Unit-1
Pharmacology- III

B.Pharma 6th Sem Notes

Unit: 1

1. Pharmacology of drugs acting on Respiratory system

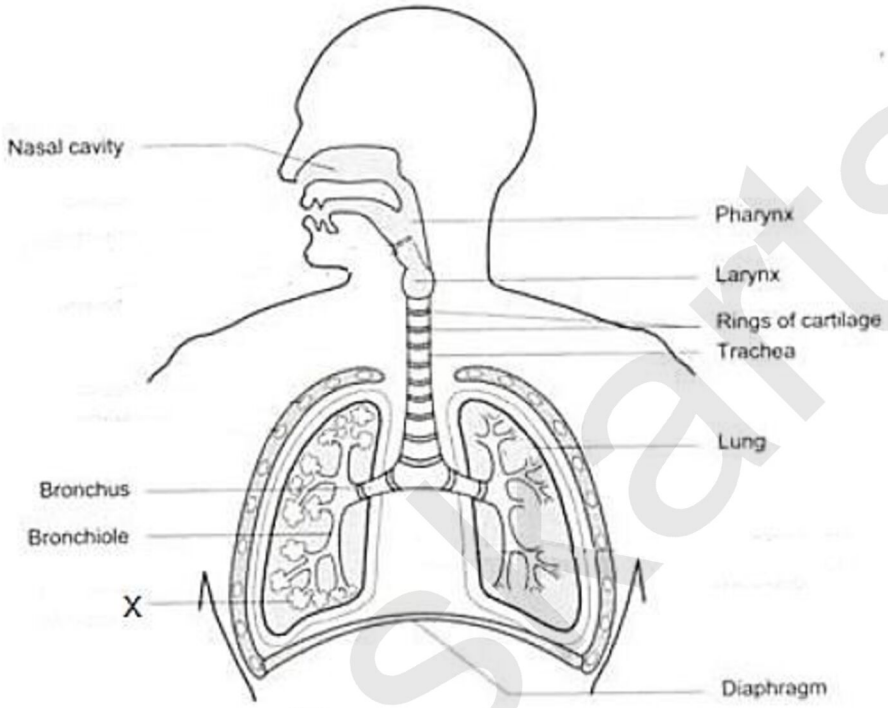
- Anti-asthmatic drugs
- Drugs used in the management of COPD
- Expectorants and antitussives
- Nasal decongestants
- Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

- Antiulcer agents.
- Drugs for constipation and diarrhoea.
- Appetite stimulants and suppressants.
- Digestants and carminatives.
- Emetics and anti-emetics.

Respiratory System

The **respiratory system** is responsible for the **exchange of gases** (oxygen and carbon dioxide) between the body and the environment. It enables us to breathe, supplying oxygen to the blood and removing carbon dioxide produced by the body.



Main Organs:

1. **Nose and Nasal Cavity** – Filter, warm, and moisten air.
2. **Pharynx and Larynx** – Passageway for air; larynx contains vocal cords.
3. **Trachea** – Also known as the windpipe; carries air to the lungs.
4. **Bronchi and Bronchioles** – Branching tubes that direct air into the lungs.
5. **Lungs** – Main organs where gas exchange takes place.
6. **Alveoli** – Tiny air sacs where oxygen enters the blood and carbon dioxide is removed.

Functions:

- **Inhalation** – Taking in oxygen-rich air.
- **Exhalation** – Expelling carbon dioxide-rich air.
- **Gas Exchange** – Oxygen enters the blood; CO_2 is removed.
- **Regulation of blood pH** – By controlling CO_2 levels.
- **Voice production** – Through the larynx.

Mechanism of Breathing:

- **Inspiration** – Diaphragm contracts, chest expands.
- **Expiration** – Diaphragm relaxes, air is pushed out.

