.
- **Neuromuscular junction:** Activation of nicotinic receptors at the neuromuscular junction leads to muscle contraction in skeletal muscle.

Sympathetic Nervous System (SNS):

1. **Adrenergic Receptors:**

- **Alpha-1 (α1) Receptors:**
- **Location:** Mainly found on smooth muscle cells in blood vessels.
    - **Effect:** Activation leads to vasoconstriction, increasing blood pressure.
    - **Alpha-2 (α2) Receptors:**
    - **Location:** Found in various tissues, including the central nervous system.
    - **Effect:** Activation inhibits the release of norepinephrine, providing negative feedback.
    - **Beta-1 (β1) Receptors:**
    - **Location:** Predominantly located in the heart.
    - **Effect:** Activation increases heart rate, contractility and the force of heart contraction.
    - **Beta-2 (β2) Receptors:**
    - **Location:** Found in smooth muscle of bronchioles and blood vessels, as well as in the liver.
    - **Effect:** Activation leads to bronchodilation and vasodilation.
    - **Beta-3 (β3) Receptors:**
    - **Location:** Primarily found in adipose tissue.
    - **Effect:** Activation promotes lipolysis (breakdown of fats).

ANS Ganglia

Both parasympathetic and sympathetic nervous systems have relay stations called ganglia. They are located between the CNS and end organ.

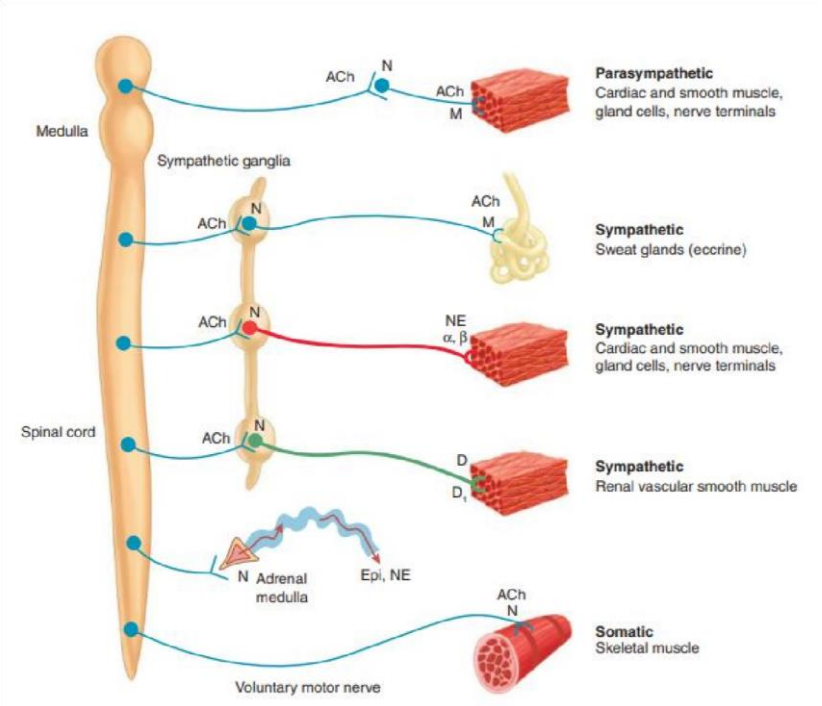

Figure 2.1: Schematic diagram comparing some features of parasympathetic & sympathetic division of autonomic nervous system

Clinically important ANS drugs
Adrenaline/Epinephrine

Adrenaline, also known as epinephrine, is used as a medication in various medical situations to address specific conditions. It is a potent hormone and neurotransmitter that can rapidly affect the cardiovascular system, respiratory system and other physiological processes.

Mechanism of action: The mechanism of action of adrenaline (epinephrine) involves, its binding to specific receptors, leading to different physiological responses. Adrenaline acts primarily through two types of adrenergic receptors:

- Alpha-adrenergic receptors
- Beta-adrenergic receptors

Adrenaline Release and Regulation:

- Adrenaline is released into the bloodstream in response to signals from the sympathetic nervous system, which is part of the autonomic nervous system.
- The release of adrenaline is triggered by stress, fear, exercise, or any situation that activates the "fight or flight" response.

Effects on the Body:

- **Cardiovascular System:**
- Adrenaline increases heart rate.
- It increases the force of heart contractions.
- It causes blood vessels to constrict in certain areas, redirecting blood flow to vital organs and muscles.
- **Respiratory System:**
- Adrenaline dilates the bronchioles in the lungs, improving airflow.
- **Metabolism:**
- Adrenaline increases the breakdown of glycogen into glucose in the liver, providing a quick source of energy.
- It enhances the release of glucose from the liver into the bloodstream. Adrenaline increases the metabolic rate, helping to mobilize energy resources.
- **Muscles:**
- Adrenaline increases blood flow to skeletal muscles.
- It enhances muscle strength and performance.
- **Pupils:**

- Adrenaline causes pupil dilation (mydriasis) thus improving far vision.
- **Blood Clotting:**
- Adrenaline can increase blood clotting by constricting blood vessels. **Lipolysis:**

  Adrenaline promotes the breakdown of fat stores, releasing fatty acids into the bloodstream to produce energy.

Duration of Effects:

- The effects of adrenaline are relatively short-lived because it is quickly metabolized in the body.
-

Medical Uses of Adrenaline:

Here are some common medical uses of adrenaline:

Anaphylaxis Treatment:

- Adrenaline is the first-line treatment for anaphylaxis, a severe and potentially life-threatening allergic reaction.
- It is administered through an injection (usually intramuscular) to rapidly counteract symptoms such as airway constriction, low BP and shock.

Cardiac Arrest:

- Adrenaline is used for the treatment of cardiac arrest.
- It is administered intravenously in diluted form to increase heart rate and improve the force of cardiac contractions, thereby supporting circulation.

Severe Asthma Attacks:

- In cases of severe asthma attacks that do not respond to other treatments, adrenaline may be used to rapidly dilate the bronchioles, improving airflow.
- Adrenaline can be administered through inhalation or subcutaneous injection, depending on the severity of the situation.

Hemostasis (Control of Bleeding):

- Adrenaline is sometimes added to local anesthetics or injected directly into tissues during certain surgical procedures to reduce blood flow and control bleeding.
- It can be used in surgeries or dental procedures where vasoconstriction is beneficial.

Bradycardia (Slow Heart Rate):

- In certain cases of severe bradycardia (slow heart rate), especially if it is causing hypotension or inadequate perfusion, adrenaline may be used to increase heart rate.

Shock:

- Adrenaline can be administered in cases of severe shock to increase blood pressure and improve organ perfusion.

Adverse Effects:

Here are some potential adverse effects of adrenaline:

Cardiovascular Effects:

- **Increased Heart Rate (Tachycardia):** Adrenaline stimulates the heart, leading to an increase in heart rate, palpitations, arrhythmias or even death.
- **Increased Blood Pressure:** Adrenaline can cause vasoconstriction, leading to an increase in blood pressure. This effect may be more marked in certain individuals or at higher doses.
- **Chest Pain:** Adrenaline use can result in chest pain, especially in persons having already heart problem.

Central Nervous System Effects:

- **Anxiety and Restlessness:** Adrenaline can stimulate the central nervous system results in anxiety, restlessness or nervousness.
    - **Headache:** Some individuals may experience headaches as a side effect of adrenaline.

Respiratory Effects:

- **Respiratory Distress:** In rare cases, especially with excessive doses, adrenaline can cause respiratory difficulties or exacerbate existing respiratory conditions.

Metabolic Effects:

- **Hyperglycemia:** Adrenaline promotes the breakdown of glycogen into glucose in the liver, potentially leading to elevated blood sugar levels. This effect is usually temporary.

Local Effects (Injection Site):

- **Tissue Necrosis:** If adrenaline is accidentally injected into a small blood vessel or if the injection site receives excessive doses, it can lead to vasoconstriction, reduced blood flow and causing tissue damage.

Dopamine

Dopamine is a neurotransmitter that plays a role in mood regulation, movement control and the regulation of the reward system. Dopamine is also used to treat certain shocks.

Mechanism of Action:

- Dopamine acts as a neurotransmitter. In body Norepinephrine and epinephrine are made from it.
- When dopamine is given it stimulates dopaminergic, beta-adrenergic and alpha-adrenergic receptors in the body.

Clinical Uses:

Shock and Hypotension:

- Dopamine is used in cases of shock and severe hypotension to increase blood pressure.

- **Heart Failure:**
  - In certain cases of heart failure, dopamine may be used to improve cardiac function and increase renal blood supply.
  - **Renal Perfusion:**
  - Dopamine, at lower doses, can stimulate dopaminergic receptors, leading to vasodilation and increase renal blood flow.

Dosage and Administration:

- Dopamine is administered intravenously.
- The dosage is carefully titrated based on the patient's response and the desired effect.

Adverse Effects:

- Adverse effects can occur at higher doses which are
- Increased heart rate
- Arrhythmias
- Increased blood pressure

Salbutamol

Salbutamol or albuterol is a bronchodilator medication commonly used to treat respiratory conditions in which bronchoconstriction or airway obstruction occur.

Mechanism of Action:

- Salbutamol activates beta-2 adrenergic receptors of the airways, leading to relaxation of bronchial muscles.
- This bronchodilator effect helps open up the airways, making it easier to breathe.
- **Clinical Uses:**
- **Asthma:**
- It is commonly used as inhaler or intravenously during asthma attacks or for the prevention of exercise-induced bronchospasm.
- **Chronic Obstructive Pulmonary Disease (COPD):**
- Salbutamol is used for COPD to relieve bronchoconstriction and improve airflow.

Administration:

- Salbutamol is available in various formulations, including inhalers, nebulizer solutions, oral tablets and injections.

- **Adverse Effects:**
  - Common side effects are tremors, palpitations, increased heart rate, and headache.

Ephedrine

Ephedrine is a medication with both stimulant and decongestant properties.

Mechanism of Action:

- Ephedrine is a sympathomimetic drug.
- It stimulates both alpha and beta-adrenergic receptors, leading to the release of norepinephrine.
- The stimulation of beta receptors results in bronchodilation and increased heart rate, while alpha receptor stimulation causes vasoconstriction.

Clinical Uses:

- **Nasal Congestion:**
- Ephedrine is commonly used as a nasal decongestant in conditions like the common cold or allergies.
- It constricts blood vessels in the nasal passages, reducing swelling and congestion.
- **Asthma and Bronchitis:**
- Ephedrine has been used in the past for the management of asthma and bronchitis.

Dosage and Administration:

- Ephedrine is available in various forms, including oral tablets, nasal drops, and injections.
- **Adverse Effects:**
- These may be increased heart rate, high blood pressure, restlessness, insomnia, and tremors.

Methyldopa

Mechanism of Action:

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- **Central Alpha-2 Agonist:** Activation of central alpha-2 receptors inhibits sympathetic outflow, leading to a decrease in norepinephrine release.

Clinical Uses:

Hypertension (High Blood Pressure):

- Methyldopa is primarily used for the treatment of hypertension.
- Especially used in pregnancy-related hypertension.

Dosage and Administration:

- Methyldopa is typically administered orally in the form of tablets or capsules.

Adverse Effects:

- **Central Nervous System Effects:**
- Drowsiness and sedation are common side effects.
- Vivid dreams and nightmares may occur.
- **Hematologic Effects:**
- Hemolytic anemia has been reported, especially in patients with glucose-6-phosphate dehydrogenase (G6PD) deficiency.

- Positive Coombs test without hemolysis may occur.
- Dry mouth, nasal congestion, and weight gain may occur.

Beta blockers

Beta blockers are a class of medications that block the effects of adrenaline (epinephrine) and other stress hormones. They are commonly used to treat various cardiovascular conditions.

Classification:

1. Non-Selective Beta Blockers:

These beta blockers block both beta-1 and beta-2 adrenergic receptors.

Examples:

- Propranolol
- Nadolol

2. Selective Beta-1 Blockers:

These beta blockers selectively block beta-1 adrenergic receptors, mainly found in the heart.

- **Examples:**
- Atenolol
- Metoprolol

3. Beta Blockers with Alpha-Blocking Activity:

These beta blockers have both beta-blocking and alpha blocking activity. Alpha-blocking activity can result in vasodilation.

- **Examples:**
- Carvedilol
- Labetalol

- **Mechanism of Action:**

Beta blockers primarily act by blocking beta-adrenergic receptors. These receptors are found in the heart and other tissues. By blocking these receptors, beta blockers reduce the effects of adrenaline and results in:

- **Decreased Heart Rate:** Beta blockers slow down the heart rate.
- **Decreased Contractility:** They reduce the force of contraction of the heart.
- **Vasodilation:** Some beta blockers cause blood vessels to relax, leading to a reduction in blood pressure.

Uses:

- **Hypertension (High Blood Pressure):** Beta blockers are often prescribed to lower blood pressure.
- **Angina Pectoris:** Used to reduce chest pain caused by reduced blood flow to the heart.
- **Arrhythmias:** They help control irregular heart rhythms.
- **Heart Failure:** Beta blockers may improve symptoms in stable heart failure patients and prolong their life.
- **Migraine Prevention:** these are used to prevent migraines.
- **Glaucoma:** beta blockers are used to reduce intraocular pressure in the eyes.
- **Side Effects:**
- Fatigue or Weakness
- Cold Hands and Feet
- Bradycardia
- Hypotension
- Bronchoconstriction , increase risk of asthma
- **Contraindications:**
- **Asthma:** Non-selective beta blockers may worsen bronchoconstriction in asthmatic patients.
- **Heart Block:** Beta blockers may slowing down the heart rate further.
- **Severe Heart Failure:** Beta blockers are contraindicated in acute heart failure.

Drugs used in Glaucoma

Definition: Glaucoma is a condition in eye in which the intraocular pressure (IOP) is increased and optic nerve may be damage leading to irreversible blindness.

IOP is maintained by aqueous humour. To treat Glaucoma drugs either decrease its production or increase its drainage.

There are several classes of medications used to treat glaucoma:

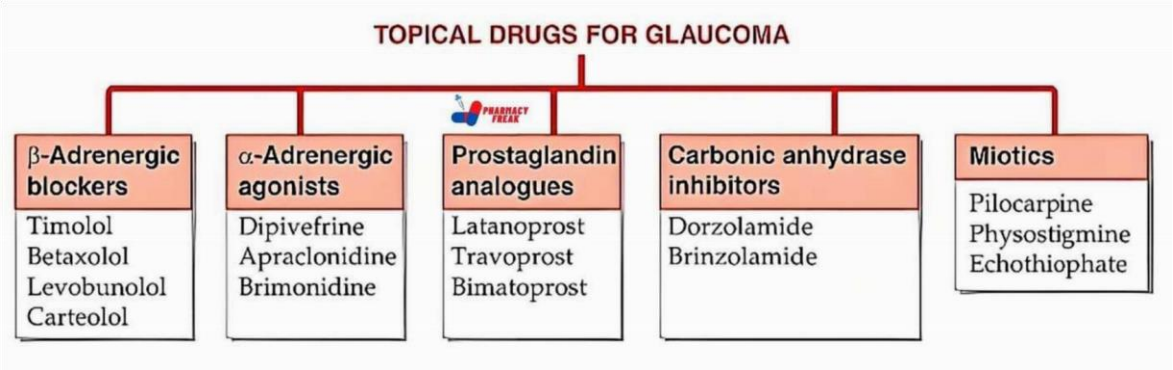


Figure 2.2: Topical drugs used for Glaucoma

1. **Prostaglandin Analogs:**

Examples: Latanoprost, Travoprost,

Mechanism of Action: Increase the outflow of aqueous humor (fluid within the eye) by relaxing the muscles in the eye.

Administration: Usually applied topically once daily in the evening.

Side effects

- Redness or irritation of the eye
- Making the iris color darker
- Increased eyelash growth

2. **Beta-Blockers:**

Examples: Timolol, Betaxolol

Mechanism of Action: Reduce the production of aqueous humor by blocking beta receptors present in the eye.

Administration: Topical formulations (eye drops)

Side effects

- **Fatigue and weakness:**
- **Cold extremities**
- **Bradycardia (slow heart rate):**
- **Low blood pressure:**
- **Breathing difficulties:**

3. **Alpha Agonists:**

Examples: Apraclonidine, Brimonidine

Mechanism of Action: Reduce aqueous humor production and increase its outflow.

Administration: Usually applied topically (eye drops)

4. **Carbonic Anhydrase Inhibitors:**

Examples: Dorzolamide, Brinzolamide

Mechanism of Action: Reduce aqueous humor production by inhibiting the enzyme carbonic anhydrase.

Administration: Available as eye drops and sometimes as oral tablets.

Side effects:

- Burning or stinging sensation in the eyes
- Blurred or altered vision
- Sensitivity to light increases

5. **Pilocarpine**

Mechanism of Action:

- **Mechanism:** In the eye causes miosis (pupil constriction) and increased outflow of aqueous humor, reducing intraocular pressure.

- **Administration:**
- Available as Eye drops.

6. Mannitol

Mechanism of Action:

- **Mechanism:** Increases osmotic diuresis thus promoting water excretion and reducing intraocular pressure in the eye.

Administration Form: Intravenous (IV) infusion.

Side Effects:

- Fluid and electrolyte imbalance:

Important Considerations

Regular use of prescribed medications is must for effective management. Skipping doses can lead to increased IOP and damage to eye

Drugs used in Angina

Angina is a medical condition characterized by chest pain or discomfort caused by reduced blood flow to the heart muscle. It is often associated with coronary artery disease. The treatment of angina typically involves lifestyle modifications, medications, and in some cases, medical procedures. The drugs used in the management of angina aim to relieve symptoms, improve blood flow to the heart, and reduce the risk of complications. Here are some common classes of drugs used in the treatment of angina:

1. **Nitrates (e.g., Nitroglycerin):**
   - **Mechanism of Action:** Nitrates relax and dilate blood vessels and improving blood flow to the heart muscle and reducing the workload on the heart.
   - **Side Effects:** Headache, tachycardia, dizziness, flushing and low blood pressure. Tolerance may develop with prolonged use.
2. **Beta-Blockers (e.g., Metoprolol, Atenolol):**
   - **Mechanism of Action:** Beta-blockers reduce the heart rate, blood pressure, and myocardial oxygen demand by blocking the effects of adrenaline (epinephrine) on the heart.
   - **Side Effects:** Fatigue, dizziness, cold extremities, risk of asthma
3. **Calcium Channel Blockers (e.g., Amlodipine, Verapamil, Diltiazem):**
   - **Mechanism of Action:** Calcium channel blockers dilate blood vessels and reduce the workload on the heart
   - **Side Effects:** Headache, dizziness, flushing, and ankle swelling. Verapamil and diltiazem may cause constipation.
4. **Antiplatelet Agents (e.g., Aspirin, Clopidogrel):**
   - **Mechanism of Action:** Aspirin inhibits platelet aggregation, reducing the risk of blood clot formation. Clopidogrel is also an antiplatelet agent.
   - **Side Effects:** Aspirin can cause gastrointestinal bleeding and allergic reactions. Clopidogrel may be associated with bleeding disorders.

Drugs used in Hypertension

Hypertension or high blood pressure is a common condition that requires treatment. If remain untreated it will damage vital organs like heart, kidneys, brain and eyes There are several classes of drugs used to treat hypertension and the choice of medication depends on stage of hypertension, presence of other diseases and individual patient's characteristics. Here are some commonly prescribed classes of drugs for hypertension along with examples and their mechanisms of action:

BLOOD PRESSURE STAGES

Blood Pressure Category	Systolic mm Hg (upper number)		Diastolic mm Hg (lower number)
Normal	Less Than 120	and	Less Than 80
Elevated	120-129	and	Less Than 80
High Blood Pressure (Hypertension) Stage 1	130-139	or	80-89
High Blood Pressure (Hypertension) Stage 2	140 or Higher	or	90 or Higher
Hypertensive Crisis (consult your doctor immediately)	Higher Than 180	and/ or	Higher Than 120

1. **Thiazide Diuretics (e.g., Hydrochlorothiazide):**
   - **Mechanism of Action:** Thiazide diuretics increase urine production, leading to reduced fluid volume and lower blood pressure. They also relax blood vessels.
   - **Side Effects:** Electrolyte imbalances (e.g., low potassium), increased blood glucose levels, and increased uric acid levels.
2. **Angiotensin-Converting Enzyme (ACE) Inhibitors (e.g., Enalapril, Lisinopril):**
   - **Mechanism of Action:** ACE inhibitors block the conversion of angiotensin I to angiotensin II (a hormone that causes increase in B.P by constricting the blood vessels). By inhibiting this process, ACE inhibitors lead to vasodilation and reduced blood pressure.
   - **Side Effects:** Cough, contraindicated in pregnancy, elevate blood potassium level
3. **Angiotensin II Receptor Blockers (ARBs) (e.g., Losartan, Valsartan):**
   - **Mechanism of Action:** ARBs block the effects of angiotensin II, resulting in vasodilation and reduced blood pressure.
   - **Side Effects:** Contraindicated in Pregnancy, elevate blood potassium level,
4. **Calcium Channel Blockers (e.g., Amlodipine, Diltiazem):**
   - **Mechanism of Action:** Calcium channel blockers inhibit the entry of calcium into heart and blood vessel cells, leading to vasodilation and reduced blood pressure.
   - **Side Effects:** Headache, dizziness, ankle swelling and constipation.