Asthma:

- Asthma is a chronic respiratory disease that inflames and narrows the airways in the lungs, causing difficulty breathing.
- The severity of asthma varies from person to person and can range from mild, infrequent symptoms to severe, life-threatening attacks.

Types of Asthma:

There are several different types of asthma, including:

- **Allergic Asthma:** This is the most common type and is triggered by allergens such as pollen, dust mites, pet dander, and mold.
- **Non-Allergic Asthma:** This type is triggered by irritants in the air that are not allergens, such as smoke, cold air, air pollution, and certain perfumes or cleaning products.
- **Exercise-Induced Asthma (or Exercise-Induced Bronchoconstriction):** This type is triggered by physical activity, especially vigorous exercise in cold, dry air.
- **Occupational Asthma:** This is caused by inhaling dusts, gases, or fumes in the workplace.
- **Cough-Variant Asthma:** The main symptom of this type of asthma is a chronic, dry cough. Other typical asthma symptoms like wheezing and shortness of breath may not be present.
- **Aspirin-Induced Asthma:** This type is triggered by taking aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDs).
- **Steroid-Resistant Asthma:** A severe type of asthma that doesn't respond well to standard corticosteroid treatments.
- **Childhood Asthma:** Asthma that develops in children. Many children outgrow asthma, but it can persist into adulthood.

Researchers are also looking at asthma through the lens of **inflammation endotypes**, categorizing it based on the specific biological pathways of inflammation involved. These endotypes include eosinophilic, neutrophilic, mixed eosinophilic and neutrophilic, and non-inflammatory (paucigranulocytic).

Causes of Asthma:

The exact cause of asthma is not fully understood, but it is believed to be a combination of genetic and environmental factors. Some known risk factors and triggers include:

- **Genetics and Family History:** Having a parent or sibling with asthma significantly increases the risk of developing the condition.
- **Allergies:** People with other allergic conditions like eczema (atopic dermatitis) and allergic rhinitis (hay fever) are more likely to develop asthma.
- **Early Life Factors:** Factors during early development can increase asthma risk, such as low birth weight, prematurity, exposure to tobacco smoke (secondhand smoke) and other air pollutants, and viral respiratory infections.

- **Environmental Factors:** Exposure to various environmental allergens (like dust mites, mold, pollen, pet dander) and irritants (like air pollution, chemical fumes, occupational dusts) can trigger asthma in susceptible individuals.
- **Obesity:** Children and adults who are overweight or obese have a higher risk of developing asthma.
- **Viral Infections:** Certain viral infections during childhood can damage the lungs and increase the risk of asthma.

Symptoms of Asthma:

Asthma symptoms can vary in severity and frequency. Common symptoms include:

- **Wheezing:** A whistling sound when breathing, especially when exhaling.
- **Coughing:** Often worse at night or in the early morning. It can be dry or produce mucus.
- **Shortness of Breath:** Feeling like you can't get enough air in or out.
- **Chest Tightness:** A feeling of pressure or squeezing in the chest.

Symptoms can be mild or severe and may come and go. An **asthma attack** is a sudden worsening of symptoms, making it very difficult to breathe. This can be life-threatening and requires immediate medical attention. Triggers for asthma symptoms can include exercise, air pollution, cold air, and allergens.

Diagnosis of Asthma:

Diagnosing asthma typically involves a combination of:

- **Medical History:** Your doctor will ask about your symptoms, their frequency and severity, potential triggers, and your family history of asthma or allergies.
- **Physical Exam:** The doctor will listen to your breathing and check for other signs of asthma or allergies.
- **Lung Function Tests (Pulmonary Function Tests):**
    - **Spirometry:** This is the most common test. You will blow forcefully into a device called a spirometer, which measures how much air you can exhale and how quickly you can exhale it. This helps determine if your airways are narrowed.
    - **Peak Expiratory Flow (PEF):** This test measures how fast you can blow air out of your lungs. It can be done at home with a peak flow meter to monitor asthma control.
- **Allergy Testing:** Skin or blood tests can identify specific allergens that may be triggering your asthma.
- **Methacholine Challenge Test:** If lung function tests are normal but asthma is still suspected, this test involves inhaling a substance called methacholine, which can cause mild airway narrowing in people with asthma. Your lung function is then tested to see if there is a decrease.
- **Exhaled Nitric Oxide (FeNO) Test:** This test measures the amount of nitric oxide in your exhaled breath, which can be higher in people with eosinophilic asthma (a type of allergic asthma).
- **Blood Tests:** May be done to look for signs of inflammation or other conditions.