5. **Beta-Blockers (e.g., Metoprolol, Atenolol):**
    - **Mechanism of Action:** Beta-blockers reduce the heart rate and the force of contraction, lowering blood pressure.
    - **Side Effects:** Fatigue, dizziness, cold extremities, and worsening of respiratory conditions.
6. **Alpha1-Blockers (e.g., Prazosin, Doxazosin):**
    - **Mechanism of Action:** Alpha-blockers relax smooth muscles in blood vessels, leading to vasodilation and reduced blood pressure.
    - **Side Effects:** Dizziness, fatigue and orthostatic hypotension (a sudden drop in blood pressure upon standing).
7. **Central sympathoplegic drugs (e.g. Methyldopa, Clonidine)**

    Mechanism of action: Central Alpha-2 Agonist: Activation of central alpha-2 receptors inhibits sympathetic outflow, leading to a decrease in B.P
    Drug of choice for hypertension in Pregnancy
    - **Side Effects :** Drowsiness, sedation, Vivid dreams, Hemolytic anemia, Positive Coombs test

8. **Diuretics (Potassium-Sparing) (e.g., Spironolactone, Amiloride):**
    - **Mechanism of Action:** These diuretics increase urine production (but save the potassium thus help to balance electrolytes).It reduces blood volume and thus decrease B.P
    - **Side Effects:** Elevate blood potassium levels, gynecomastia (enlarged breast tissue in males).
9. **Renin Inhibitors (e.g., Aliskiren):**

    Mechanism of Action: Aliskiren inhibits renin, an enzyme involved in the production of angiotensin II, leading to reduced blood pressure.

    Side Effects: Diarrhea, elevated blood potassium levels

Drugs acting on Respiratory System

Cough

- Cough is an Important defense mechanism
- Most frequent respiratory symptom
- Protective reflex
- Expel sputum & other irritant material

Antitussives

- Drugs used for the symptomatic treatment of cough are called antitussives. These are Cough suppressants.

Central Antitussives

These suppress cough by a direct action on medullary cough center.

1. **Narcotic antitussives**

Codeine phosphate

- Centrally acting
- Antitussive effect occurs in smaller doses which are ineffective for analgesia
- Used for dry or painful cough
- Contraindicated in liver disease

Adverse effects: Constipation, addiction and Respiratory depression

Pholcodine

- Centrally acting
- Mild sedative and analgesic action
- Used for dry or painful cough
- Less liable to cause addiction than codeine
- Does not cause constipation

2. **Non-Narcotic Antitussives**

Noscapine

- Weak bronchodilator
- No analgesic or sedative action
- Used for dry or painful cough

Dextromethorphan

- Acts centrally to elevate the threshold for coughing
- Antitussive potency is equal to codeine

- Used for dry or painful cough
- Adverse effects
    - Drowsiness, excitation, mental confusion, GI disturbances

Peripheral Antitussives

These decrease the input of stimuli from cough receptors in respiratory passages

Demulcents

- Liquorice (glycyrrhiza)
- Steam inhalation
- Benzoin

Drugs with local anesthetic activity

- Benzonatate

Miscellaneous

- Dropropizine

Expectorants

- These Promote expulsion of sputum
- Liquefy or reduce viscosity of sputum and facilitates the removal of respiratory secretions by coughing
- They can act reflexly or directly on bronchial secretory cells

- Drugs acting reflexly

Ipecacuanha

- Expectorant in small doses
- Emetic in large doses
- Acts reflexly through irritation of gastric mucosa

Ammonium chloride

- Expectorant
- Contraindicated in impaired hepatic or renal function
- Large doses may cause
- Nausea, vomiting, thirst, headache, hyperventilation, acidosis and hypokalemia

Ammonium bicarbonate

- Irritant to gastric mucosa

Guaiphenesin

- Reduces viscosity of tenacious sputum
- May cause GI upset , drowsiness

- **Drugs acting directly**
  - **Sodium iodide & potassium iodide**
  - Directly acting expectorants
  - Stimulate bronchial secretory cells & liquefy the tenacious sputum
  - Used in chronic bronchitis & tuberculosis
  - Adverse effects

    Metallic taste, gastric irritation, sneezing, rhinitus, increased salivation,

Mucolytics

- These drugs make mucous less viscous so sputum is easily cleared
- Acts by depolymerization of mucopolysccharide protein fibres
- Useful in chronic asthma & bronchitis
- Mucolytics are of two types

1. Inhalational
   - Acetylcysteine
   - Tyloxapol
2. Oral
   - Acetylcysteine
   - Carbocisteine
   - Methylcysteine

Bronchodilators

Bronchodilators are medications used to relax and widen the airways (bronchi and bronchioles) in the lungs, making it easier to breathe. They are commonly used in the treatment of respiratory conditions such as asthma, chronic obstructive pulmonary disease (COPD) and other conditions associated with bronchoconstriction. There are different classes of bronchodilators

1.Beta2-Adrenergic Agonists:

Short-Acting Beta2-Agonists : Albuterol, Levalbuterol

- **Mechanism of Action:** Stimulate beta2-adrenergic receptors in the airway smooth muscles, leading to relaxation and bronchodilation.
- **Side Effects:** Tachycardia, tremors, headache,.

Long-Acting Beta2-Agonists : Salmeterol, Formoterol

- **Mechanism of Action:** bronchodilation by stimulating beta2-adrenergic receptors.

2. Anticholinergic Bronchodilators: Ipratropium , Tiotropium

- **Mechanism of Action:** by Blocking muscarinic receptors inhibiting the effects of acetylcholine, leading to bronchodilation.
- **Side Effects:** Dry mouth, blurred vision, urinary retention, constipation.

3. **Methylxanthines: Theophylline**
   - **Mechanism of Action:** It inhibits the enzyme Phosphodiesterase leading to smooth muscle relaxation and bronchodilation.
   - **Side Effects:** Nausea, vomiting, insomnia, tachycardia

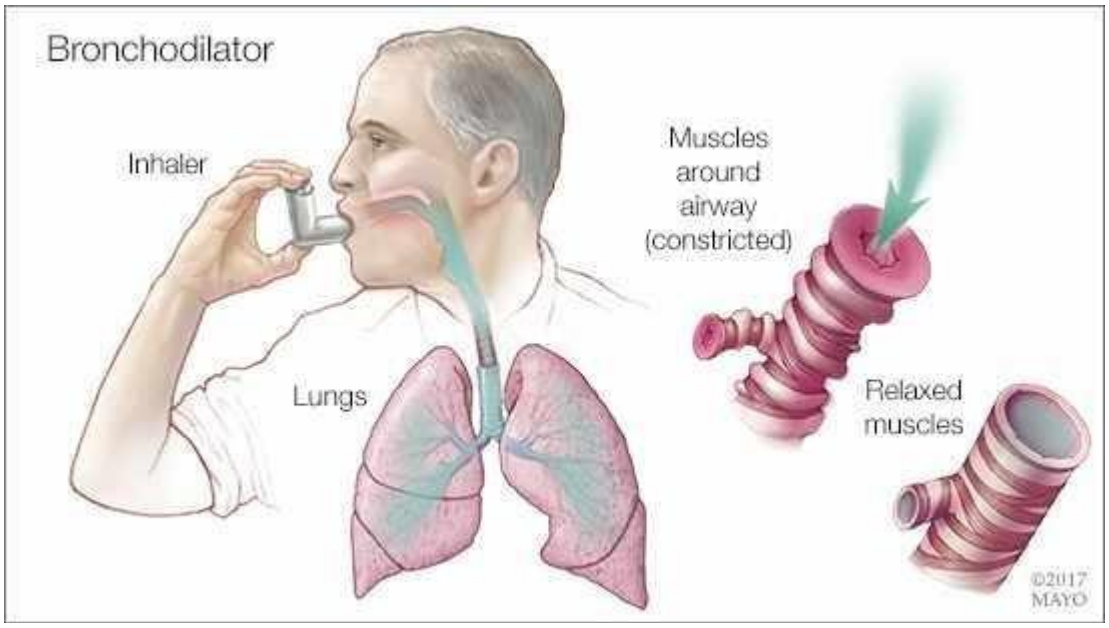


Figure 2.3: Effect of bronchodilators on airway muscles

Antibiotics and Chemotherapeutic Agents

Antibiotic: An antibiotic is a medicine that inhibits the growth of or destroys microorganisms.

Antibiotics target specific structures or functions in bacteria, interfering with their growth and reproduction. Common targets include bacterial cell walls, protein synthesis machinery, DNA replication, and other essential bacterial processes.

Examples of Antibiotics:

1. Penicillins (e.g., amoxicillin)

2. Cephalosporins (e.g., cephalexin)
3. Macrolides (e.g., erythromycin)
4. Tetracyclines (e.g., doxycycline)
5. Fluoroquinolones (e.g., ciprofloxacin)

Use: Antibiotics are used to treat bacterial infections, and the choice of antibiotic depends on the type of bacteria causing the infection.

Cell wall synthesis inhibitors

Penicillins:

Mechanism of Action: Penicillins inhibits bacterial cell wall synthesis.

Adverse Effects:

- Hypersensitivity reactions, ranging from rashes to severe anaphylaxis
- Gastrointestinal disturbances.
- Nephritis.

Cephalosporins:

Mechanism of Action: Cephalosporins also inhibit bacterial cell wall synthesis.

Adverse Effects:

- Hypersensitivity reactions, especially in patients with penicillin allergies.
- Gastrointestinal disturbances

Vancomycin:

Mechanism of Action: Vancomycin inhibits bacterial cell wall synthesis leading to bacterial death. Importantly, vancomycin is effective against Gram-positive bacteria.

Adverse Effects:

- Renal Toxicity
- Ototoxicity
- Red Man Syndrome: Rapid infusion can lead to "Red Man Syndrome," characterized by flushing, rash and histamine release. Slowing the infusion rate can prevent this.
- Thrombophlebitis
- Allergic Reactions

Protein synthesis inhibitors

Aminoglycosides:

Example: Streptomycin, Gentamycin, Tobramycin

Mechanism of Action: Aminoglycosides inhibit bacterial protein synthesis by binding to the 30S ribosomal subunit.

Adverse Effects:

- Nephrotoxicity and ototoxicity.
- Neuromuscular blockade.

Tetracyclines:

Mechanism of Action: Tetracyclines inhibit bacterial protein synthesis by binding to the 30S ribosomal subunit.

Adverse Effects:

- Gastrointestinal disturbances.
- Photosensitivity and bone deformity
- Discoloration of teeth in children.

Chloramphenicol:

Mechanism of Action: Chloramphenicol inhibits bacterial protein synthesis by binding to the 50S ribosomal subunit.

Adverse Effects:

- Aplastic anemia (rare but severe).
- Gray baby syndrome in newborns.
- Gastrointestinal disturbances.

Macrolides (e.g., Erythromycin, Clarithromycin, Azithromycin): Mechanism of Action: Macrolides inhibit bacterial protein synthesis by binding to the 50S ribosomal subunit.

Adverse Effects:

- Gastrointestinal disturbances (less common with azithromycin).
- QT interval prolongation leading to arrhythmia (especially with erythromycin).
- Hepatotoxicity.

Folate synthesis inhibitors

Sulfonamides:

Mechanism of Action: Sulfonamides inhibit bacterial folate synthesis thus interferes with bacterial DNA synthesis.

Adverse Effects:

- Hypersensitivity reactions, including skin rashes and more severe reactions like Stevens-Johnson syndrome.
- Hematologic effects, such as hemolytic anemia and agranulocytosis.
- Photosensitivity and gastrointestinal disturbances.

Cotrimoxazole (Trimethoprim/Sulfamethoxazole):

Mechanism of Action:

- Trimethoprim and sulfamethoxazole both inhibits bacterial folate synthesis and finally DNA formation. Their combined action helps more rapid killing of bacteria.
- .

Adverse Effects:

- Similar to sulfonamides

DNA synthesis inhibitors

Fluoroquinolones:

- **Examples:** Ciprofloxacin, Levofloxacin
- **Mechanism of Action:** Inhibits bacterial DNA replication and synthesis.

Adverse Effects:

- Dizziness, headache
- Tendonitis and tendon rupture
- Prolongation of the QT interval leading to arrhythmia

Anti-fungal drugs

Antifungal drugs are medications used to treat fungal infections. Fungal infections can affect various parts of the body including the skin, nails, respiratory tract and internal organs. Antifungal drugs work by targeting specific sites of fungal cell or function.

Azoles:

Examples: Fluconazole, Voriconazole

- **Mechanism of Action:**
- Azoles inhibit the enzyme used in ergosterol synthesis pathway. Lack of this ergosterol damage the fungal cell membrane.

Adverse Effects:

- Gastrointestinal disturbances (nausea, vomiting)
- Hepatotoxicity (monitor liver function)
- Rash
- QT interval prolongation (especially with voriconazole)

Polyenes:

Examples: Amphotericin B, Nystatin

Mechanism of Action:

- Polyenes bind to ergosterol in the fungal cell membrane, forming pores that increase membrane permeability, leading to cell death.

Adverse Effects:

- Nephrotoxicity (particularly with amphotericin B)
- Infusion-related reactions (fever, chills)
- Electrolyte disturbances

Echinocandins: Examples:

Caspofungin, Micafungin , Anidulafungin **Mechanism of Action:**

- Echinocandins inhibit the synthesis of beta-glucans, an essential component of the fungal cell wall, leading to cell wall damage and cell death.

Adverse Effects:

- Gastrointestinal disturbances (nausea, abdominal pain)
- Elevated liver enzymes

Allylamines:

Examples: Terbinafine

Mechanism of Action:

- Allylamines inhibit and disrupt the synthesis of ergosterol in the fungal cell membrane.

Adverse Effects:

- Gastrointestinal disturbances
- Headache
- Taste disturbances

Flucytosine:

Examples: Flucytosine

Mechanism of Action:

- Flucytosine is converted to 5-fluorouracil within fungal cells, disturbing RNA and protein synthesis.

Adverse Effects:

- Hematologic toxicity (monitor blood counts)
- Gastrointestinal disturbances
- Hepatotoxicity

Anti-viral drugs

Antiviral drugs are medications designed to treat viral infections by targeting specific steps in the viral life cycle.

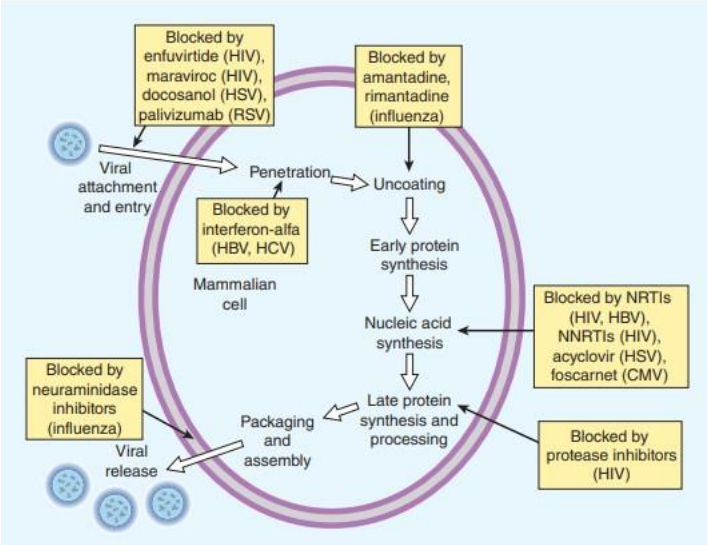


Figure 2.4: The major sites of antiviral drug action

Nucleoside/Nucleotide Analogs:

Examples:

Acyclovir, Valacyclovir, Famciclovir (Herpesviruses)

- **Mechanism of Action:** These drugs are phosphorylated by virus and the result is inhibition of viral DNA synthesis.
- **Adverse Effects:**
- Generally well-tolerated.
- Renal toxicity at high doses.

Examples:

Zidovudine, Lamivudine, Tenofovir (HIV)

- **Mechanism of Action:** These drugs inhibit an enzyme involved in the replication of the viral RNA genome into DNA.

Adverse Effects:

- Bone marrow suppression (anemia, neutropenia).
- Gastrointestinal disturbances.

Protease Inhibitors:

Examples:

Ritonavir, Atazanavir, Darunavir (HIV)

Mechanism of Action: Protease inhibitors block the activity of the HIV protease enzyme required for viral maturation.

Adverse Effects:

- Metabolic effects (lipodystrophy, dyslipidemia).
- Gastrointestinal disturbances.

Neuraminidase Inhibitors:

Examples:

Oseltamivir, Zanamivir (Influenza)

Mechanism of Action: Inhibit the neuraminidase enzyme, preventing the release of newly formed influenza virus from infected cells.

Adverse Effects:

- Generally well-tolerated.
- Gastrointestinal disturbances (more common with oseltamivir).

Fusion Inhibitors:

Example:

Enfuvirtide (HIV)

Mechanism of Action: Binds to the viral protein and preventing fusion of the viral and cellular membranes.

Adverse Effects:

- Injection site reactions (redness, swelling).

Polymerase Inhibitors (HCV):

Examples:

Sofosbuvir, Ledipasvir (Hepatitis C)

Mechanism of Action: Directly inhibit viral RNA polymerase, disrupting viral replication.

Adverse Effects:

- Generally well-tolerated.
- Headache, fatigue, gastrointestinal disturbances.

Integrase Inhibitors (HIV):

Examples:

Raltegravir, Dolutegravir

Mechanism of Action: Block the integrase enzyme, preventing integration of the viral DNA into the host genome.

Adverse Effects:

- Generally well-tolerated.
- Headache, gastrointestinal disturbances.

RNA Polymerase Inhibitors (SARS-CoV-2):

Example: Remdesivir

Mechanism of Action: Inhibits viral RNA synthesis.

Adverse Effects:

- Generally well-tolerated.
- Liver function abnormalities.

Drugs used in the treatment of Tuberculosis

Isoniazid (INH):

Mechanism of Action: Inhibits the synthesis of mycolic acids, an essential component of the mycobacterial cell wall.

Uses:

- Treatment of both latent and active TB.
- Prophylaxis for individuals at high risk of developing active TB.

Adverse Effects:

- Hepatotoxicity (monitor liver function).
- Peripheral neuropathy (give vitamin B6 for prevention)

Rifampin:

Mechanism of Action: Inhibits bacterial RNA synthesis by binding to the RNA polymerase enzyme.

Uses:

Treatment of active TB.

Prophylaxis in individuals exposed to known cases of drug-resistant TB.

Adverse Effects:

- Hepatotoxicity.
- Orange discoloration of bodily fluids.

Ethambutol:

Mechanism of Action: Inhibits the synthesis of a component of the bacterial cell wall.

Uses:

- Treatment of active TB in combination with other drugs.

Adverse Effects:

- Optic neuritis (visual disturbances), requiring regular eye examinations.

Pyrazinamide:

Mechanism of Action: Converts to pyrazinoic acid, disrupting bacterial metabolism.

Uses:

- Used in the initial phase of treatment for active TB.

Adverse Effects:

- Hepatotoxicity.
- Hyperuricemia (monitor in patients with gout).

Streptomycin:

Mechanism of Action: Inhibits protein synthesis in bacteria by binding to the 30S subunit of the ribosome.

Uses:

- Treatment of active TB, especially when resistance to other first-line drugs is suspected.

Adverse Effects:

- Hearing and Balance disturbance (regular monitoring required).

Important Considerations:

- TB treatment often involves a combination of these drugs, known as the Directly Observed Treatment Short-course (DOTS) regimen.
- Treatment duration is typically prolonged, and patient adherence to the prescribed regimen is crucial to prevent drug resistance.
- Close monitoring of liver function and other potential side effects is essential throughout the course of treatment.
- Drug interactions, especially with antiretroviral medications in HIV-positive individuals, should be carefully managed.

Drugs used in the treatment of Leprosy:

Leprosy is caused by the bacterium Mycobacterium leprae. The treatment of leprosy typically involves a combination of antibiotics. Here are some of the drugs used in the treatment of leprosy along with their mechanisms of action, uses, and potential adverse effects:

Dapsone:

Mechanism of Action: Inhibits bacterial folate synthesis, thereby preventing DNA and RNA synthesis.

Uses:

- Treatment of leprosy, especially in combination with other drugs.
- Prophylaxis for contacts of leprosy patients.

Adverse Effects:

- Hemolysis (especially in individuals with glucose-6-phosphate dehydrogenase deficiency).
- Methemoglobinemia.
- Skin reactions.

Rifampin:

Mechanism of Action: Inhibits bacterial RNA synthesis by binding to the RNA polymerase enzyme.

Uses:

- Treatment of leprosy in combination with other drugs.

Adverse Effects:

- Hepatotoxicity.
- Orange discoloration of bodily fluids.

Clofazimine:

Mechanism of Action: it has anti-inflammatory and antimicrobial effects.

Uses:

- Treatment of leprosy, particularly in multidrug therapy (MDT) regimens.

Adverse Effects:

- Skin discoloration (reddish-brown to black).
- Gastrointestinal disturbances.
- QT interval prolongation.

Important Considerations:

- Multidrug therapy (MDT) regimens, recommended by the World Health Organization (WHO), involve combinations of these drugs for effective treatment.
- Treatment duration varies and may last several months to years, depending on the type and severity of leprosy.
- Acting upon prescribed treatment regimen is necessary to prevent relapse and the development of drug resistance.
- Regular monitoring for adverse effects, especially in long-term treatment, is essential for patient safety.

Drugs used for the treatment of Amoebiasis:

Amoebiasis, caused by the protozoan parasite Entamoeba histolytica. It is typically treated with anti-amoebic medications. Here are some drugs commonly used in the treatment of amoebiasis along with their mechanisms of action, uses, and potential adverse effects:

Metronidazole:

Mechanism of Action: Disrupts DNA synthesis and inhibits the growth of the parasite by forming cytotoxic compounds.

Uses:

- Treatment of uncomplicated intestinal amoebiasis.
- Treatment of amoebic liver abscess.

Adverse Effects:

- Metallic taste.
- Gastrointestinal disturbances.
- Peripheral neuropathy (with prolonged use).

Tinidazole:

Mechanism of Action:

- Similar to metronidazole, it disrupts DNA synthesis and is effective against anaerobic organisms.

Uses:

- Treatment of intestinal and extraintestinal amoebiasis.

Adverse Effects:

- Metallic taste.
- Gastrointestinal disturbances.

Paromomycin:

Mechanism of Action: Inhibits protein synthesis in the parasite.

Uses: Often used in combination with other medications for the treatment of intestinal amoebiasis.

Adverse Effects:

- Gastrointestinal disturbances.
- Nephrotoxicity (with prolonged use).

Diloxanide Furoate:

Mechanism of Action: Acts locally in the intestine to eliminate residual amoebae.

Uses:

- Used as a luminal agent following treatment with a tissue amoebicide.

Adverse Effects:

- Generally well-tolerated.

Drugs used in the treatment of Malaria:

Malaria is a parasitic infection caused by Plasmodium parasites and is transmitted through the bites of infected mosquitoes. The treatment of malaria involves the use of antimalarial drugs. Here are some commonly used antimalarial drugs, along with their mechanisms of action, uses, and potential adverse effects:

Chloroquine:

Mechanism of Action: Accumulates in the food vacuoles of the parasite, preventing the detoxification of heme into hemozoin.

Uses:

- Treatment of uncomplicated malaria caused by susceptible Plasmodium species.

Adverse Effects:

- Gastrointestinal disturbances.
- Pruritus (itching) and skin reactions.
-

Artemisinin-based Combination Therapies:

Mechanism of Action: Artemisinin and its derivatives, such as artesunate, dihydroartemisinin, and artemether, act by generating free radicals that damage the parasite's membranes.

Uses:

- First-line treatment for uncomplicated malaria in many regions with Plasmodium falciparum resistance to other antimalarial drugs.

Adverse Effects:

Generally well-tolerated, but some individuals may experience nausea, vomiting, and dizziness.

Mefloquine:

Mechanism of Action: Inhibits the polymerization of heme, leading to the accumulation of toxic heme in the parasite.

Uses:

- Treatment of uncomplicated malaria caused by Plasmodium falciparum, P. vivax, and P. malariae.
- Prophylaxis for travelers to areas with chloroquine-resistant malaria.

Adverse Effects:

- Neuropsychiatric effects, including vivid dreams and nightmares.
- Gastrointestinal disturbances.

Doxycycline:

Mechanism of Action:

Inhibits protein synthesis in the parasite by binding to the 30S ribosomal subunit.

Uses:

- Treatment of uncomplicated malaria in combination with other antimalarials.
- Prophylaxis for travelers to malaria-endemic areas.

Adverse Effects:

- Photosensitivity.
- Gastrointestinal disturbances

Atovaquone-Proguanil:

Mechanism of Action: Atovaquone inhibits mitochondrial electron transport in the parasite, while proguanil inhibits folic acid synthesis in parasite.

Uses:

- Treatment and prophylaxis of uncomplicated malaria.

Adverse Effects:

- Gastrointestinal disturbances.
- Headache.

Primaquine:

Mechanism of Action: Kills the exoerythrocytic forms of the parasite, preventing relapse of P. vivax and P. ovale infections.

Uses:

Treatment of the dormant liver forms in P. vivax and P.ovale infections.

Adverse Effects:

- Hemolysis in individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency.
- Gastrointestinal disturbances.

Drug	Uses	Adverse Effects
Chloroquine	Prophylaxis and treatment in areas without resistant *P falciparum;* treatment of *P vivax* and *P ovale* malaria	GI distress, rash, headache; auditory dysfunction and retinal dysfunction (high dose)
Artemisinins	Standard of care for all chloroquine-resistant malaria	GI distress, rare neutropenia, anemia, liver enzymes, allergic reactions
Mefloquine	Prophylaxis and treatment in areas with resistant *P falciparum*	GI distress, rash, headache; cardiac conduction defects and neurologic symptoms (high dose)
Quinine[a]	Treatment of multidrug-resistant malaria	Cinchonism, hemolysis in G6PD deficiency, blackwater fever
Primaquine	Eradication of liver stages of *P vivax* and *P ovale*	GI distress, methemoglobinemia, hemolysis in G6PD deficiency
Antifolates	Prophylaxis and treatment of multidrug-resistant *P falciparum* malaria	GI distress, renal dysfunction, hemolysis, folate deficiency
Atovaquone-proguanil (Malarone)	Prophylaxis and treatment of multidrug-resistant *P falciparum* malaria	GI distress, headache, rash hemolysis, folate deficiency

Figure 2.5: Drugs used in the treatment of malaria.

Prophylaxis of Malaria:

Malaria prophylaxis involves the use of medications to prevent the occurrence of malaria in individuals traveling to regions where the disease is endemic. The choice of prophylactic medication depends on factors such as the destination, the specific type of malaria in that region, the duration of travel, individual health considerations, and any drug allergies.

Drug	Use[2]	Adult Dosage[3]
Chloroquine	Areas without resistant *P falciparum*	500 mg weekly
Malarone	Areas with chloroquine-resistant *P falciparum*	1 tablet (250 mg atovaquone/100 mg proguanil) daily
Mefloquine	Areas with chloroquine-resistant *P falciparum*	250 mg weekly
Doxycycline	Areas with multidrug-resistant *P falciparum*	100 mg daily
Primaquine[4]	Terminal prophylaxis of *P vivax* and *P ovale* infections; alternative for primary prevention	52.6 mg (30 mg base) daily for 14 days after travel; for primary prevention 52.6 mg (30 mg base) daily

Figure 2.6: Prophylaxis of Malaria

Anti-helminthic drugs:

Antihelminthic drugs are medications used to treat infections caused by parasitic worms, also known as helminths. The following are examples of commonly used antihelminthic drugs, along with their mechanisms of action, uses, and potential adverse effects:

Mebendazole:

Mechanism of Action: Inhibits microtubule formation in helminth cells, disrupting their metabolism and causing immobilization and death.

Uses:

- Treatment of intestinal nematode infections, including roundworms, whipworms, and hookworms.

Adverse Effects:

- Gastrointestinal disturbances (nausea, abdominal pain).
- Rarely, hepatic toxicity.

Albendazole:

Mechanism of Action: Inhibits microtubule formation, leading to the disruption of the helminth's glucose uptake and immobilization.

Uses:

- Treatment of a broad spectrum of helminthic infections, including intestinal and tissue-dwelling parasites.

Adverse Effects:

- Gastrointestinal disturbances.
- Hepatic enzyme elevation.

Praziquantel:

Mechanism of Action: Increases cell membrane permeability to calcium, leading to muscle contraction and paralysis in schistosomes and tapeworms.

Uses:

- Treatment of schistosomiasis, tapeworm infections, and fluke infections.

Adverse Effects:

- Gastrointestinal disturbances (abdominal pain, nausea).
- Headache.
- Dizziness.

Ivermectin:

Mechanism of Action: Binds to nerve and muscle cells of helminths, leading to increased membrane permeability and paralysis.

Uses:

- Treatment of certain filarial infections (e.g., onchocerciasis or river blindness) and some intestinal parasites.

Adverse Effects:

- Usually well-tolerated, but may cause transient mild side effects such as headache and dizziness.

Diethylcarbamazine:

Mechanism of Action: Exact mechanism not fully understood, but it has activity against certain filarial worms.

Uses:

- Treatment of lymphatic filariasis and onchocerciasis.

Adverse Effects:

- Inflammatory reactions, especially in individuals with high microfilarial loads.
- Gastrointestinal disturbances.

Drugs Acting on Blood

Hematinics:

Mechanism of Action: Hematinics are substances that promote the formation of hemoglobin and red blood cells. The mechanism of action varies depending on the specific hematinic:

Iron:

- Incorporates into hemoglobin, helping in the transport of oxygen in red blood cells.
- Stimulates the production of red blood cells.

Use: . Treatment of iron-deficiency anemia.

- Prevention of iron deficiency in pregnancy, menstruating women, and individuals with poor iron absorption.

Vitamin B12 (Cyanocobalamin):

- Essential for DNA synthesis and maturation of red blood cells. Acts as a cofactor for enzymes involved in folate metabolism.

Use: Treatment of pernicious anemia.

Management of vitamin B12 deficiency due to malabsorption.

Folic Acid:

- Essential for DNA synthesis and cell division.
- Promotes the maturation of red blood cells.

Use: Treatment of folic acid deficiency anemia.
Prevention of neural tube defects in pregnancy

Adverse Effects:

Iron:

- Gastrointestinal disturbances (nausea, constipation, diarrhea).
- Dark stools.
- Teeth staining (with liquid formulations).

Vitamin B12 (Cyanocobalamin):

- Generally well-tolerated, but high doses may cause diarrhea, itching, and rash.

Anticoagulants:

Mechanism of Action: Anticoagulants interfere with the blood clotting process, preventing the formation of blood clots. The main classes of anticoagulants include:

1. **Vitamin K Antagonists (e.g., Warfarin):**
   - Inhibit the synthesis of vitamin K-dependent clotting factors (II, VII, IX, X) in the liver.
   - Require regular monitoring of the International Normalized Ratio (INR) to ensure therapeutic efficacy.
2. **Direct Oral Anticoagulants :**
   - **Dabigatran (Direct Thrombin Inhibitor):** Inhibits thrombin (factor IIa)
   - **Rivaroxaban, Apixaban, Edoxaban (Factor Xa Inhibitors):** Inhibit factor Xa in the coagulation process.
   - Act more selectively and have a more predictable anticoagulant effect than warfarin.
3. **Heparins (Unfractionated Heparin and Low Molecular Weight Heparins):**
   - Enhance the activity of antithrombin III, which inhibits thrombin and factor Xa, preventing the formation of blood clots.
   - Administered parenterally (intravenously or subcutaneously).

Uses:

1. **Warfarin:**
    - Prevention and treatment of thromboembolic events, such as deep vein thrombosis (DVT) and pulmonary embolism (PE). Stroke prevention in atrial fibrillation.
2. **Direct Oral Anticoagulants :**
    - Prevention and treatment of venous thromboembolism (DVT and PE).
    - Stroke prevention in atrial fibrillation.
3. **Heparins:**
    - Rapid anticoagulation in various clinical settings, including surgery and certain medical conditions.
    - Prevention of DVT and PE in hospitalized patients.

Adverse Effects:

1. **Warfarin:**
    - Bleeding (main adverse effect)
    - Various drug interactions.
2. **Direct Oral Anticoagulants:**
    - Bleeding (main adverse effect).
    - Gastrointestinal disturbances.
    - Liver enzyme elevation in some cases.
3. **Heparins:**
    - Bleeding (main adverse effect).
    - Heparin-induced thrombocytopenia (HIT).
    - Osteoporosis with long-term use.

Drugs acting on Gastrointestinal Tract

Antacids:

MECHANISM OF ACTION: Antacids are weak bases that neutralizes gastric acidity by reacting with gastric HCl to form a salt & water.

Examples :

- Sodium Bicarbonate
- Magnesium Oxide
- Magnesium Trisilicate
- Calcium Carbonate
- Aluminium Hydroxide

- **Uses:** •

- **Relief of Heartburn and Indigestion:** Antacids are commonly used to provide symptomatic relief from conditions such as heartburn, indigestion, and acid reflux.

- **Peptic Ulcer Disease:** Antacids may be used as part of the treatment for peptic ulcer disease to relieve symptoms and promote healing.
- **Gastroesophageal Reflux Disease (GERD):** Management of symptoms associated with GERD, including acid regurgitation and chest discomfort.

Adverse effects of Antacids:

- **Constipation:**
  - Antacids containing aluminium or calcium may lead to constipation, particularly with prolonged or excessive use.
- **Diarrhea:**
  - Antacids containing magnesium, especially in high doses or with prolonged use, may cause diarrhea.
- **Electrolyte Imbalances:**
  - Magnesium-containing antacids may lead to electrolyte imbalances, including hypomagnesemia.
- **Alkalosis:**
  - Overuse of antacids, particularly those containing bicarbonate, can result in metabolic alkalosis (an elevated blood pH).
- **Calcium Accumulation:**
  - Long-term use of calcium-containing antacids may contribute to hypercalcemia, particularly in individuals with impaired renal function.

- **Aluminum Accumulation:**
  - Aluminum-containing antacids may contribute to aluminum accumulation in individuals with impaired renal function.
- **Drug Interactions:**
  - Antacids may interfere with the absorption of certain medications, such as antibiotics (e.g., tetracyclines), iron supplements, and some antifungal drugs. • **Rebound Acid Hypersecretion:**
  - Prolonged use of antacids, particularly those that rapidly neutralize acid, may lead to rebound acid hypersecretion when the medication is discontinued, potentially causing worsening symptoms.

Purgatives:

Purgatives or laxatives are medications that are used to induce bowel movements and relieve constipation. They work by promoting the elimination of stool from the intestines. Here are some common types of purgatives:

Bulk-Forming Agents:

Mechanism of Action: These agents add bulk to the stool, promoting the retention of water and softening the stool.

Examples: Psyllium husk, methylcellulose.

Uses: Constipation relief, prevention of straining during bowel movements.

Stool Softeners (Emollient Laxatives):

Mechanism of Action: These agents increase the water content of the stool, making it softer and easier to pass.

Examples: Docusate sodium.

Uses: Prevention of constipation, especially in individuals with conditions that require reduced straining.

Osmotic Laxatives:

Mechanism of Action: These agents increase the water content in the intestines by drawing water into the bowel lumen through osmosis. **Examples:** Polyethylene glycol, lactulose, magnesium hydroxide, sodium phosphate.

Uses: Constipation relief, bowel preparation for medical procedures.

Stimulant Laxatives:

Mechanism of Action: These agents stimulate the muscles of the intestines, promoting bowel movements.

Examples: Senna, bisacodyl, castor oil.

Uses: Constipation relief, bowel preparation for medical procedures.

Saline Laxatives:

Mechanism of Action: These agents draw water into the intestines and stimulate bowel movements through osmosis.

Examples: Magnesium citrate, magnesium sulfate (Epsom salt).

Uses: Constipation relief, bowel preparation for medical procedures.

Lubricant Laxatives:

Mechanism of Action: These agents coat the surface of the stool, making it slippery and easier to pass.

Examples: Mineral oil.

Uses: Constipation relief.

Anti-Emetics:

Anti-emetics are medications that are used to prevent or treat nausea and vomiting. They work by acting on various receptors in the central nervous system and gastrointestinal tract. Here are some common classes of antiemetic drugs:

Serotonin (5-HT3) Receptor Antagonists:

Mechanism of Action: Block serotonin receptors in the brain and gastrointestinal tract.

Examples: Ondansetron, granisetron, palonosetron.

Uses: Prevention and treatment of nausea and vomiting associated with chemotherapy and surgery.

Dopamine (D2) Receptor Antagonists:

Mechanism of Action: Block dopamine receptors in the brain.

Examples: Metoclopramide, prochlorperazine.

Uses: Treatment of nausea and vomiting associated with chemotherapy, surgery, and certain medical conditions (e.g., gastroparesis).

Antihistamine (H1) Receptor Antagonists:

Mechanism of Action: Block histamine receptors in the brain.

Examples: Dimenhydrinate, meclizine, promethazine.

Uses: Prevention and treatment of motion sickness, nausea, and vomiting.

Neurokinin-1 (NK1) Receptor Antagonists:

Mechanism of Action: Block substance P, a neurotransmitter involved in the vomiting reflex.

Examples: Aprepitant, fosaprepitant, netupitant.

Uses: Prevention of acute and delayed nausea and vomiting associated with chemotherapy.

Cannabinoids:

Mechanism of Action: Activate cannabinoid receptors in the brain.

Examples: Dronabinol, nabilone.

Uses: Treatment of nausea and vomiting associated with chemotherapy and appetite stimulation in conditions such as HIV/AIDS.

Prokinetic Agents:

Mechanism of Action: Enhance gastrointestinal motility.

Examples: Domperidone, trimethobenzamide.

Uses: Treatment of nausea and vomiting associated with gastroparesis and other gastrointestinal disorders.

Anti-muscarinic drugs:

Mechanism of Action: Blocks muscarinic receptors, particularly in the vestibular system.

Example: Scopolamine:

Uses: Prevention of motion sickness and nausea associated with certain medical conditions.

Drugs used in peptic ulcer:

Peptic ulcers: Peptic ulcers are open sores that develop on the inner lining of the stomach, upper small intestine or esophagus.

Causes of peptic ulcers: The primary causes of peptic ulcers include infection with Helicobacter pylori bacteria, long-term use of non-steroidal anti-inflammatory drugs (NSAIDs or pain killers) and excess stomach acid.

The management of peptic ulcers involves a combination of medications to reduce stomach acid production, treat infections, and protect the lining of the gastrointestinal tract. Here are some classes of drugs used in the treatment of peptic ulcers:

Proton Pump Inhibitors (PPIs):

Examples: Omeprazole, Esomeprazole, Lansoprazole, Pantoprazole,

Mechanism of Action: PPIs irreversibly inhibit the proton pump in the gastric parietal cells, leading to a profound and long-lasting reduction in gastric acid secretion.

Uses: Treatment of peptic ulcers, gastroesophageal reflux disease (GERD), Zollinger-Ellison syndrome and conditions associated with excessive gastric acid production.

Adverse Effects: Generally well-tolerated, but long-term use may be associated with an increased risk of fractures, Clostridium difficile infection, hypomagnesemia,

H2 Blockers (H2 Receptor Antagonists):

Examples: Ranitidine, Famotidine, Cimetidine**.**

Mechanism of Action: H2 blockers competitively inhibit histamine H2 receptors on the gastric parietal cells, reducing the production of gastric acid. **Uses:** Treatment and prevention of peptic ulcers, GERD, Zollinger-Ellison syndrome

Adverse Effects: Generally well-tolerated, but long-term use may be associated with an increased risk of pneumonia, and cimetidine may interact with various drugs due to its inhibition of cytochrome P450 enzymes.

Antacids:

Examples: calcium carbonate, aluminum hydroxide, magnesium hydroxide, aluminum hydroxide, magnesium hydroxide

Mechanism of Action: Antacids neutralize gastric acid

Uses: Symptomatic relief of heartburn, indigestion, and mild GERD. **Adverse Effects:** Can cause constipation or diarrhea depending on the type, and long-term use of aluminum-containing antacids may lead to aluminum toxicity.

Antibiotics (for *H. pylori* eradication):

Examples: Clarithromycin, Amoxicillin, Metronidazole, Tetracycline.

Mechanism of Action: Antibiotics are used to eradicate Helicobacter pylori, a common cause of peptic ulcers.

Uses: Combined with acid-reducing medications for H. pylori eradication in certain cases of peptic ulcer disease.

Adverse Effects: Antibiotic-specific side effects

Cytoprotective Agents:

Example: Misoprostol.

- **Mechanism of Action:** Misoprostol is a synthetic prostaglandin that promotes mucus production, reduces acid secretion, and has cytoprotective effects on the stomach lining.
- **Uses:** Prevention of NSAID-induced ulcers in high-risk patients.
- **Adverse Effects:** Diarrhea, abdominal pain, and uterine contractions (contraindicated in pregnancy)

Antidiarrheal drugs:

Antidiarrheal drugs are medications used to alleviate symptoms of diarrhea by slowing down bowel movements and reducing the frequency of loose or watery stools. Here are some common classes of antidiarrheal drugs with their mechanisms of action, uses, and potential adverse effects:

Loperamide (Imodium):

Mechanism of Action: Acts on opioid receptors in the intestinal wall, slowing down peristalsis and reducing bowel movements.

Uses:

- Symptomatic relief of acute and chronic diarrhea. Reduction of stool frequency and fluid loss.

Adverse Effects:

- Constipation (especially with high doses).
- Abdominal cramps.
- Nausea.

Colloidal Bismuth compounds:

Mechanism of Action: Exhibits antimicrobial effects against certain bacteria causing diarrhea. Has anti-inflammatory and antisecretory properties.

Uses:

- Symptomatic relief of mild to moderate diarrhea.
- Prevention of traveler's diarrhea.
- Treatment of Helicobacter pylori infection (as part of combination therapy).

Adverse Effects:

- Darkening of the tongue and stool (harmless side effect).
- Constipation.

Diphenoxylate with Atropine:

Mechanism of Action: Diphenoxylate is an opioid agonist that acts on the gastrointestinal tract, slowing down bowel movements. Atropine is added to discourage misuse by addicts.

Uses:

- Symptomatic relief of acute and chronic diarrhea.

Adverse Effects:

- Dizziness.
- Drowsiness.
- Dry mouth.
- Urinary retention (especially in men with prostate enlargement).

Adsorbents (Kaolin and Pectin):

Mechanism of Action: Kaolin absorbs water and toxins in the intestines. Pectin forms a gel-like substance that helps bulk up the stool.

Uses:

- Symptomatic relief of mild diarrhea.

Adverse Effects:

- Constipation.
- Flatulence.

Drugs acting on Central Nervous System

Antipsychotic Drugs (Major Tranquilizers)

Antipsychotic drugs or major tranquilizers or neuroleptics are medications used to manage symptoms of schizophrenia, psychosis, including delusions, hallucinations, and disorganized thinking. There are two main classes of antipsychotic drugs

- **Typical Antipsychotics**

- **Atypical Antipsychotics**

Typical Antipsychotics:

Haloperidol:

Mechanism of Action: Blocks dopamine D2 receptors in the brain, reducing dopaminergic neurotransmission**.**

Uses:

- Treatment of schizophrenia.
- Acute psychotic episodes.
- Agitation and severe behavioral disturbances.

Adverse Effects:

- Extrapyramidal symptoms (EPS), including parkinsonism, dystonia, and tardive dyskinesia.
- Neuroleptic malignant syndrome (NMS).
- Sedation and drowsiness.
- Elevated prolactin levels.
- Risk of QT prolongation.

Chlorpromazine:

Mechanism of Action: Blocks dopamine, acetylcholine, norepinephrine, and histamine receptors in the brain.