Treatment of Asthma:

The goals of asthma treatment are to:

- Control symptoms on an ongoing basis.
- Prevent asthma attacks.

Treatment typically involves a combination of medications and lifestyle management:

- **Long-Term Control Medications (Preventers):** These medications are taken daily to reduce inflammation in the airways and prevent asthma symptoms. Examples include:
  - **Inhaled Corticosteroids (ICS):** Such as fluticasone, budesonide, beclomethasone. These are the most effective long-term control medications.
  - **Long-Acting Beta-Agonists (LABAs):** Such as salmeterol and formoterol. These are often used in combination with inhaled corticosteroids to help open the airways.
  - **Leukotriene Modifiers:** Such as montelukast and zafirlukast. These block the effects of leukotrienes, substances that cause airway inflammation and narrowing.
  - **Theophylline:** An older medication taken in pill form to help relax airway muscles and reduce inflammation.
  - **Biologics:** For severe asthma, injectable medications like omalizumab, mepolizumab, reslizumab, benralizumab, and dupilumab target specific inflammatory pathways.
- **Quick-Relief Medications (Rescue Medications or Bronchodilators):** These medications work quickly to relax the muscles around the airways and open them up, making it easier to breathe during an asthma attack or when symptoms flare up. Examples include:
  - **Short-Acting Beta-Agonists (SABAs):** Such as albuterol and levalbuterol. These are typically inhaled.
  - **Ipratropium (Anticholinergic):** Can be used in combination with SABAs for severe asthma exacerbations.
- **Oral Corticosteroids:** Such as prednisone. These may be prescribed for short periods to treat severe asthma attacks and reduce inflammation throughout the body.

Anti-asthmatic drugs:

Anti-asthmatic drugs are medications used to prevent, control, and relieve the symptoms of asthma, a chronic inflammatory disorder of the airways characterized by bronchoconstriction, airway hyper responsiveness, and inflammation.

OR

Anti-asthmatic drugs are medications used to manage asthma, a chronic respiratory condition characterized by inflammation and narrowing of the airways. These drugs aim to relieve

symptoms like wheezing, coughing, shortness of breath, and chest tightness, as well as prevent asthma attacks.

Classification of Anti-asthmatic Drugs:

Anti-asthmatic drugs can be broadly classified into two main categories:

1. **Bronchodilators:** These medications work by relaxing the muscles around the airways, causing them to widen (dilate) and making it easier to breathe. They provide quick relief of acute asthma symptoms. Common types include:
    - **Short-acting beta-2 agonists (SABAs):** These are "rescue" medications that provide rapid relief of symptoms. Examples include salbutamol (albuterol) and terbutaline.
    - **Long-acting beta-2 agonists (LABAs):** These provide longer-term control of asthma symptoms and are usually used in combination with inhaled corticosteroids. Examples include salmeterol and formoterol.
    - **Anticholinergics (Muscarinic antagonists):** These also help to relax airway muscles and reduce mucus production. Ipratropium and tiotropium are examples.
    - **Methylxanthines:** Theophylline is an example, but it is less commonly used now due to potential side effects and drug interactions.
2. **Anti-inflammatory Agents:** These medications reduce inflammation in the airways, which is a key underlying factor in asthma. They are used for long-term control and prevention of asthma attacks. Common types include:
    - **Inhaled Corticosteroids (ICS):** These are the most effective long-term control medications for most people with asthma. Examples include beclomethasone, budesonide, fluticasone, and ciclesonide.
    - **Leukotriene Modifiers:** These drugs block the action of leukotrienes, substances in the body that cause inflammation and airway narrowing. Examples include montelukast and zafirlukast.
    - **Mast Cell Stabilizers:** These prevent the release of inflammatory substances from mast cells in the airways. Examples include cromolyn sodium and nedocromil sodium.
    - **Monoclonal Antibodies:** These are injectable medications used for severe asthma that is not well-controlled by other treatments. Examples include omalizumab (anti-IgE), mepolizumab, reslizumab, and benralizumab (all anti-IL-5), and dupilumab (anti-IL-4 and IL-13).