Uses:

- Treatment of schizophrenia.
- Control of severe nausea and vomiting. Management of agitation and anxiety.

Adverse Effects:

- Sedation and drowsiness.
- Anticholinergic effects (dry mouth, blurred vision, constipation).
- Hypotension.
- Photosensitivity.

Atypical Antipsychotics:

Olanzapine:

Mechanism of Action: Blocks serotonin (5-HT2A), dopamine (D2), and other receptors in the brain.

Uses:

- Treatment of schizophrenia.
- Bipolar disorder (manic and mixed episodes). □ Maintenance treatment of bipolar disorder.

Adverse Effects:

- Weight gain and metabolic effects.
- Sedation and drowsiness.
- Hyperlipidemia.
- Risk of diabetes.

Risperidone:

Mechanism of Action: Blocks serotonin (5-HT2A) and dopamine (D2) receptors.

Uses:

- Treatment of schizophrenia.
- Bipolar disorder (manic and mixed episodes).
- Irritability associated with autistic disorder in children.

Adverse Effects:

- Increased prolactin levels.
- Weight gain.
- Extrapyramidal symptoms (EPS).
- Risk of QT prolongation.

Aripiprazole:

Mechanism of Action: Partial agonist at dopamine (D2) and serotonin (5-HT1A) receptors.

Uses: Treatment of schizophrenia.

- Bipolar disorder.
- Major depressive disorder as an adjunctive treatment.

Adverse Effects:

- Activation and insomnia.
- Headache.
- Akathisia.
- Less risk of weight gain.

Clozapine:

Mechanism of Action: Blocks serotonin (5-HT2A), dopamine (D4), and other receptors.

Uses:

- Treatment-resistant schizophrenia.
- Reduction of the risk of suicidal behavior in schizophrenia or schizoaffective disorder.

Adverse Effects:

- Agranulocytosis (requires regular blood monitoring).
- Weight gain and metabolic effects.
- Seizures.
- Myocarditis.

Antianxiety Drugs (Minor Tranquilizers)

Antianxiety drugs or anxiolytics or minor tranquilizers are medications used to alleviate symptoms of anxiety and promote relaxation. These drugs primarily act on the central nervous system to modulate neurotransmitter activity. Here are some common classes of antianxiety drugs.

Benzodiazepines:

Alprazolam:

Mechanism of Action: Enhances the inhibitory effects of gamma-aminobutyric acid (GABA) on neurotransmission, leading to increased chloride ion influx and neuronal hyperpolarization.

Uses:

Generalized anxiety disorder (GAD).

- Panic disorder.
- Social anxiety disorder.

Adverse Effects:

- Sedation and drowsiness.
- Dizziness.
- Risk of dependence and withdrawal.
- Cognitive and psychomotor impairment.
- Potential for abuse.

Lorazepam:

Mechanism of Action: Similar to alprazolam, enhancing the effects of GABA.

Uses:

- Anxiety disorders.
- Acute agitation and seizures.
- Premedication for medical or dental procedures.

Adverse Effects:

- Sedation and drowsiness.
- Amnesia.
- Respiratory depression (at high doses).

- Dependence and withdrawal.

Buspirone:

Mechanism of Action: Partial agonist at serotonin (5-HT1A) receptors and antagonist at dopamine (D2) receptors.

Uses:

- Generalized anxiety disorder (GAD).
- Short-term relief of anxiety symptoms.

Adverse Effects:

- Dizziness and lightheadedness.
- Nausea.
- Headache.

Delayed onset of action (several weeks).

Selective Serotonin Reuptake Inhibitors (SSRIs):

Escitalopram:

Mechanism of Action: Inhibits the reuptake of serotonin at the synaptic cleft, enhancing serotonin neurotransmission.

Uses:

- Generalized anxiety disorder (GAD). □ Major depressive disorder.

Adverse Effects:

- Nausea.
- Insomnia or sedation.
- Sexual dysfunction.
- Weight changes.

Selective Serotonin-Norepinephrine Reuptake Inhibitors (SNRIs):

Venlafaxine:

Mechanism of Action: Inhibits the reuptake of both serotonin and norepinephrine.

Uses:

- Generalized anxiety disorder (GAD).

- Major depressive disorder. □ Panic disorder.

Adverse Effects:

- Nausea.
- Insomnia or sedation.
- Increased blood pressure (at higher doses).
- Withdrawal symptoms.

Narcotic-Analgesics

Narcotic analgesics or opioids are medications used for pain relief. They act on specific receptors (e.g.mu opioid receptors) in the central nervous system to modulate pain perception. Here are some common narcotic analgesics

Morphine:

Mechanism of Action: Binds to opioid receptors (mainly mu receptors) in the central nervous system, modulating pain transmission.

Uses:

- Severe pain (postoperative, traumatic, cancer-related).
- Acute pulmonary edema. □ Comforting care.

Adverse Effects:

- Respiratory depression.
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence and tolerance.

Codeine:

Mechanism of Action: Metabolized to morphine in the liver, activating opioid receptors.

Uses:

- Mild to moderate pain.
- Antitussive (cough suppression).

Adverse Effects:

- Respiratory depression (at higher doses).
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence.

Oxycodone:

Mechanism of Action: Binds to opioid receptors, primarily mu receptors.

Uses:

- Moderate to severe pain.
- Chronic pain conditions (e.g., cancer pain, osteoarthritis).

Adverse Effects:

- Respiratory depression.
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence.

Hydrocodone:

Mechanism of Action: Binds to opioid receptors, primarily mu receptors.

Uses:

- Moderate to severe pain.
- Antitussive (combined with acetaminophen).

Adverse Effects:

- Respiratory depression.
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence.

Fentanyl:

Mechanism of Action: Binds to opioid receptors, primarily mu receptors.

Uses:

- Severe pain (e.g., postoperative, cancer pain). □ Anesthesia induction.

Adverse Effects:

- Rapid onset and short duration of action.
- Respiratory depression.
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence.

Tramadol:

Mechanism of Action: Acts as a weak mu-opioid receptor agonist and inhibits the reuptake of serotonin and norepinephrine.

Uses:

- Moderate to moderately severe pain. □ Neuropathic pain.

Adverse Effects:

- Lower risk of respiratory depression compared to traditional opioids.
- Sedation.
- Constipation.
- Nausea and vomiting.
- Potential for dependence.

Meperidine:

Mechanism of Action: Binds to opioid receptors, primarily mu receptors.

Uses:

- Moderate to severe pain. □ Preoperative analgesia.

Adverse Effects:

- Short duration of action.
- Respiratory depression.
- Sedation.
- Constipation.

- Nausea and vomiting.
- Potential for dependence

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) Analgesics-Antipyretics

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are a class of analgesics and antipyretics that also possess anti-inflammatory properties. They work by inhibiting the enzymes involved in the production of prostaglandins, which are substances involved in pain, inflammation, and fever. Here are some common NSAIDs

Ibuprofen:

Mechanism of Action: Inhibits the activity of both cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) enzymes, leading to decreased prostaglandin synthesis.

Uses:

- Pain relief (mild to moderate).
- Inflammation reduction
- Fever reduction.
- Antiplatelet (anticlotting action)

Adverse Effects:

- Gastrointestinal irritation and ulcers.
- Renal impairment.
- Increased risk of cardiovascular events.
- Allergic reactions.
- Risk of bleeding (especially in high doses).

Aspirin (Acetylsalicylic Acid):

Mechanism of Action: Irreversibly inhibits COX-1 and COX-2 enzymes, leading to decreased prostaglandin synthesis.

Uses:

- Pain relief (mild to moderate).
- Inflammation reduction.
- Fever reduction.
- Antiplatelet effects (used for cardiovascular protection).

Adverse Effects:

- Gastrointestinal irritation and ulcers.
- Bleeding risk (due to antiplatelet effects).
- Reye's syndrome (in children with viral infections).
- Hypersensitivity reactions.

Dose-related effects of aspirin:

1.
   - **Clinical Use:**
     1. **Antiplatelet Effects: Low Doses (75-100 mg daily):**

     Low-dose aspirin is commonly prescribed for cardiovascular protection, reducing the risk of blood clot formation and preventing heart attacks and strokes.
2. **Analgesic Effects: Intermediate Doses (325-650 mg):**
   - **Clinical Use:** Used for pain relief (mild to moderate), reducing inflammation, and lowering fever.
3. **Antipyretic Effects: Standard Analgesic Doses (325-1000 mg):**
   - **Clinical Use:** Aspirin is commonly used to lower elevated body temperature associated with fever.
4. **Anti-Inflammatory Effects: High Doses:**

- **Clinical Use:** High doses may be used in certain inflammatory conditions under medical supervision.

Naproxen:

Mechanism of Action: Inhibits both COX-1 and COX-2 enzymes, similar to ibuprofen.

Uses:

5. Pain relief (mild to moderate).
6. Inflammation reduction.
7. Fever reduction.
8. Longer duration of action compared to some other NSAIDs.

Adverse Effects:

9. Gastrointestinal irritation and ulcers.
10. Renal impairment.
11. Increased risk of cardiovascular events.
12. Allergic reactions.
13. Risk of bleeding.

•

Diclofenac:

Mechanism of Action: Inhibits both COX-1 and COX-2 enzymes.

Uses:

- Pain relief (mild to moderate).
- Inflammation reduction. □ Fever reduction.

Adverse Effects:

- Gastrointestinal irritation and ulcers.
- Renal impairment.
- Increased risk of cardiovascular events.
- Hypersensitivity reactions.

Ketorolac:

Mechanism of Action: Inhibits both COX-1 and COX-2 enzymes.

Uses:

- Short-term management of moderate to severe pain.

Adverse Effects:

- Gastrointestinal irritation and ulcers.
- Renal impairment.
- Increased risk of bleeding.
- Not recommended for long-term use.

Celecoxib:

Mechanism of Action: Selective inhibition of COX-2 enzyme, sparing COX-1.

Uses:

- Pain relief (osteoarthritis, rheumatoid arthritis).
- Inflammation reduction.
- Not typically used for fever reduction.

Adverse Effects:

- Lower risk of gastrointestinal irritation compared to non-selective NSAIDs.
- Increased risk of cardiovascular events.
- Renal impairment.
- Hypersensitivity reactions.

Acetaminophen:

Acetaminophen or Paracetamol is a commonly used over-the-counter medication for relief of pain and fever. It is not classified as a non-steroidal anti-inflammatory drug (NSAID) like aspirin or ibuprofen because it lacks significant anti-inflammatory effects. Here are key aspects of acetaminophen:

Mechanism of Action:

- The exact mechanism of action is not fully understood. It is believed to inhibit cyclooxygenase COX3 (an enzyme in the brain)
- Unlike NSAIDs, acetaminophen has little anti-inflammatory activity.
- **Uses:**

1. **Pain Relief:**
    - Mild to moderate pain, such as headaches, musculoskeletal pain, and dental pain.
    - It is often used as an alternative to NSAIDs for individuals who cannot tolerate them.
2. **Fever Reduction:**
    - Acetaminophen is commonly used to lower fever in various conditions.

Adverse Effects:

- **Liver Toxicity:** High doses or prolonged use can lead to liver damage. Individuals with liver disease or those who consume alcohol regularly should use acetaminophen with caution.
- **Overdose:** Acetaminophen overdose can cause severe liver damage and is a medical emergency.

Alcohol

Ethanol:

Ethanol is the type of alcohol found in alcoholic beverages

Mechanism of Action:

- Ethanol is oxidized to acetaldehyde in a reaction catalyzed by alcohol dehydrogenase (ADH).
- Acetaldehyde is subsequently metabolized to acetate by another enzyme called acetaldehyde dehydrogenase (ALDH).
- The reaction involves the conversion of acetaldehyde to acetate, and it utilizes cofactors such as NAD^+.
- Acetate is a less toxic substance that can undergo further metabolism in the body

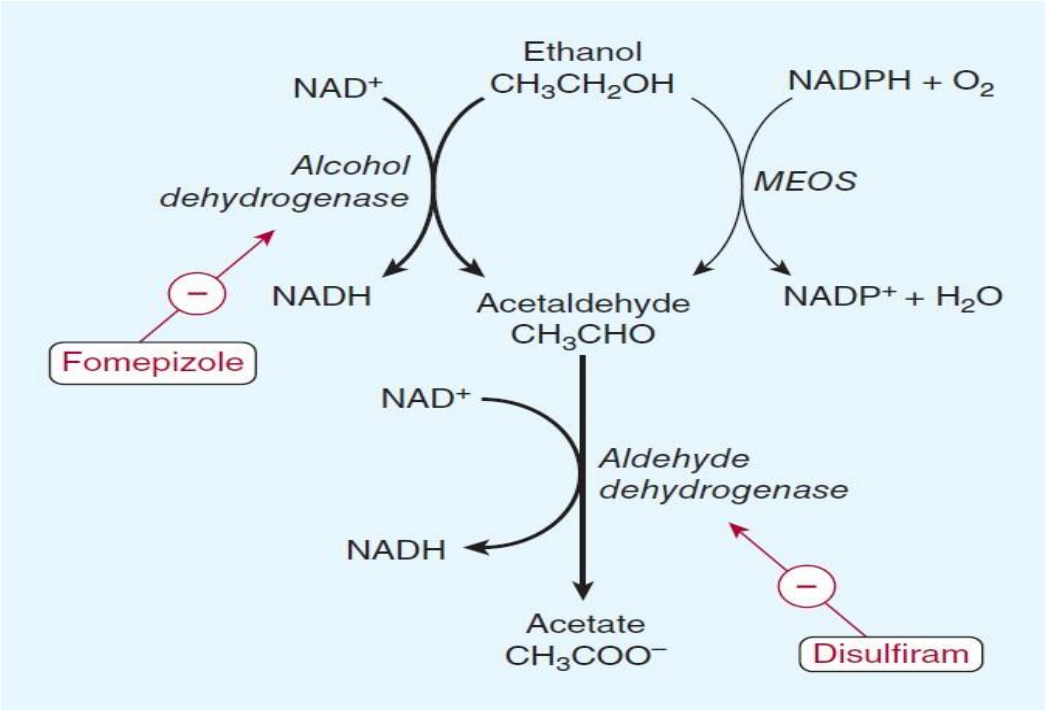


Figure 2.7: Metabolism of ethanol by alcohol dehydrogenase (ADH) and the microsomal ethanol-oxidizing system (MEOS)

Adverse Effects:

- **Intoxication:**
- Impaired coordination, slurred speech and altered judgment.
- **Addiction:**
- Chronic use can lead to alcohol dependence and addiction.
- **Organ Damage:**
- Long-term heavy drinking can damage the liver, pancreas, and cardiovascular system.
- **CNS Depression:**
- Excessive consumption can lead to respiratory depression, unconsciousness, and, in severe cases, death.
- **Withdrawal:**
- Abrupt cessation can lead to withdrawal symptoms, including tremors, anxiety, seizures, and delirium tremens.

Methanol (Wood Alcohol):

Mechanism of Action:

- Methanol is metabolized to formaldehyde and then to formic acid. The toxic effects are primarily due to the buildup of formic acid, leading to metabolic acidosis and damage to the optic nerve.

Uses:

- **Industrial Solvent:**
- Methanol is used as an industrial solvent and as a component in various chemical processes.
- **Fuel:**
- It is used as a fuel and fuel additive.

Adverse Effects:

- **Metabolic Acidosis:**
- Methanol toxicity can lead to metabolic acidosis.
- **Optic Nerve Damage:**
- Formic acid accumulation can cause damage to the optic nerve, leading to visual disturbances and potential blindness.
- **Organ Damage:**
- Methanol toxicity can affect multiple organs, including the liver and kidneys.
- **CNS Depression:**
- Symptoms may include headache, dizziness, nausea, and, in severe cases, coma.

Ethylene Glycol:

Mechanism of Action:

- Ethylene glycol is metabolized to glycolic acid and oxalic acid. The toxic effects are mainly due to the formation of calcium oxalate crystals, leading to renal damage and metabolic acidosis.

- **Uses: □ Coolant and Antifreeze:**

- Ethylene glycol is commonly used as a coolant and antifreeze in automotive and industrial applications.

- **Deicing Agent:**
- It is used as a deicing agent for aircraft and runways.

Adverse Effects:

- **Renal Damage:**

- The formation of calcium oxalate crystals in the kidneys can lead to renal damage and failure.
- **Metabolic Acidosis:**
- Ethylene glycol toxicity can result in metabolic acidosis.
- **CNS Depression:**
- Symptoms may include confusion, seizures, and coma.
- **Organ Damage:**
- Ethylene glycol can affect multiple organs, including the heart, lungs, and nervous system.

Hypnotics

Hypnotics are a class of medications that are used to induce and maintain sleep. They act on the central nervous system to promote sleep and are commonly prescribed for the treatment of insomnia.

Mechanism of Action:

- Many hypnotics enhance the effects of gamma-aminobutyric acid (GABA), which is an inhibitory neurotransmitter in the brain.
- GABAergic activity leads to an increase in chloride ion influx, resulting in neuronal hyperpolarization and inhibition, ultimately promoting sedation and sleep.
- **Uses:**
- **Insomnia:**
- The primary use of hypnotic medications is to treat insomnia, a common sleep disorder characterized by difficulty falling asleep, staying asleep, or experiencing non-restorative sleep.

Types of Hypnotics:

Benzodiazepines:

- Examples: Diazepam,Temazepam, Triazolam, Estazolam.
- **Mechanism:** Enhance GABAergic activity.
- **Uses:** Short-term treatment of insomnia, anxiety, panic attacks, muscle relaxant, seizer disorder
- **Adverse Effects:** Day time drowsiness, dizziness, tolerance, dependence, withdrawal symptoms upon discontinuation.

Barbiturates :

Example: Phenobarbitai, Secobarbital, Amobarbital

Mechanism: Enhance GABAergic activity

Uses: Insomnia, anesthesia, seizer disorder

Adverse Effects: CNS depression, tolerance, dependence

Non-Benzodiazepine Hypnotics:

- Examples: Zolpidem, Zaleplon, Eszopiclone.
- **Mechanism:** Act on the same GABA-A receptors as benzodiazepines.
- **Uses:** Treatment of insomnia with a focus on shorter duration of action.
- **Adverse Effects:** Similar to benzodiazepines but generally have a better safety profile regarding tolerance and dependence.

Melatonin Receptor Agonists:

- Example: Ramelteon.
- **Mechanism:** Acts on melatonin receptors to regulate the sleep-wake cycle.
- **Uses:** Treatment of insomnia, particularly in individuals with difficulty initiating sleep.
- **Adverse Effects:** Dizziness, fatigue, headache.

Orexin Receptor Antagonist:

- Example: Suvorexant.
- **Mechanism:** Blocks the action of orexin, a neurotransmitter associated with wakefulness.
- **Uses:** Treatment of insomnia.
- **Adverse Effects:** Daytime sleepiness, abnormal dreams, headache.

Adverse Effects (Common to Hypnotics in General):

Daytime Drowsiness:

- Many hypnotics can cause residual daytime drowsiness, impairing cognitive and motor function.
- **Cognitive and Psychomotor Impairment:**
- Impaired memory, attention, and coordination may occur, especially if the medication is not allowed sufficient time to be metabolized before waking.
- **Tolerance and Dependence:**
- Long-term use of some hypnotics, particularly benzodiazepines, can lead to tolerance and dependence.
- **Withdrawal Symptoms:**
- Abrupt discontinuation of certain hypnotics, especially benzodiazepines, can result in withdrawal symptoms such as rebound insomnia, anxiety, and agitation.
- **Drug Interactions:**
- Hypnotics can interact with other medications, leading to additive central nervous system depression and increased risk of adverse effects.
- **Complex Sleep-Related Behaviors:**
- Rarely, certain hypnotics have been associated with complex sleep related behaviors, such as sleepwalking and sleep-driving.

Anesthesia

Anesthesia is a reversible loss of response to a painful stimuli

- General Anesthesia(loss of consciousness)
- Local Anesthesia(consciousness maintained)

General Anesthesia

- It is a state of depressed brain function
- It is characterized by
- Reversible loss of consciousness
- Analgesia
- Amnesia
- Skeletal muscle relaxation
- Loss of reflexes

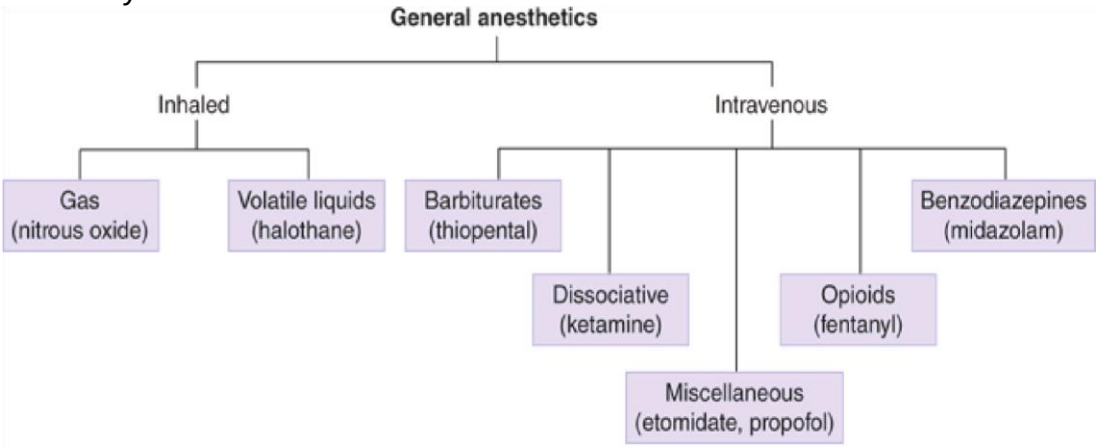
- None of the currently available anesthetic drugs can achieve all five of these desired effects well
- Modern practice relies on the use of combinations(balanced anesthesia)
- **Inhaled drugs**
- **Intravenous drugs**

BALANCED ANESTHESIA

Anesthesia produced by a mixture of drugs to use the favorable effects of each drug and minimize their adverse effects

Consists of 3 phases

- Induction by intravenous agents
- Maintenance by inhalational agents
- Recovery



Source: A.J. Trevor, B.G. Katzung, M. Kruidering-Hall: Katzung & Trevor's Pharmacology: Examination & Board Review, 11th Ed.
www.accesspharmacy.com

Figure 2.8: Classification of General anesthetics

Inhaled anesthetics

These can be volatile and gaseous in nature

- Volatile anesthetics- Halothane, Enflurane, Isoflurane, Desflurane, Sevoflurane
- Gaseous anesthetics- Nitrous Oxide , Xenon

Nitrous Oxide:

Mechanism of Action: Nitrous oxide is a gas that interacts with the central nervous system, enhancing the activity of gammaaminobutyric acid (GABA) receptors and inhibiting excitatory neurotransmission.

Uses:

- Commonly used as an analgesic and adjunctive anesthetic in dental procedures.
  - Used in combination with other anesthetics during surgery

Halothane:

Mechanism of Action: Exact mechanism not fully understood; likely involves modulation of GABA receptors. Halothane causes dose dependent depression of the central nervous system.

Uses:

- Used for induction and maintenance of general anesthesia.

Adverse Effects:

- Hepatotoxicity: Rare but serious risk of hepatic necrosis.
- Sensitization of the heart to catecholamines, leading to arrhythmias.
- Malignant hyperthermia: A rare, life-threatening reaction in susceptible individuals.

Isoflurane, Enflurane, Sevoflurane, Methoxyflurane:

Mechanism of Action Modulates GABA receptors and inhibits excitatory neurotransmission.

Uses:

- Widely used for general anesthesia.

Adverse Effects:

- Respiratory depression.
- Cardiovascular effects, including hypotension.
- Malignant hyperthermia (rare).

Intravenous general anesthetics
Thiopental and Methohexital:

Mechanism of Action: Thiopental and methohexital enhance the activity of the inhibitory neurotransmitter (GABA) at its receptors, leading to central nervous system depression.

Uses:

Induction of Anesthesia: Rapid induction of anesthesia for surgical procedures.

Adverse Effects:

- Cardiovascular Depression
- Respiratory Depression
- Injection Site Reactions

Midazolam:

Mechanism of Action: Acts on GABA-A receptors, enhancing the effects of GABA, leading to sedation and anxiolysis.

Uses:

- **Sedation:** Used for procedural sedation and preoperative sedation.
- **Induction of Anesthesia:** Used as an adjunct to general anesthesia.
- **Adverse Effects:**
- Respiratory Depression
- Hypotension

Fentanyl, Alfentanyl, Remifentanil, Morphine:

Mechanism of Action: These drugs act on mu-opioid receptors in the central nervous system, producing analgesia and sedation.

Uses:

Analgesia: Used for pain management in various settings, including surgery and postoperative care.

Adverse Effects:

- Respiratory Depression
- Sedation and Euphoria

Ketamine:

Mechanism of Action: Blocks (NMDA) receptors, producing dissociative anesthesia and analgesia.

Uses:

Induction of Anesthesia: Particularly in situations where maintaining airway reflexes is desirable.

Analgesia: Used for pain management, especially in patients with chronic pain.

Adverse Effects:

Emergence Phenomena: Hallucinations, vivid dreams, and altered perceptions during recovery.

Cardiovascular Stimulation: May cause an increase in heart rate and blood pressure.

Propofol:

Mechanism of Action: Enhances the activity of GABA-A receptors, leading to rapid central nervous system depression.

Uses:

- **Induction and Maintenance of Anesthesia:** Widely used for general anesthesia.
- **Sedation:** Used for procedural sedation.

Adverse Effects:

- **Respiratory Depression:** A common concern, especially with rapid administration.
- **Hypotension:** May cause a drop in blood pressure.

Local Anesthesia

Local anesthetics are drugs that block nerve conduction in a specific region of the body, resulting in temporary loss of sensation and pain. They can be classified into two main chemical groups based on their structure: Esters & Amides

Esters:

Examples of Esters: Procaine, Chloroprocaine:

- Higher potential for allergic reactions and short acting

Amides:

- **Examples of Amides: Lidocaine, Bupivacaine, Mepivacaine**
- Longer duration of action, less likely to cause allergic reactions, suitable for surgical procedures and postoperative pain management.
- Intermediate duration, often used in dental procedures.
- **Ropivacaine:** Similar to bupivacaine with a slightly faster onset and shorter duration.

Mechanism of Action:

- Local anesthetics block nerve conduction by inhibiting sodium channels in the neuronal cell membrane.
- **Uses:**
- Local anesthetics are used for various medical and dental procedures to induce temporary loss of sensation and pain.
- They can be administered topically via infiltration (local injection), nerve block, or epidural/spinal routes.

Adverse Effects:

- **Local Reactions:** Injection site pain, swelling, or bruising.
- **Allergic Reactions:** More common with esters than amides.
- **Vasoconstrictors:** Local anesthetics are often combined with vasoconstrictors like epinephrine to prolong their duration.

- **Warning:** in fingers, toes and nose vasoconstrictors should not be used due to the risk of ischemia.

Analeptics (Nikethamide)

Nikethamide is a respiratory analeptic, which means it stimulates respiration and can be used in certain medical situations to counteract respiratory depression.

Mechanism of Action:

- Nikethamide primarily acts by stimulating the central respiratory centers by carbon dioxide(CO2) in the medulla oblongata of the brain, leading to an increase in the rate and depth of respiration.

Uses:

- **Respiratory Depression:**
- Nikethamide has been used in emergency situations to treat respiratory depression, such as in cases of drug overdose or anesthesia induced respiratory depression.
- **Neonatal Apnea:**
- **Diagnostic Purposes:**
- To stimulate respiratory responses and assess the function of the respiratory system.

Adverse Effects:

- Restlessness, anxiety and tremors, can cause changes in heart rate and blood pressure, nausea and vomiting, Allergic reaction

Toxicology

Toxicology is the scientific study of the adverse effects of chemical substances on living organisms. It involves the examination of the toxicity, properties, and interactions of various substances, including drugs, chemicals, pollutants, and biological toxins, to understand their potential harm and impact on biological systems. The primary goals of toxicology are to assess and characterize the hazards associated with exposure to toxic substances and to determine the levels at which these substances become harmful to humans, animals, and the environment.

Principles in the Management of Poisoned Patients:

1. **Patient-Centered Approach:**
   - Treat the patient, not just the poison.
   - Assess and manage the airway, breathing, and circulation.
   - Act immediately on life-threatening toxic effects (e.g., changes in blood pressure, heart rate, breathing, body temperature,arhythmias).
2. **Initial Evaluation:**
   - Assess acid/base and electrolyte disturbances.
   - Administer oxygen, maintain I/V line and place the patient on a cardiac monitor.
3. **Altered Mental Status:**
   - Consider the "coma cocktail" for patients with altered mental status.
   - The "coma cocktail" includes intravenous dextrose for hypoglycemia, naloxone for opioid or clonidine toxicity, and thiamine for ethanol-induced Wernicke encephalopathy.

Management Strategies:

A. Decontamination:

- For ocular exposures: Flush eyes with saline or lukewarm water.
- For dermal exposures: Rinse the skin.
- For ingestions: Consider gastric lavage, activated charcoal, or whole bowel irrigation (limited use for certain substances).

B. Elimination Enhancement:

1. **Hemodialysis:** e.g.for methanol, ethylene glycol, salicylates poisoning.

2. **Urinary Alkalinization:** with intravenous sodium bicarbonate, for salicylates or phenobarbital poisoning as it increases excretion of drug in urine

- Goal is urine pH should be within 7.5 – 8.0

Select pharmaceuticals and occupational toxicities

Acetaminophen:

- **Antidote:**
- N-acetylcysteine (NAC) it acts as an antioxidant.
- Most effective if given within 8 to 10 hours of ingestion.

Alcohols:

Methanol and Ethylene Glycol:

- Converted to toxic products (formic acid, glycolic acid) causing CNS depression. **Antidote:**
- Fomepizole: it inhibits oxidative pathway; hemodialysis removes toxic acids.

Carbon Monoxide:

- Colorless, odorless gas from burning. It binds strongly to hemoglobin and reduces oxygen delivery in body, causing hypoxia and death.
- **Management**: Remove from source, administer 100% oxygen; hyperbaric oxygen for severe cases.

Cyanide:

- **Antidotes:** Hydroxocobalamin or sodium nitrite and sodium thiosulfate.

Iron:

- Radiopaque; ingestion symptoms include nausea, vomiting, abdominal pain.
- Severe toxicity leads to hypovolemia, metabolic acidosis, hypotension, coagulopathy, organ failure.
- **Antidote:** Deferoxamine: it chelates iron; intravenous route preferred.

Lead:

- Environmental exposure from paint, water, dust; chronic exposure occurs.
- Inorganic lead affects tissues and bones.

- Chronic exposure effects include neurological, hematological, and renal issues.
- **Antidote:** Succimer, dimercaprol, calcium disodium edetate

Antidotes

Antidotes are substances or treatments that counteract the effects of a poison or toxic substance. Some common antidotes for specific types of poisoning are shown in figure

POISON	ANTIDOTE(S)
Acetaminophen	*N-Acetylcysteine*
Anticholinergic agents (antihistamines, etc.)	*Physostigmine*
Arsenic	*Succimer (dimer-captosuccinic acid, DMSA), dimercaprol*
Benzodiazepine	*Flumazenil*
Carbon monoxide	Oxygen (± hyperbaric chamber)
Cyanide	*Hydroxocobalamin Sodium nitrite and sodium thiosulfate*
Digitalis	*Digoxin-immune Fab*
Hydrofluoric acid	*Calcium*
Iron	*Deferoxamine*
Isoniazid and gyromitra mushrooms	*Pyridoxine*
Methanol and ethylene glycol	*Fomepizole*
Heparin	*Protamine sulfate*
Lead	*Succimer (dimer-captosuccinic acid, DMSA), dimercaprol, calcium disodium edetate*
Methemoglobinemia	*Methylene blue*
Opiates, *clonidine*	*Naloxone*
Organophosphates, nerve gases	*Atropine, pralidoxime*
Warfarin	*Vitamin K1 (phytonadione)*

Figure 2.9: Antidotes

Treatment of Over-dosage and Poisoning

Morphine/Opioid poisoning:

Morphine acts as a depressant on the central nervous system and the effects of a morphine overdose impact both the brain and body.

- **Recognition of Morphine/Opioid Poisoning:**

Three key symptoms of morphine overdose are

1. Slow and difficult breathing 2. Loss of consciousness 3.Very narrow pupils

- **Maintain Airway and Breathing:**

Administer oxygen if available.

- **Administer Naloxone:**

Naloxone is antidote to opioid. It blocks the opioid receptors and can rapidly reverse the effects of opioid overdose, including morphine.

- **Fluid Resuscitation:**

Administer intravenous fluids to maintain blood pressure and perfusion. Correct electrolyte imbalances.

- **Activated Charcoal:**

Activated charcoal can help prevent further absorption of the drug in the gastrointestinal tract.

- **Gastric Lavage:**

Gastric lavage (stomach pumping) may be considered in certain situations, especially if the ingestion was recent.

- **Supportive Care:**

Provide supportive care, including monitoring and treatment of complications such as respiratory depression, hypotension and hypoxia.

Consider mechanical ventilation if respiratory function is severely compromised.

- **Seizure Management:**

Administer anticonvulsants if seizures occur.

Atropine poisoning:

Atropine is a medication that belongs to a class of drugs known as anti-muscarinics or anti-cholinergics. It is commonly used for various medical purposes, such as in the treatment of bradycardia (slow heart rate), organophosphate poisoning, and some eye conditions. However, excessive or inappropriate use of atropine can lead to atropine poisoning. Here are the general principles for the management of atropine poisoning:

- **Recognition of Atropine Poisoning:**

Signs and symptoms of atropine toxicity include dry mouth, blurred vision, dilated pupils, confusion, hallucinations, elevated heart rate and fever.

- **Discontinuation of Atropine Exposure:**

Stop the administration of atropine or any other anti-muscarinic medications contributing to the toxicity.

- **Maintain Airway and Breathing:**

Ensure proper oxygenation and ventilation. In severe cases, intubation and mechanical ventilation may be necessary.

- **Fluid Resuscitation and maintain body temperature:**

Maintain hydration with intravenous fluids to prevent dehydration and maintain body temperature by cold sponging

- **Physostigmine Administration:**

Physostigmine can counteract the effects of atropine toxicity. It should be administered cautiously by healthcare professionals in a monitored setting.

- **Monitoring:**

Continuous monitoring of vital signs, including heart rate, blood pressure, respiratory rate, oxygen saturation and temperature.

- **Sedation for Agitation:**

In cases of severe agitation benzodiazepines e.g. Diazepam may be administered.

Strychnine poisoning

Strychnine is a highly toxic alkaloid found in the seeds of the Nux-vomica tree. It acts as a convulsant by blocking inhibitory neurotransmission in the spinal cord, leading to severe muscle spasms. Strychnine poisoning is a medical emergency that requires prompt intervention. Here are the general principles for the management of strychnine poisoning:

- **Recognize the Signs and Symptoms:**
  Symptoms typically include muscle stiffness, jaw clenching, arching of the back, and severe convulsions.
- **Activate Emergency Medical Services:**
  Call for emergency medical assistance immediately. Strychnine poisoning requires rapid intervention.
- **ABCs of Resuscitation:**
  Ensure a clear airway, provide adequate ventilation, and monitor oxygen saturation.
  Initiate cardiopulmonary resuscitation (CPR) if necessary.
- **Administer Activated Charcoal:**
  If the ingestion is recent and the patient is conscious, administration of activated charcoal may help reduce further absorption of strychnine.
- **Seizure Management:**
  Benzodiazepines, such as diazepam or lorazepam, are the first-line agents for controlling seizures in strychnine poisoning.
  Administer intravenous benzodiazepines in repeated doses until seizures are controlled.
- **Gastric Lavage (if appropriate):**
  Gastric lavage may be considered if the ingestion is recent However, this should be done cautiously due to the risk of inducing seizures during the procedure.
- **Maintain a Quiet Environment:**
  Limit external stimuli, put patient in dark, quiet and warm room as sensory stimuli can trigger seizures in individuals with strychnine poisoning.
- **Administration of Muscle Relaxants:**
  Intravenous diazepam or midazolam may be considered to reduce muscle spasms.
- **Intensive Monitoring:**
  Continuous monitoring of vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation.
    - **Hospitalization:**

  Hospital admission is necessary for individuals with strychnine poisoning, as they require close monitoring and supportive care.

Insecticide poisoning

Organophosphates or insecticides inhibit acetylcholinesterase, an enzyme crucial for the normal functioning of the nervous system. Poisoning with these chemicals can lead to the accumulation of acetylcholine, causing overstimulation of cholinergic receptors and resulting in a range of symptoms. Here are general guidelines for the management of organophosphate poisoning:

- **Remove from Exposure:**
  Move the affected person away from the source of exposure to prevent further contact with the insecticide.
- **Administer Atropine:**
  Atropine is the primary antidote for organophosphate poisoning. It works by blocking the effects of excess acetylcholine.
- **Pralidoxime (2-PAM):**
  Pralidoxime is another antidote that helps reactivate acetylcholinesterase but its effectiveness is limited once aging of the enzyme has occurred.
- **Decontamination:**
  Remove contaminated clothing.
  Wash the affected skin with soap and water.
  Flush eyes with plenty of water if exposed.
- **Supportive Care:**
  Maintain airway, breathing and circulation.
  Administer supplemental oxygen if respiratory distress is present.
  Use mechanical ventilation if necessary.
- **Seizure Management:**
  Administer benzodiazepines such as diazepam or lorazepam for seizure control.
- **Monitoring:**
  Continuous monitoring of vital signs, including heart rate, blood pressure, respiratory rate and oxygen saturation.
- **Gastric Lavage and Activated Charcoal (if appropriate):**
  Gastric lavage may be considered if the ingestion is recent and the patient presents soon after exposure.
  Activated charcoal may be administered to limit further absorption if indicated.
- **Hospitalization:**
  Depending on the severity of poisoning, hospital admission may be necessary for close monitoring and further treatment.

Kerosene oil poisoning

Kerosene oil poisoning can occur when individuals ingest or inhale kerosene, a flammable hydrocarbon liquid commonly used as a fuel. Ingestion or inhalation of kerosene can lead to various adverse effects, and management should be prompt and supportive. Here are general guidelines for the management of kerosene oil poisoning:

- **Remove from Exposure:**
  Move the affected person away from the source of exposure to prevent further contact with kerosene.
- **Do Not Induce Vomiting:**
  In cases of kerosene ingestion, do not induce vomiting. Vomiting can lead to aspiration and cause additional complications.
- **Provide Basic First Aid:**
  If kerosene comes into contact with the skin, remove contaminated clothing and wash the affected area with soap and water.
  If kerosene gets into the eyes, flush the eyes with clean water for at least 15 minutes.
- **Do Not Administer Milk or Water:**
  Avoid giving the affected person milk or water to drink. Ingesting liquids may increase the risk of aspiration into the lungs.
- **Protect the Airway:**
  If there is a risk of aspiration (inhalation of kerosene into the lungs), the person should be placed in a position that protects the airway.
- **Supportive Care:**
  Maintain the airway, breathing, and circulation.
  Provide oxygen therapy if respiratory distress is present.
  Monitor vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation.
- **Chest X-ray (if necessary):**
  In cases of suspected aspiration, a chest X-ray may be performed to assess the lungs for the presence of kerosene.
- **Hospitalization:**
  Depending on the severity of symptoms, hospital admission may be necessary for close monitoring and further treatment.

Acid/Alkali Ingestion

- Acid and alkali (base) ingestion are serious medical emergencies that require immediate attention. The management of acid or alkali ingestion involves several

key steps to minimize damage and prevent complications. Here are general guidelines for the management of acid or alkali ingestion

- **Keep patient NPO (Nothing Per Oral):**
  Do not give patient anything by mouth.
- **Do Not Induce Vomiting:**
  Do not attempt to induce vomiting, as it may cause additional damage to the esophagus and oral cavity.
- **Give IV fluids:**
  Administer IV fluids to the patient.
- **Protect the Airway**
- **Remove Contaminated Clothing:**
  If the acid has come into contact with the skin, remove contaminated clothing and wash the affected area with copious amounts of water.
- **Irrigation of Eyes (if affected):**
  If the acid/alkali has entered the eyes, irrigate the eyes with a gentle stream of water for at least 15 minutes. Use an eye wash station if available.
- **Monitor and Manage Symptoms:**
  Monitor the person's vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation.
- **Hospitalization:**
  Admission to the hospital is often necessary for close monitoring and further management.
- **Endoscopy (if indicated):**
  In cases of severe acid ingestion, endoscopy may be performed to assess the extent of damage to the esophagus and stomach.
- **Symptomatic Treatment:**
  Treat symptoms as they arise, including pain management, anti-emetics, antibiotics and other supportive measures.

CHAPTER 3: STERILIZATION & VACCINATION

Sterilization is the process of eliminating or destroying all forms of microbial life, including bacteria, viruses, fungi, and spores, to achieve a state of complete absence of viable microorganisms.

Terminology

Sterility: The state of being free from living microorganisms, including bacteria, viruses, fungi, and spores.

Bactericidal: Capable of killing bacteria. Bactericidal agents directly destroy or eliminate bacteria.

Bacteriostatic: Inhibiting the growth or reproduction of bacteria without necessarily killing them. Bacteriostatic agents prevent the further development or multiplication of bacteria.

The **Disinfection:** process of reducing or eliminating harmful microorganisms from surfaces and objects, but not necessarily achieving complete sterilization. Disinfection aims to reduce the microbial load to a level that is considered safe for public health.

Sepsis: A severe and often life-threatening response to an infection, characterized by the body's systemic inflammatory reaction. Sepsis can lead to organ dysfunction and failure.

Aseptic: Free from contamination by pathogenic microorganisms. Aseptic techniques are used to prevent the introduction of microbes into a sterile environment.

Antisepsis: The process of inhibiting or arresting the growth of microorganisms on living tissues. Antisepsis is commonly applied to the skin or mucous membranes to prevent infection.

Maintenance of Operating Theater (OT) and Aseptic Standards:

1. Allocate one day per week for OT maintenance.
2. Conduct regular swabbing of OT surfaces.
3. Ensure periodic checks on the air conditioning system in the OT.
4. Maintain and clean filters regularly.
5. Keep spare bulbs in stock within the OT department.
6. Ensure consistent and adequate pressure at all times.
7. Prohibit operating staff with infections from entering the OT.
8. Implement thorough sterilization of mobile equipment and operation table.

Policy on Cleaning Techniques:

Preparatory Cleaning:

- Clean and carbolize OT equipment, tables, walls, and floors every morning before starting a case, using a 1% hypochlorite solution.
- Verify the concentration of available hypochlorite and dilute as needed (e.g., dilute 1 part of a 4% sodium hypochlorite solution with 4 parts water to make a 1% solution).

Operative Cleaning:

- Immediately clean areas contaminated by organic debris, such as blood and sputum, during operations.

Terminal Cleaning:

1. Conduct a thorough cleaning of the OT at the end of each day.
2. Clean the OT area after removing all used materials and items for disposal.
3. Mop the floor with a 1% sodium hypochloride solution.
4. After mopping, carbolize the OT walls, floors, table tops, and equipment.

Fumigation:

Fumigation is defined as the action or process of disinfecting or purifying an area with the fumes of certain chemicals.

It is a process of gaseous sterilization which is used for killing of microorganisms and prevention of microbial growth in air, surface of wall or floor.

Requirements for fumigation:

- Personal protective equipment (PPE) set that includes face protection, goggles and mask or face shields, gloves, gown or overall, head cover and rubber boots.
- Formalin/ saturated formaldehyde solution (37%)
- Distilled water
- Electric boiler
- Potassium permanganate
- Ammonia

Electric Boiler Fumigation Method:

To perform electric boiler fumigation, add 500 ml of 40% formaldehyde solution to 1000 ml of purified water (or tap water if purified water is unavailable) for every 1000 cubic feet. This mixture is placed in an electric boiler. Once the boiler is turned on,

step outside the Operation Theatre, and close the door. The boiler should be switched off after 45 minutes, though the exact timing depends on the heating device's volume and efficiency.

Precautions:

Formaldehyde can be irritating to the eyes and nose and is a potential carcinogen. Therefore, fumigators should wear personal protective equipment (PPE), including a cap, mask, and foot covers. A warning sign indicating ongoing fumigation should be prominently displayed on the Operation Theatre's front door.

Benefits of Fumigation:

- **Complete Eradication:** Fumigation helps eliminate all stages of the pathogen's life cycle.
- **Time-Saving:** This method is efficient and time-saving.
- **Reach in Hard-to-Access Areas:** Fumigation can reach areas inaccessible to other chemicals.
- **Minimal Residue:** It leaves less residue on articles within the fumigation zone.

Potassium Permanganate Method:

Fumigation Process:

- Heat generation is initiated by the oxidizer potassium permanganate ($KMnO_4$), causing auto-boiling and the release of formaldehyde fumes. In a heat-resistant container, preferably a steel bucket, mix 500ml of 40% formaldehyde with 1000ml of distilled or tap water. Add 450mg of $KMnO_4$ for every 1000 cubic feet of theater volume. Repeat the process in separate buckets for every additional 1000 cubic feet until the entire theater volume is covered. It's crucial to add $KMnO_4$ simultaneously to minimize fume exposure, requiring 3-4 persons at different locations.
- Once formaldehyde vapor is initiated, promptly exit the room and seal it for a minimum of 12-24 hours.

Neutralization Process:

- Before neutralization, remove the formaldehyde fumigation system from the Operating Theatre (OT). Neutralize the toxicity of formaldehyde vapor with ammonia solution.

- Place a cotton ball and pour 300ml of 10% ammonia (for each 500ml of formaldehyde used) on the OT floor at least 4 hours before the Sterility Test.
- The reaction between formaldehyde gas and ammonia gas produces hexamine, considered a harmless substance.
- Switch on the air conditioning at least 2 hours before the Sterility Test.

Example:

- Calculate OT volume: L×B×H = 20×15×10 = 300 cubic feet (round to the nearest 1000 if the volume is in fractions).
- Formaldehyde required for fumigation: 500ml for 1000 cubic feet, so 1500ml of formaldehyde is needed (to be diluted in 3000ml of distilled water).
- Ammonia required for neutralization: 300ml of 10% ammonia for 500ml of aldehyde, so 900ml of 10% ammonia is required.

Sterilization of dressings:

A dressing is a sterile pad or compress applied to wound to promote healing and protect the wound.

Materials for surgical dressings:

Cotton wool balls, gauze swabs, ribbon gauze, bandages etc.

Stages of sterilization of surgical dressings:

- Packing or wrapping
- Loading into sterilizer
- Air replacement in sterilizer
- Heating
- Removal of contents
- Labelling **Procedure:**

Surgical dressing material is wrapped or packed into a suitable container. For this purpose a metal drum is used and those drums are perforated in order to allow free flow of steam or those materials are wrapped in muslin cloth. Surgical dressing is exposed for 30-45 minutes at 121º c. The contents are removed and labelled.

Figure 3.1: A) dressing drum with perforations for entry of steam B) perforations are closed to prevent contamination

Sterilization of hands and skin:

The principles of sterilization for hands and skin, commonly referred to as aseptic or surgical hand hygiene, are essential to prevent the transmission of microorganisms and maintain a sterile environment in healthcare settings.

It includes

- **Rubbing**
  - It removes microorganisms from the skin
- **Lathering** ○ It holds microorganisms suspended away from the skin surface
- **Rinsing** ○ Washes them off the hands **Antiseptics used in hand washing**
- Povidone iodine
- Chlorhexidine
- Ethyl alcohol
- Isopropyl alcohol

The steps to properly wash hands is shown in Figures 3.2, 3.3, 3.4 and 3.5

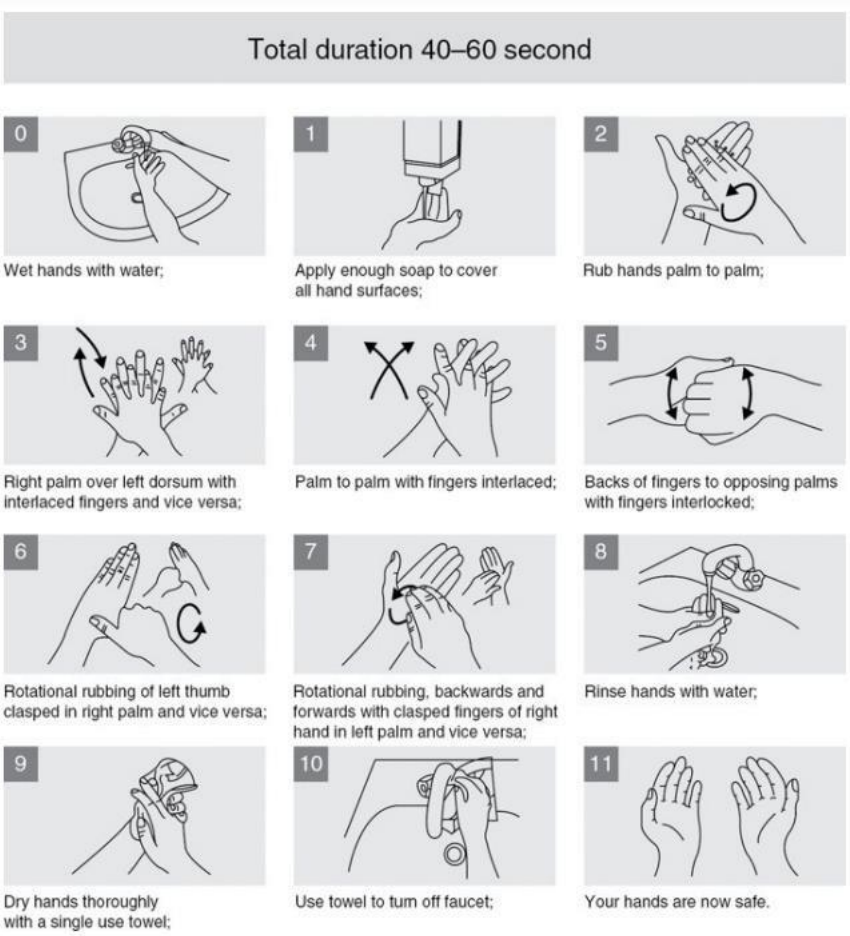


Figure 3.2: Steps on how to properly perform hand hygiene using soap and water (WHO guidelines)

Figure 3.3: steps on how to properly perform hand hygiene using soap and water (WHO guidelines) in urdu

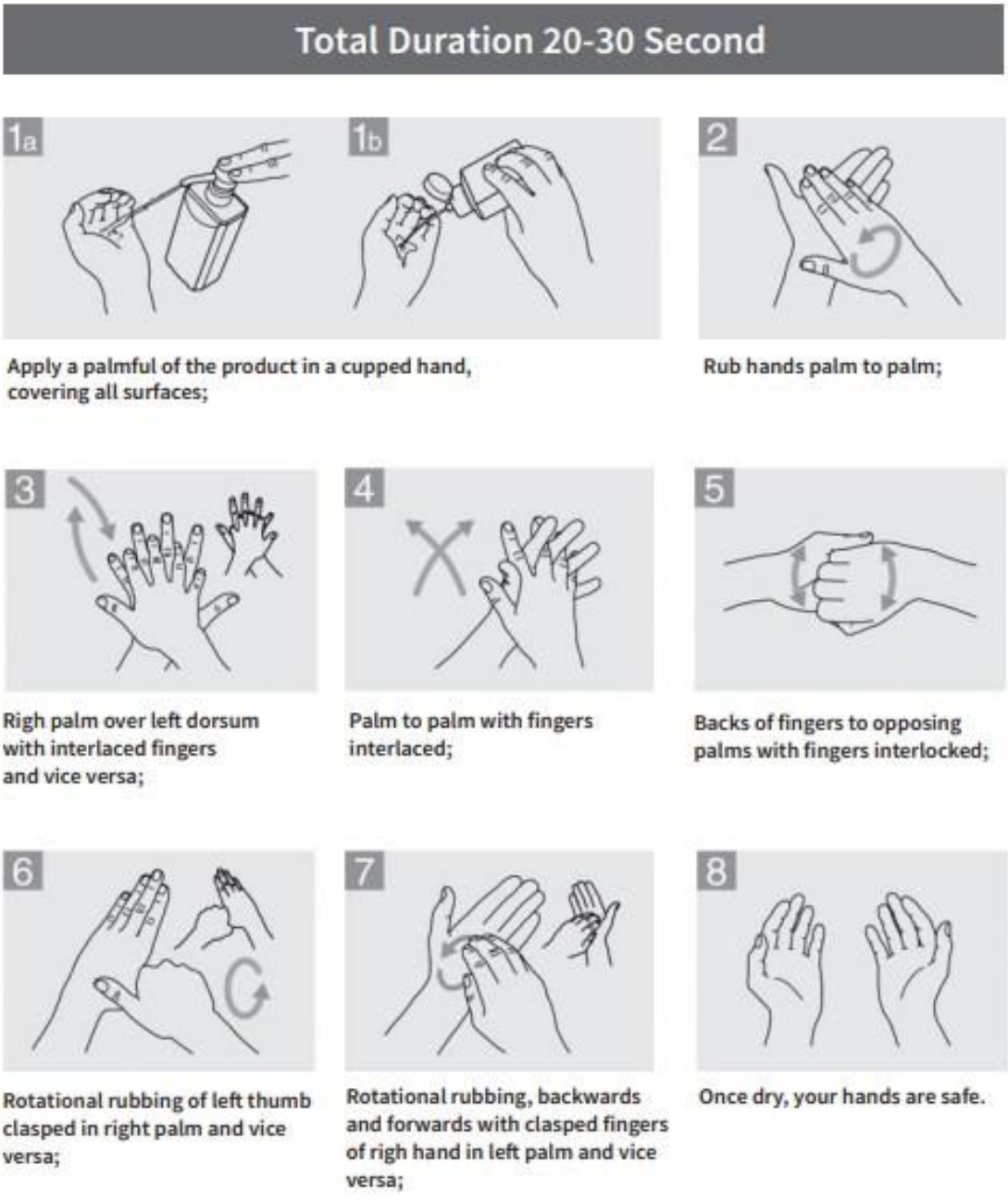


Figure 3.4: steps on how to properly perform hand hygiene using Alcohol based hand rub (WHO guidelines)

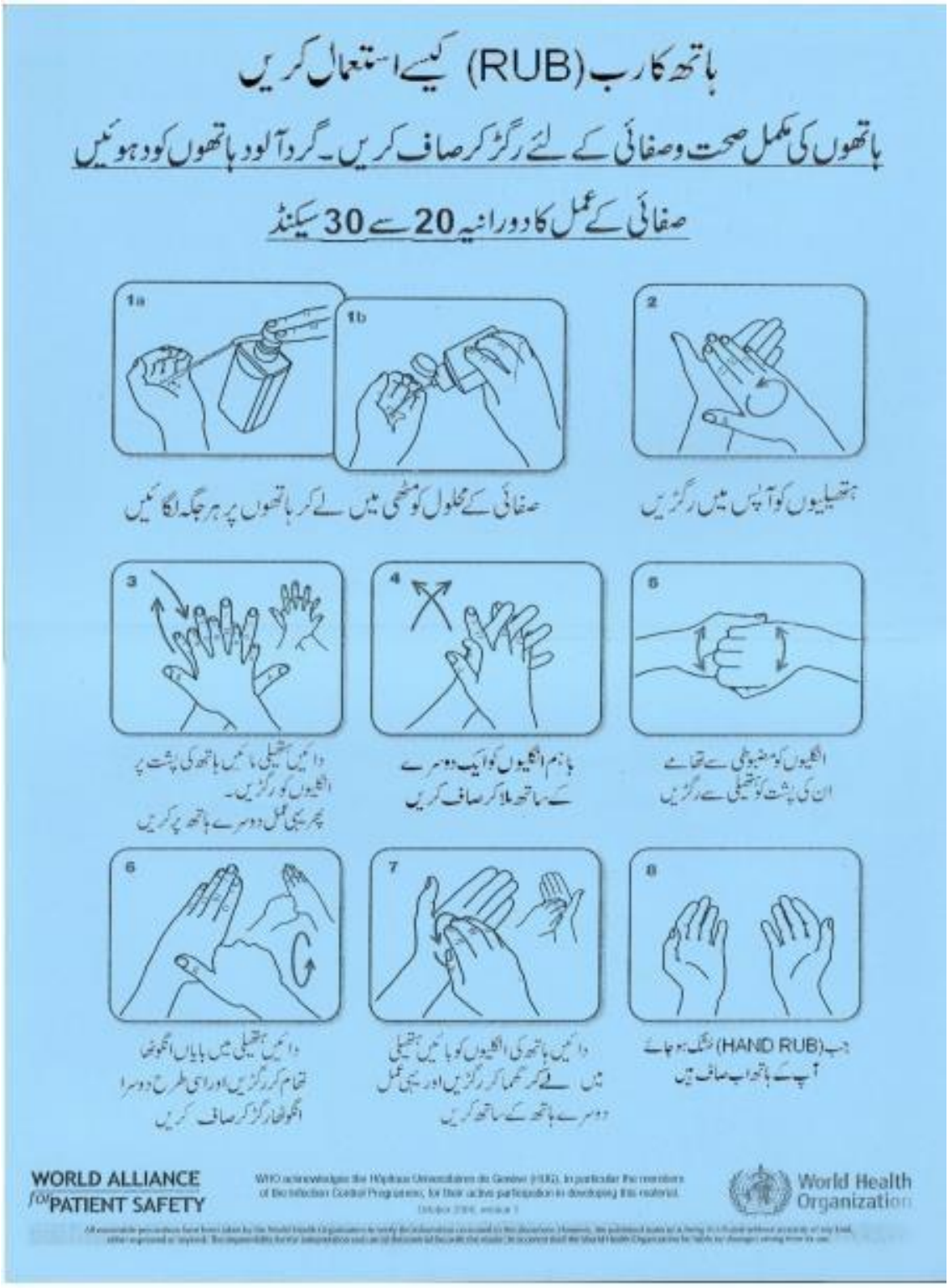


Figure 3.5: Steps on how to properly perform hand hygiene using Alcohol based hand rub (WHO guidelines) in urdu

Sterilization of hypodermic injections and syringes

Hypodermic injections and syringes: Hypo means low or beneath and Dermic means skin. The injection of a medicine or drug given under the skin is known as a hypodermic injection.

Whereas a type of syringe consisting of a hollow cylinder, usually of glass or plastic, a tightly fitting piston, and a hollow needle (hypodermic needle), used for withdrawing blood samples, injecting medicine etc. is known as a hypodermic syringe.

Types of hypodermic injections:

Generally, there are four main types of hypodermic needles, depending upon their usage

- Intramuscular injection.
- Intradermal injection.
- Subcutaneous injection.
- Intravenous injection.

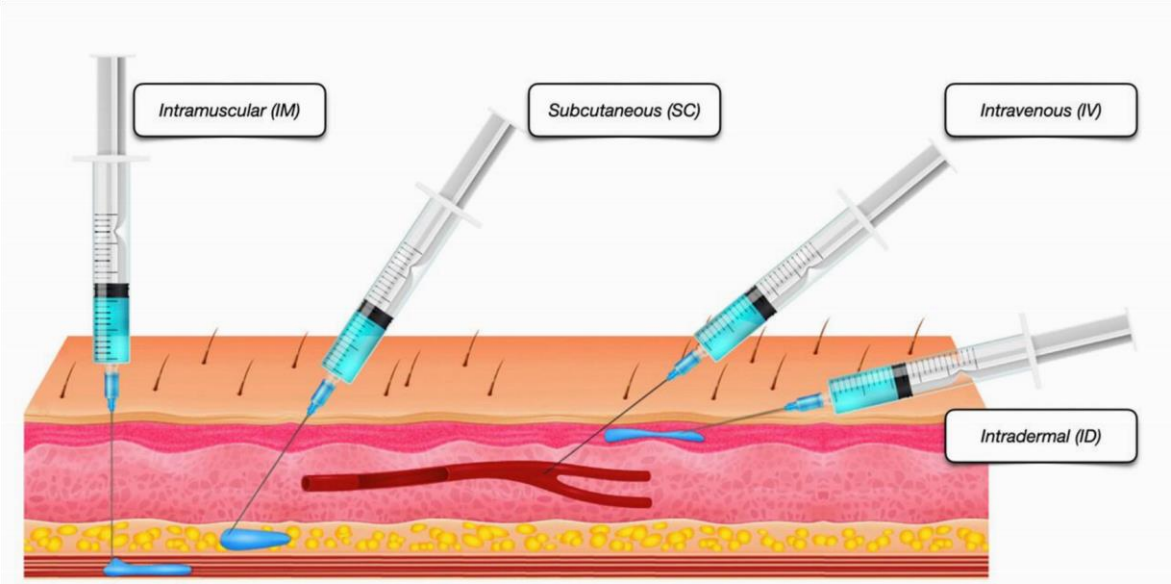


Figure 3.6: Types of hypodermic injections

Preparing medications from ampules and vials

Specific equipment, such as syringes and needles, is required to prepare and administer parenteral medications. The selection of the syringe and needle is based on the type and location of injection; amount, quality, and type of medication; and the body size of the patient. Many syringes come with needleless systems or needles

with safety shields to prevent injuries. Aseptic technique is paramount to the preparation and administration of these medications.

Parenteral medications are supplied in sterile vials, ampules, and prefilled syringes.

Ampules are glass containers in 1 ml to 10 ml sizes that hold a single dose of medication in liquid form. They are made of glass and have a scored neck to indicate where to break the ampule (see Figure 3.7).

Medication is withdrawn using a syringe and a filter needle. A blunt fill needle with filter must be used when withdrawing medication to prevent glass particles from being drawn up into the syringe. Never use a filter needle to inject medication.

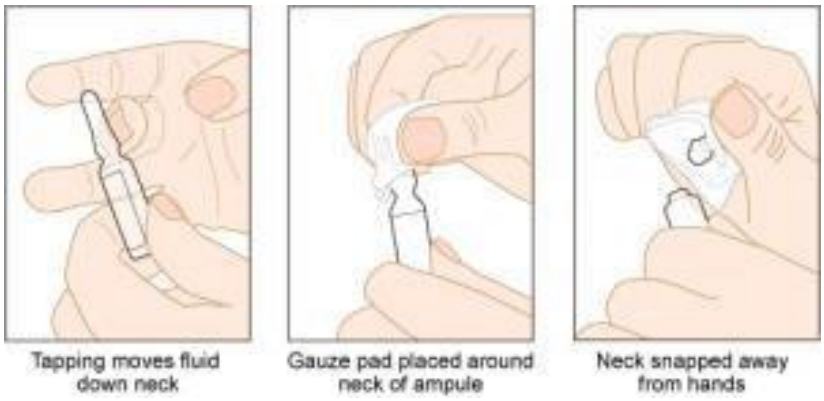


Figure 3.7: Breaking open an ampule

A **vial** is a single- or multi-dose plastic container with a rubber seal top, covered by a metal or plastic cap. A single-use vial must be discarded after one use; a multi-dose vial must be labelled with the date it was opened. Check hospital policy to see how long an open vial may be used. The vial is a closed system, and air must be injected into the vial to permit the removal of the solution.

Figure 3.8: Preparing medication from a vial

A **syringe** is a sterile, single-use device that has a Luer lock or non-Luer lock tip, which influences the name of the syringe. Syringes come in various sizes from 0.5 ml to 60 ml. Syringes may come with or without a sterile needle and will have a safety shield on the needle

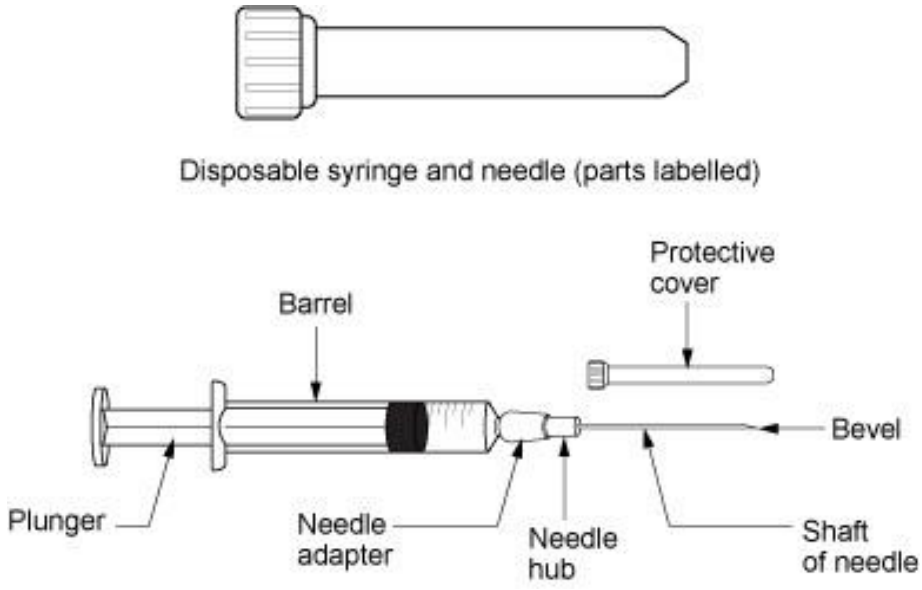


Figure3.9: Labelled syringe

Needles are made of stainless steel, are sterile and disposable, and come in various lengths and sizes. The needle is made up of the hub, shaft, and bevel. The bevel is the tip of the needle that is slanted to create a slit into the skin. The hub fits onto the tip of the syringe. All three parts must remain sterile at all times. The length of the needle will vary from 1/8 in. to 3 in., depending on the injection.

Figure 3.10: Variety of needles with different gauges and lengths

Sterilization Methods for Hypodermic Needles

- **Autoclaving:** Autoclaving is one of the most common and effective methods used to sterilize hypodermic needles. This process involves subjecting the needles to high-pressure steam at temperatures above the boiling point of water. The combination of heat and moisture effectively kills microorganisms and spores, ensuring thorough sterilization. Autoclaving is highly reliable and suitable for most types of hypodermic needles.
- **Ethylene Oxide (ETO) Sterilization**: Ethylene oxide gas is a commonly used sterilant for medical devices, including hypodermic needles. This method involves placing the needles in a sealed chamber and exposing them to a controlled concentration of ETO gas. The gas penetrates the packaging and kills microorganisms through a process known as alkylation. ETO sterilization is particularly effective for heat-sensitive materials and intricate needle designs.
- **Gamma Irradiation:** Gamma irradiation is a sterilization method that utilizes high-energy gamma rays from a radioactive source, such as cobalt-60 or cesium-137. The needles are exposed to these rays, which penetrate the packaging and disrupt the DNA of microorganisms, rendering them unable to reproduce. Gamma irradiation is widely used for single-use disposable hypodermic needles, as it is quick, efficient, and does not leave any chemical residue.
- **Electron Beam (E-beam) Sterilization:** E-beam sterilization involves exposing hypodermic needles to a beam of high-energy electrons. These electrons disrupt the genetic material of microorganisms, preventing their ability to reproduce. E-beam sterilization is a rapid method that can be applied to a wide range of materials, including plastics and metals. It is particularly suitable for mass production settings due to its efficiency and scalability.

Training in emergency procedures

Training in emergency procedures is crucial for individuals in various professions and settings to respond effectively to unexpected and potentially life-threatening situations.

- **Assessment:**
    - **Explanation:** Before providing first aid, assess the situation and the injured or ill person. Ensure that the environment is safe for both the responder and the victim. Check for any potential dangers or hazards.
- **Communication:**
    - **Explanation:** Call for professional medical help immediately if the situation requires it. Provide clear and concise information to emergency services, including the nature of the emergency, the location, and the number of individuals involved.
- **ABCs of First Aid:**
    - **Airway, Breathing, Circulation:**
        - Ensure the airway is clear.
        - Check for breathing.
        - Check for signs of circulation (pulse).
- **Cardiopulmonary Resuscitation (CPR):**
    - **Explanation:** If the person is not breathing or their heart has stopped, initiate CPR. This involves chest compressions and rescue breaths to maintain blood circulation and provide oxygen until professional help arrives.
- **Wound Care:**
    - **Explanation:** Clean and dress wounds to prevent infection. Apply direct pressure to control bleeding. Elevate the injured area if possible.
- **Burn Care:**
    - **Explanation:** Cool the burn with running water for at least 10 minutes. Cover the burn with a sterile non-stick dressing. Do not use ice.
- **Fracture and Sprain Management:**
    - **Explanation:** Immobilize the injured area using splints or slings. Support the injured limb to minimize movement.
- **Choking Response:**
    - **Explanation:** Perform the Heimlich maneuver to dislodge an object blocking the airway. Adapt techniques based on the age of the victim.
- **Shock Management:**

- **Explanation:** Keep the person warm and lying down. Elevate the legs if possible. If there are no signs of head, neck, or spine injury, raise the person's legs about 12 inches.

- **Seizure Response:**
  - **Explanation:** Move objects away from the person to prevent injury. Place the person on their side after the seizure to aid breathing.
- **Allergic Reactions:**
  - **Explanation:** Administer an epinephrine auto-injector (if available) for severe allergic reactions. Seek emergency medical help.
- **Insect Bites and Stings:**
  - **Explanation:** Remove the stinger if present. Clean the area with soap and water. Apply a cold compress to reduce swelling.

  Eye Injuries:
  - **Explanation:** Rinse the eye with clean water if a foreign object is present. Do not rub the eye. Cover the injured eye with a sterile dressing.

Vaccination

Vaccination is a preventive medical intervention aimed at stimulating an individual's immune system to provide protection against specific infectious diseases. It involves the administration of a vaccine, which contains antigens (weakened, inactivated, or parts of pathogens) that trigger an immune response. The immune system then produces antibodies and memory cells, providing immunity and protection against the targeted disease. The primary goal of vaccination is to prepare the immune system to recognize and respond effectively to the actual pathogen if encountered in the future.

Vaccine: A vaccine is a biological preparation that contains antigens derived from pathogens, such as viruses, bacteria, or toxins. These antigens are often modified or inactivated to make them safe while retaining their ability to stimulate an immune response. Vaccines may contain live attenuated organisms, inactivated (killed) organisms, subunit proteins, toxoids, or genetic material (like mRNA) from the pathogen. The purpose of vaccines is to induce a protective immune response, including the production of antibodies and memory cells, without causing the disease itself.

Types of Vaccines:

1. **Live Attenuated Vaccines:**
   - Contain weakened, but still live, forms of the pathogen.
   - Examples: Measles, Mumps, Rubella (MMR), Oral Polio Vaccine (OPV).
2. **Inactivated (Killed) Vaccines:**
   - Contain pathogens that have been killed or inactivated.
   - Examples: Hepatitis A, Polio (inactivated polio vaccine, IPV), Rabies.
3. **Subunit, Recombinant, or Conjugate Vaccines:**
   - Contain only specific antigens or parts of the pathogen.
   - Examples: Hepatitis B, Human Papillomavirus (HPV), Haemophilus influenzae type b (Hib) conjugate vaccine.
4. **Toxoid Vaccines:**
   - Contain inactivated toxins produced by bacteria. □ Examples: Diphtheria, Tetanus.
5. **mRNA Vaccines:**
   - Use genetic material (mRNA) to instruct cells to produce antigens.
   - Examples: Pfizer-BioNTech COVID-19 vaccine, Moderna COVID-19 vaccine.
6. **Viral Vector Vaccines:**
   - Use a harmless virus to deliver genetic material and stimulate an immune response.

- Example: Oxford-AstraZeneca COVID-19 vaccine.

Storage of vaccines

The storage of vaccines is a crucial aspect of maintaining their potency and ensuring their effectiveness. The cold chain refers to the system of transporting and storing vaccines within a recommended temperature range to prevent spoilage or loss of efficacy.

Cold chain is a system of storage and transport of vaccine at low temperature from the manufacturer to the actual vaccination site.

Cold chain equipment:

- Cold box- for transport of large quantities of vaccine
- Vaccine carrier- for transport of small quantities of vaccine by foot or vehicle
- Flasks – used when vaccine carrier is not available
- Ice packs
- Freezer/Refrigerator

Figure 3.11: EPI Schedule for Pakistan

Preparation of Emergency Room

Following steps should be taken for preparation of emergency room

1. Ensure all necessary emergency equipment is readily available and in proper working condition.
2. Stock essential medical supplies and medications for immediate use.
3. Regularly check and maintain emergency room facilities and infrastructure.
4. Verify the functionality of life-saving devices such as defibrillators and ventilators.
5. Keep emergency exits clear and accessible at all times.
6. Train emergency room staff in emergency protocols and procedures.
7. Establish a communication plan for swift coordination during emergencies.
8. Conduct regular drills and simulations to assess the team's preparedness.
9. Maintain a designated area for critical patients with appropriate monitoring equipment.
10. Establish a protocol for the rapid admission and evaluation of incoming patients.
11. Ensure continuous availability of emergency power sources.
12. Regularly update emergency contact information for on-call specialists and support services.
13. Implement infection control measures to prevent the spread of communicable diseases.
14. Have a well-defined plan for managing mass casualty incidents.
15. Regularly review and update emergency response protocols based on feedback and evolving best practices.

CHAPTER 4: RECORD KEEPING AND MAINTENANCE OF REGISTERS

Charting Temperature, pulse etc.

A vital signs monitoring chart is a visual representation of key physiological parameters that reflect the body's basic functions. Vital signs are essential indicators of a person's overall health and can include measurements such as temperature, heart rate (pulse), respiratory rate, blood pressure, and sometimes additional parameters like oxygen saturation (SpO2).

The purpose of a vital signs monitoring chart is to track and display these parameters over a period of time, allowing healthcare professionals to assess a patient's health status, detect trends, and make informed decisions about their care. These charts are commonly used in various healthcare settings, including hospitals, clinics, and home healthcare.

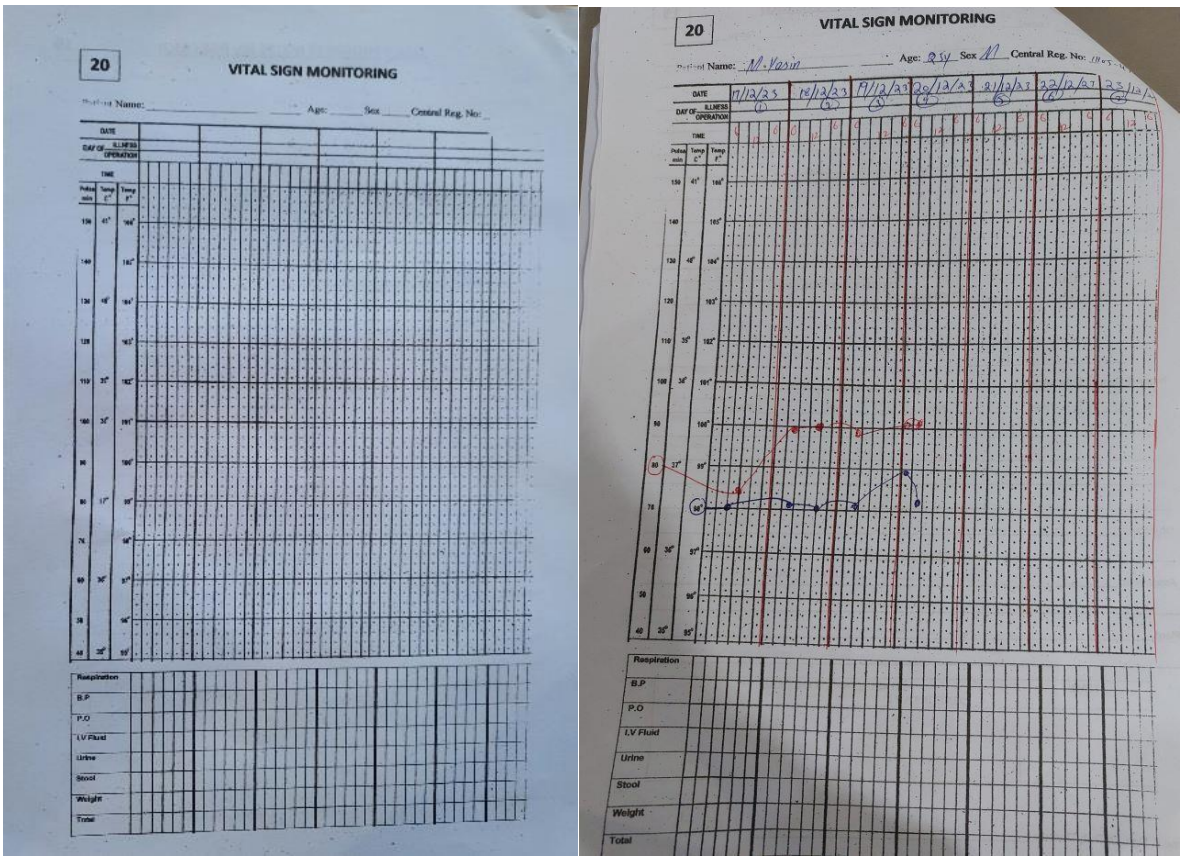


Figure 4.1: Vital signs monitoring charts

Outdoor Register

The OPD Register is maintained at the OPD of the facility for recording all the visits of the patients and treatment given at the OPD. Records of both new and follow-up/repeat cases attending the OPD are made in this register.

Purpose:

- To serve as a facility based archive of clinical diagnosis and treatment by the OPD or emergency department
- To provide facility based morbidity and malnutrition data
- To provide data on load of new cases on the OPD/emergency department, disaggregated by sex and age
- To provide data on follow-up visits and referred cases attended at the OPD/emergency department
- The register is filled at the time of consultation at OPD or emergency department.

OUT-PATIENT DEPARTMENT (OPD) REGISTER

Month:_____Year:_____.

Monthly OPD Serial No. (New cases)	Follow-up Cases (Put Tick only)	Name with Father / Husband Name	Address	SEX & AGE CATEGORY (Tick in appropriate column)										Malnutrition (Tick if Child <5yrs is low weight for age)	Referred from (if applicable)	Diagnosis	Action Taken/ Special Remarks
				MALE					FEMALE								
				<1 year	1--4	5--14	15--49	50+	<1 year	1--4	5--14	15--49	50+				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		<<Total Brought From Previous Page>>															
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Figure 4.2: OPD Register

Abstract Register

The Abstract Register is basically a tally sheet for compilation of the morbidity data from the OPD register.

Morbidity data on cases of selected diseases attending the OPD are to be reported monthly. At the time of every OPD consultation, the service provider writes the provisional diagnosis in the OPD register. This compiled data is later transferred to the monthly report.

Purpose:

- To provide compiled morbidity data recorded as on OPD Register.
- To serve as a basis for self-assessment and supervision.

OPD Abstract Form at _____OPD Month: _____Year:_____

Date: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Priority Health Problems		Tally	Total
1		2	3
Respiratory Diseases			
1	Acute (upper) respiratory infections		
2	Pneumonia < 5 yrs.		
3	Pneumonia > 5 yrs.		
4	TB Suspects		
5	Chronic Obstructive Pulmonary Diseases		
6	Asthma		
Gastro Intestinal Diseases			
7	Diarrhoea / Dysentery < 5 yrs		
8	Diarrhoea / Dysentery > 5 yrs		
9	Enteric/Typhoid Fever		
10	Worm Infestations		
11	Peptic Ulcer Diseases		
12	Cirrhosis of Liver		
Urinary Tract Diseases			
13	Urinary Tract Infections		
14	Nephritis/ Nephrosis		
15	Sexually Transmitted Infections		
16	Benign Enlargement of Prostrate		
Other Communicable Diseases			
17	Suspected Malaria		
18	Suspected Meningitis		
19	Fever due to other causes		
Vaccine Preventable Diseases			
20	Suspected Measles		
21	Suspected Viral Hepatitis		
22	Suspected Neonatal Tetanus		
Cardiovascular Diseases			
23	Ischemic heart disease		
24	Hypertension		
Skin Diseases			
25	Scabies		
26	Dermatitis		
27	Cutaneous Leishmaniasis		
Endocrine Diseases			
28	Diabetes Mellitus		
Neuro-Psychiatric Diseases			
29	Depression		
30	Drug Dependence		
31	Epilepsy		
Eye & ENT			
32	Cataract		
33	Trachoma		
34	Glaucoma		
35	Otitis Media		
Oral Diseases			
36	Dental Caries		
Injuries /Poisoning			
37	Road traffic accidents		
38	Fractures		
39	Burns		
40	Dog bite		
41	Snake bite (with signs/ symptoms of poisoning)		
Miscellaneous Diseases			
42	Acute Flaccid Paralysis		
43	Suspected HIV/AIDS		
Any Other Unusual Diseases *(Specify)*			
44			
45			

Figure 4.3: Abstract Register

Poisons Register

A poison register, often referred to as a Poison Control Register or Poison Information Center, is a systematic record-keeping system used by healthcare facilities or poison control centers to track and manage information related to cases of poisoning or exposure to toxic substances. The primary purpose of a poison register is to document details about individuals who have ingested, inhaled, or been exposed to harmful substances, and to provide essential information for medical management and follow-up.

Expense Register

An expense register is a detailed record-keeping system used to track and manage financial expenditures related to the procurement of medicines within a healthcare facility or department. It plays a crucial role in budget management, inventory control, and ensuring the availability of necessary medications for patient care.

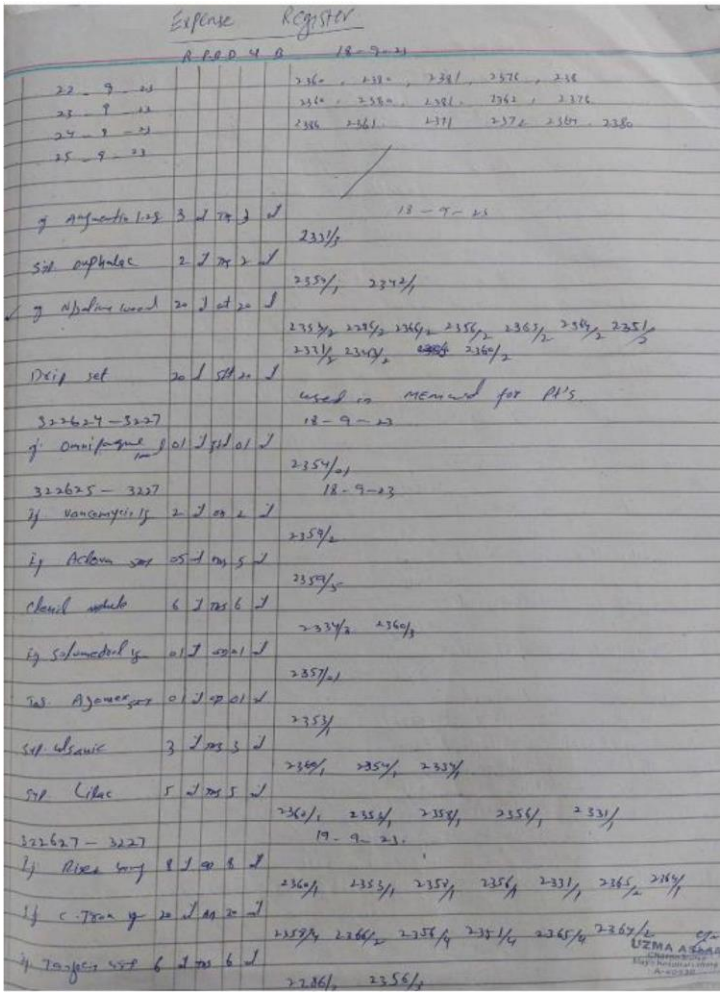


Figure 4.4: Expense Register

Medicolegal Register

A Medico-Legal Case (MLC) register is a documentation system used in healthcare settings, particularly hospitals, to record details related to cases that involve both medical and legal aspects. MLCs typically include cases where a person's injuries or medical condition are a result of accidents, violence, or other external factors that may require legal intervention or investigation. The register helps in maintaining a systematic record of such cases for medical, legal, and administrative purposes.

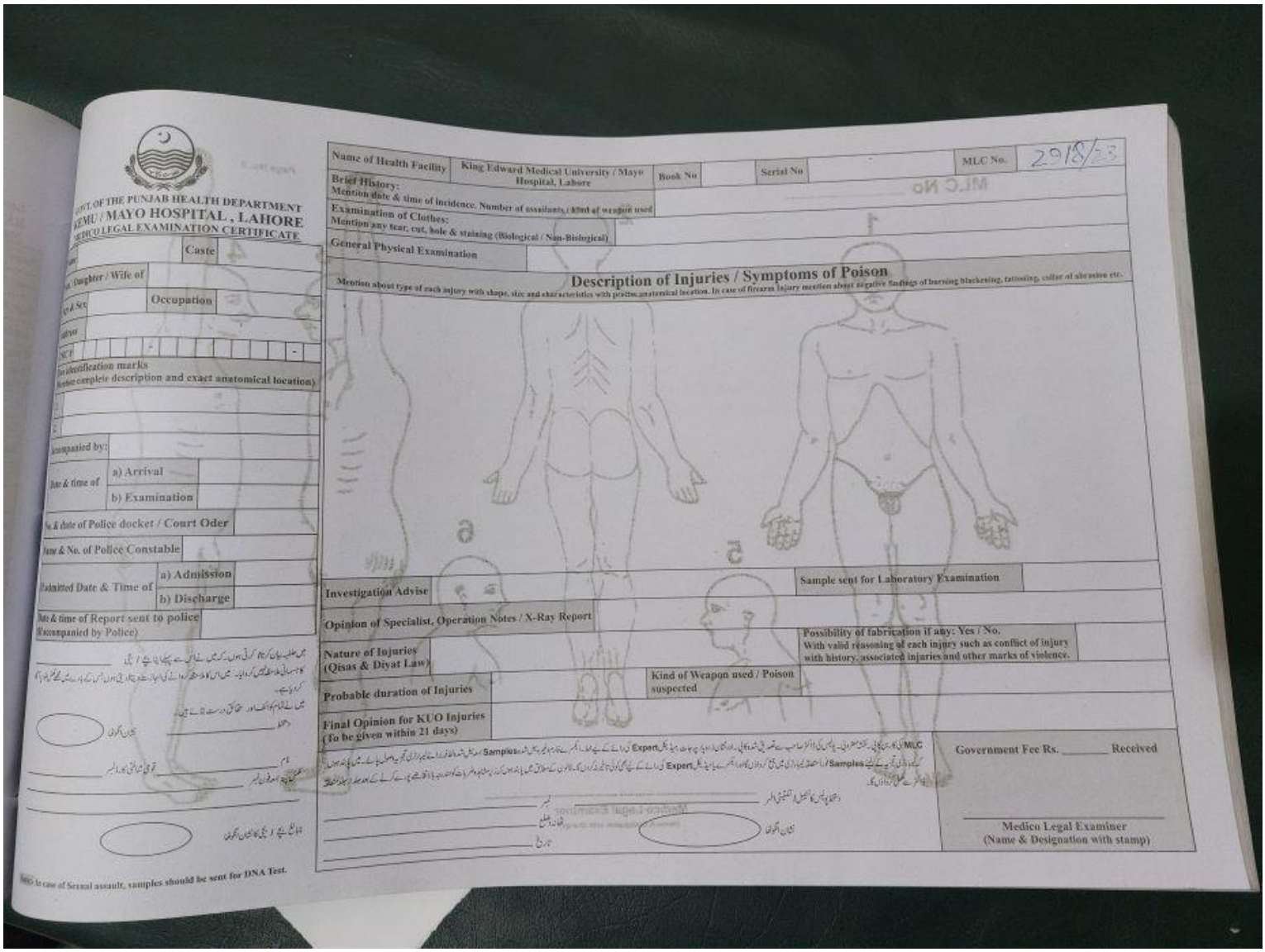
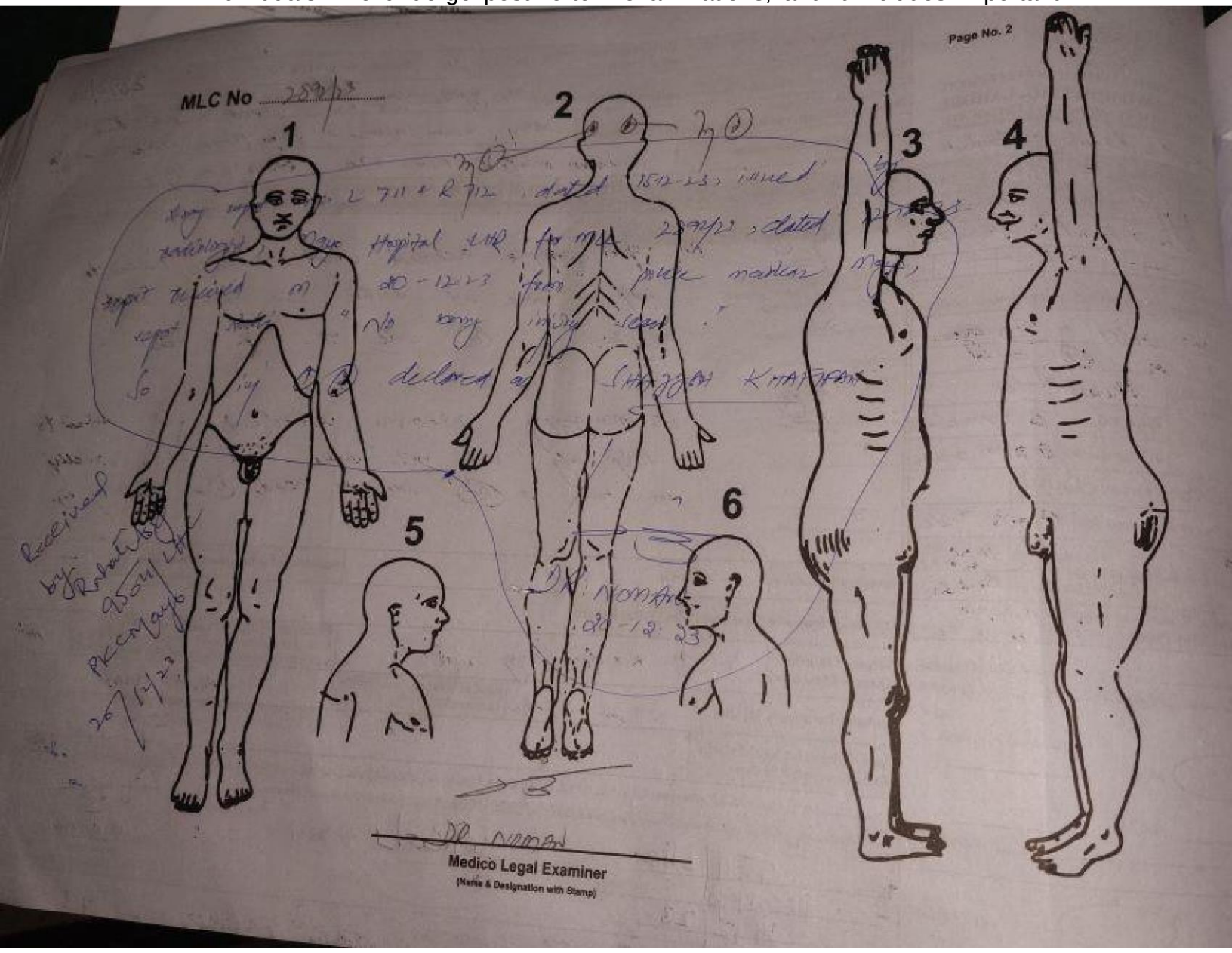


Figure 4.5: Medicolegal Register

Post mortem register

A postmortem register is a record-keeping system used in healthcare and forensic settings to document details related to postmortem examinations, also known as autopsies. The register serves as an official record of the deceased individuals who undergo postmortem examinations, and it includes important



information for medical, legal, and administrative purposes.

Figure 4.6: Postmortem Register

CHAPTER 5: STUDY OF MEDICO LEGAL CASES / POSTMORTEM

- **Definition:**
    1. Medico legal cases involve the application of medical knowledge to legal matters. These are cases that involve both medical and legal aspects, requiring expertise from both fields to establish facts, determine cause and manner of injury or death, and provide evidence for legal proceedings.
    2. **Examples of MLCs:**

The following are some of the examples of MLCs

- Assault and battery, including domestic violence and child abuse
- Accidents like Road Traffic Accidents (RTA), industrial accidents etc.
- Cases of trauma with suspicion of foul play
- Electrical injuries
- Poisoning, Alcohol Intoxication
- Undiagnosed coma
- Chemical injuries
- Burns and Scalds
- Sexual Offences
- Criminal abortions
- Attempted suicide
- Cases of asphyxia as a result of hanging, strangulation, drowning, suffocation etc.
- Custodial deaths
- Death in the operation theatre
- Unnatural deaths
- Death due to Snake Bite or Animal Bite
- Fire Arm injuries
- Drug overdose
- Drug abuse
- Dead brought to the Accident and Emergency Department / MI Room (Found dead) and deaths occurring within 24 hours of hospitalization without establishment of a diagnosis

- **Postmortem:**

Postmortem examinations, also known as autopsies, are a critical aspect of investigating deaths that may have legal implications. The primary goal is to determine the cause of death, especially in cases where it is uncertain, suspicious, or related to criminal activities. It helps establish facts for legal proceedings.

- **Purpose of postmortem**
- Determining the Cause of Death
- Providing Insights into Disease Processes
- Confirming or Discovering Medical Conditions
- Documenting Injuries
- Legal and Forensic Investigations especially in cases of homicide, suicide, accidents etc.

PRACTICALS

Preparations

Ointments

Ointments are semisolid preparations intended to apply on skin.

Usually they contain medicaments uniformly dispersed or emulsified in a suitable base. Bases are usually anhydrous and comprise fats, oils and waxes of animals or vegetables origin.

Types

Ointments are classified according to power of penetration so there are three types

1. Epidermic Ointment
2. Endodermic Ointment
3. Diadermic Ointment

- **Epidermic ointment**: These have oleaginous bases with very slight power of penetration into skin.
- **Endodermic ointment**: They possess some power of penetration into deeper layers of skin.
- **Diadermic ointment:** These ointments penetrate the skin and thus leading to better absorption of medicaments into systemic circulation e.g. Nitroglycerin ointment

Constituents of ointment:

1. Active ingredients
2. Bases

Active Ingredients: These are dispersed evenly in base and exert main pharmacological effects of ointment e.g. Sulphur, Zn, tannic acid

Bases: They are classified as

- **Oleaginous bases**: These are fatty in nature and have following characteristics

  A) Anhydrous

  b) Hydrophobic

  c) Inert

- **Non-oleaginous bases** :They are water in oil or oil in water type of emulsion bases

Example:

To prepare and dispense 12g of Sulphur ointment B.P 10%.

Apparatus:

- Balance, Ointment slab, Soft spatula, Ointment container

Ingredients:

- Sulphur, Soft paraffin

Calculations:

Formula for sulphur ointment:
Sulphur powder = 10%
Soft Parrafin =90%

To account for wastage ingredient for 15g are calculated.

Sulphur Required:

For 100g of sulphur ointment sulphur required = 10g

For 1g of sulphur ointment sulphur required = 10/100

For 15g sulphur ointment sulphur required = 10/100 x15 =1.5g

Base required = 90/100 = 13.5g

Procedure:

- Weigh 13.5g of soft paraffin and 1.5 g of sulphur powder.
- Grind sulphur in mortar with the help of pestle if it is not in a finely powdered form.
- Now place sulphur powder on ointment slab and mix it with small quantity of paraffin and thoroughly mix it by rubbing it with soft spatula until the sulphur is thoroughly distributed.
- Now mix the remaining ointment base with the above concentrated ointment and again mix them until it becomes smooth, homogenous, fine and free of granules.
- Transfer it into ointment box, label is applied, Wrap and seal it.

Uses:

Sulphur ointment is mainly used in “scabies “

Direction for use:

Apply on whole body below neck for three consecutive nights after taking bath with soap and water. Chang the cloths daily.

Solutions

Solutions are liquid preparations which contain one or more soluble

Ingredients usually dissolved in water or some other solvent. A solution is a perfectly homogeneous mixture of two substances; solute and Solvent. Water, Alcohol or glycerin can be used as solvents. Solute is dissolved in solvent. They are meant for internal or external use and for instillation into body cavities."

Classification of solution

Solutions can be classified in the following ways

- On the basis of solubility
- On the basis of osmotic pressure
- On the basis of the number of solutes

On the basis of Solubility

Depending upon solubility, they may be classified as

a) UNSATURATED SOLUTION: It is a solution which has capacity to dissolve more of a solute at a specific temperature.

b) SATURATED SOLUTION: It cannot dissolve more of a solute at a specific temperature.

c) SUPERSATURATED SOLUTION: It holds more solute than the corresponding saturated solution

On the basis of osmotic Pressure

"When the concentrated aqueous solution of a substance is placed in contact with water, diffusion occurs so that the solute becomes uniformly distributed through the liquid. The force causing this movement of solute particle is called Osmotic Pressure."

a) **Isotonic solution**: It has the same tonicity as that of other solution. When both solutions have same number of osmotically active particles e.g. a solution of 0.9% NaCl, RBC's placed in such a solution maintain their shape because normal saline has same tonicity as that of RBC's.

b) **Hypotonic solution**: Solution containing less than 0.9% of NaCl is called hypotonic solution. If RBC's placed in such a solution, the cell volume will increase and eventually burst.

c) **Hypertonic solution**: Solution containing more than 0.9% NaCl is called hypertonic solution. If RBC's placed in such a solution, cells will shrink by losing water.

On the basis of the number of solutes

Depending upon the number of solutes the solutions can be classified into two types:

a) **Simple solution:** Simple solutions are those which only contain one solute.

b) **Compound solution:** solutions containing more than one solutes.

Other solutions

- BUFFER SOLUTION

The solution which resists the change in PH brought about by the addition of some substance is called buffer solution.

- STOCK SOLUTION

Solutions which are prepared in concentrated form and can be preserved for longer periods. They can be diluted when needed.

Examples:

To prepare & dispense 100ml of 0.1% $KMnO_4$ solution by using stock solution.

Apparatus:

Colored bottles, measuring glass, weighing balance, beaker

Ingredients:

$KMnO_4$ and distilled water

Procedure:

Preparation of stock solution: Take 1g of $KMnO_4$ and transfer it to a beaker. Add water up to 100ml. this is 0.1% stock solution.

Now take 10 ml of stock solution and transfer it to the colored/dispensing bottle. Add water up to 90ml in this bottle. This is 0.1% $KMnO_4$ solution.

Directions for use:

It has to be diluted 4 times with water and to be used as mouth wash.

Uses:

It is used as an anti-septic, disinfectant, deodorant, anti-fungal and as an astringent
It is also used as stomach wash in treatment of poisoning.

Calculations

0.1% means 0.1g of $KMnO_4$ in 100ml of water

1g of $KMnO_4$ dissolved in 100ml of water to make stock solution

In order to find out Volume of stock solution to prepare 100ml of 0.1% solution following formula is used

$C_1V_1 = C_2V_2$

C_1= concentration of stock solution=1g

V_1= Volume of stock solution =?

C_2= concentration of required solution=0.1g

V_2 = volume of required solution =100ml

$C_1V_1 = C_2V_2$

$V_1 = C_2V_2 / C_1$

$V_1 = 0.1 \times 100 / 1$

V_1 = 10ml

Amount of water added to make the final solution =90ml

Prepare and dispense 2L of 5% dextrose in normal saline

5g dextrose to be dissolved in sufficient quantity of saline to make 100ml. Normal saline is 0.9% NaCl to be dissolved in sufficient quantity of water to make 100ml

As we have to prepare of 2L solution

Calculation

2L =2000ml

5% Dextrose = 5g of dextrose in 100ml = 5/100

In 2L = 5/100x2000 = 100

Dextrose required =100g

Normal saline = 0.9% NaCl = 0.9g NaCl in 100ml of water = 0.9/100

In 2L = 0.9/100x2000

NaCl required =18g

18g of NaCl and 100g of dextrose is required to make 5% dextrose in normal saline

So, you add 100g Dextrose and 18g NaCl in 2L of water

To prepare & dispense 100ml of 2% Acriflavine solution. Apparatus:

Weighing balance, Graduated cylinder or volumetric flask, Stirring rod, sterile container for storage

Ingredients:

Acriflavine powder, Distilled water

Procedure:

To prepare Acriflavine solution, weigh the required amount of Acriflavine powder using a weighing balance.

For a 2% solution, calculate 2% of the total volume you want to prepare i.e. for 100 mL of a 2% solution, you would need 2 grams of Acriflavine.

Add the weighed Acriflavine powder to a clean container. Measure the appropriate volume of distilled water (98ml) using a graduated cylinder or volumetric flask.

Use a stirring rod to mix the Acriflavine powder thoroughly with the distilled water. Stir until the powder is completely dissolved. This is 2% Acriflavine solution.

Powders

Powders are solid drugs in fine states of division meant for internal or external use.

Types of powders:

- **According to number of ingredients:**
  - **Simple powders:** When they contain one active ingredient, they are called simple powders e.g. Calomel powder
  - **Compound powders:** When they contain more than one active ingredient they are called compound powders e.g. APC powders.

- **According to use:**
  - **Internal powders:** They are taken orally. Minimum weight of powder for internal use is 120mg and maximum is 3.6g. If the weight of internal powder is less than 120mg, an inert substance e.g. lactose is added to make it equal to 120mg.Effervescent Powders dissolve with effervescence in water; they are intended to be dissolved in a tumblerful of water before administration orally e.g. Seidlitz powder.
  - **External powders:** external powder is only meant for external use.
    They do not have fixed dose or weight. They are of following types:
    - Dusting powders
    - Snuff powders
    - Insufflation powders
    - Tooth powders
- Dusting powders: they contain antiseptics in them e.g. Zinc Oxide, Boric Acid in starch base. These are meant for application on wounds and abscesses.
- Snuff powders: These preparations are meant of absorption of active ingredients from mucous membrane of oral cavity or nose. The powder adheres to the wall of mucosa and is absorbed gradually e.g. posterior pituitary extract used for treatment of diabetes insipidus.
- Insufflation powder: by this method, they are spread under pressure over the mucous membrane of whole throat and pharynx e.g. sodium cromoglycate powder for prevention of attacks of bronchial asthma.
- Tooth powder: these are used for cleaning teeth. They contain calcium carbonate, antiseptics and volatile oils like menthol.

Advantages of powders:

1. They are easy to dispense and convenient to carry about.
2. Large amount of drug can be dispensed.
3. Powders are absorbed in a better way
4. There are less chances of incompatibility of drug.

Disadvantages of powders:

Bitter substances cannot be dispensed as such. However they can be dispensed in capsule form.

Steps for preparation of powders:

Grinding: The raw material is placed in a mortar (vegetables are grinded in iron and chemicals in glass mortar) and grinded with pestle so that particles become small. It can be used to prepare powders from leaves, barks and roots of plants.
Sieving: The powdered drug is passed through sieves of different sizes so that big particles are separated from fine particles.

Weighing: For internal powder, weight is 120mg-3.6g and if weight of active ingredient is less than 120mg, an inert substance e.g. lactose is added. If it is compound then constituents are weighed separately.

Mixing: Different active ingredients are mixed to form a homogenous mass to ensure uniform mixing. Small amounts of powder should be added and mixed. This could be done on pieces of paper. Large quantities are mixed in mortar with pestle.
Dispensing: It has the following steps

- **Folding:** Thick white paper should be used. The size of paper depends on weight of the powder. If the weight of powder is less than 3g then small sized side of paper folder is used.

The size of paper should be twice the length and twice the breadth of the paper folder. Fold the paper and bring the upper fold over the other so that margin of the first remains ½ inch away from the margin of the lower portion of the paper. Fold that ½ portion. Make a second fold of similar size and bring it in the middle. Now place it over the folder and turn it downward and bring the edges in the middle. All powders should have uniform size.

- **Wrapping:** powders are arranged one on top of the other in pairs. The last powder should be placed over the other with the folded side facing the last. All packets should be wrapped in the wrapping paper of which should be of the same as that of already described for each powder. Wrapper is folded breadth wise.
- **Labeling:** Label is placed over the folded and free side of the wrapping. Label size should be similar to the size of the packet.
- **Sealing:** Thread is applied to keep the label fixed in its place. Reef knot is applied which is easily opened. Then seal is applied on any one sides of the label avoiding the written portion of the paper.

Powders can also be dispensed in following forms:

(a) Capsule

(b) Sachet

(c) Tablet

Example:

To prepare and dispense 4 powders of APC (Aspirin, Paracetamol, Caffeine)

Apparatus: Balance, paper folder, spatula, scissors, white paper, thread
Ingredients: Aspirin, Paracetamol, Caffeine
Calculations:
Formula for one APC powder
Aspirin: 250mg
Paracetamol: 250mg
Caffeine: 30mg
To account for wastage, ingredients of 1 powder are taken extra
Quantity for 05 powders
Aspirin: 250x5=1250mg
Paracetamol: 250x5=1250mg
Caffeine: 30x5=150mg
Total weight of APC powder= 1250+1250+150=2650
Weight of 5 powders = 2650
Weight of 1 powder = 2650/5= 530mg
Dispense 4 powders each having weight = 530mg

Procedure: Weigh 1250mg of aspirin, 1250mg of paracetamol and 150mg of caffeine. Place them on a pill tile. Mix them thoroughly with the help of a spatula. Weight 530mg from it and make 4 such powders.
Place each portion on separate white papers and fold them with the help of a paper folder. These 4 powders are placed in pairs in another paper of the same size which is then folded. The label is folded on the folded paper containing the 4 powders and secured properly with a thread having butterfly knot.

Directions: one powder to be taken 4 times daily or as directed by physcian
Use: APC is used as an
1. Analgesic
2. Antipyretic
3. Anti-inflammatory
4. Anti-rheumatic

Paints

Paint are thick viscous syrup preparations containing one or more active medicaments of vegetable or mineral origin intended for application to the skin or mucous membranes.

Paints are generally used for

- Astringent action – gum paint
- Analgesic action – clove oil paint
- Antiseptic action Mandl's throat paint, tincture iodine paint
- A paint is generally applied with a cotton swab.

Example:

To prepare and dispense 20ml Gum Paint (4%w/w).

Apparatus:

Measuring cylinder, china dish, hot plate, glass pestle & mortar, amber color dispensing bottle with lid, dropper, weighing balance

Ingredients:

Tannic acid Glycerine

Calculation:

4% tannic acid means 4g tannic acid in 100ml of glycerine i.e.

100ml of glycerin is required to dissolve 4g of tannic acid

1ml = 4/100

20ml = 4x20/100= 0.8g tannic acid

Procedure:

- Weigh the required quantity of tannic acid (0.8g) into a glass mortar.
- Take 20ml of glycerin in a china dish and boil it on a hot plate up to a temperature of 140-160C.
- Add 5ml of glycerin and mix the contents
- Now add rest of the 15ml glycerin and mix well to make a preparation of 20ml
- Allow it for cooling
- Transfer this paint to amber colored dispensing bottle and cover it.
- Label the bottle.

Uses of Gum paint: Used in the treatment of

- Gingivitis
- Bad breath
- Bleeding gums

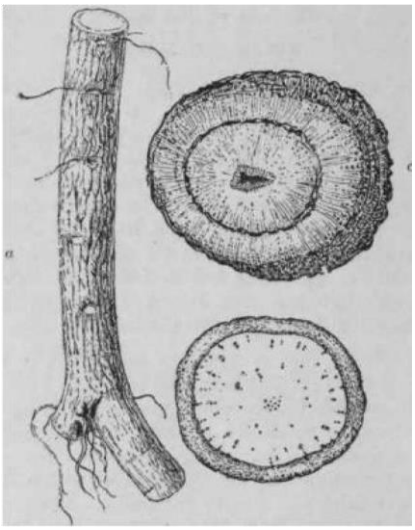
Identification of Specimens

Enteric coated tablets

Sugar coated tablets

Poppy capsules

Belladona root



Copper sulphate

Menthol

Tincture Cardamom

Spirit lamp

Gentian Violet

Gentian Violet

Acriflavine

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