- **Systemic Corticosteroids:** These are oral or injectable corticosteroids (like prednisone) used for short periods to treat severe asthma exacerbations.

Mechanism of Action:

The different classes of anti-asthmatic drugs work through various mechanisms to achieve their therapeutic effects:

- **Beta-2 agonists (SABAs and LABAs):** They stimulate beta-2 adrenergic receptors on the smooth muscle cells lining the airways. This stimulation leads to the activation of adenylyl cyclase, increasing intracellular cyclic AMP (cAMP) levels. Increased cAMP causes relaxation of the smooth muscle, resulting in bronchodilation.
- **Anticholinergics:** They block the action of acetylcholine at muscarinic receptors in the airways. Acetylcholine normally causes bronchoconstriction and mucus secretion, so blocking its action leads to bronchodilation and reduced mucus production.
- **Inhaled Corticosteroids:** They work by suppressing the inflammatory response in the airways. They reduce the production and release of inflammatory mediators, inhibit the activity of inflammatory cells (like eosinophils and mast cells), and reduce airway hyperresponsiveness.
- **Leukotriene Modifiers:**
  - **Leukotriene receptor antagonists (e.g., montelukast):** Block the binding of leukotrienes (LTC4, LTD4, LTE4) to their receptors on airway smooth muscle and inflammatory cells, preventing bronchoconstriction, mucus production, and inflammation.
  - **5-lipoxygenase inhibitors (e.g., zileuton):** Inhibit the enzyme 5-lipoxygenase, which is involved in the synthesis of leukotrienes from arachidonic acid, thus reducing leukotriene production.
- **Mast Cell Stabilizers:** They prevent the degranulation of mast cells, which releases histamine and other inflammatory mediators that contribute to airway inflammation and bronchoconstriction.
- **Monoclonal Antibodies:**
  - **Anti-IgE (e.g., omalizumab):** Binds to immunoglobulin E (IgE) antibodies, reducing the amount of IgE available to trigger allergic reactions and subsequent inflammation.
  - **Anti-IL-5 (e.g., mepolizumab, reslizumab, benralizumab):** Block the action of interleukin-5 (IL-5), a cytokine that promotes the production and survival of eosinophils, which are key inflammatory cells in some types of asthma.
  - **Anti-IL-4 and IL-13 (e.g., dupilumab):** Blocks the action of interleukin-4 (IL-4) and interleukin-13 (IL-13), cytokines that contribute to airway inflammation, mucus production, and IgE production.
- **Systemic Corticosteroids:** Similar to inhaled corticosteroids, they have potent anti-inflammatory and immunosuppressant effects throughout the body, making them effective in treating severe asthma exacerbations.

Pharmacological Action:

The pharmacological actions of anti-asthmatic drugs are primarily focused on:

- **Bronchodilation:** Widening of the airways to improve airflow and relieve symptoms like wheezing and shortness of breath. This is the main action of bronchodilators.
- **Reduction of Airway Inflammation:** Decreasing the swelling, mucus production, and hyper responsiveness of the airways to prevent asthma attacks and control chronic symptoms. This is the main action of anti-inflammatory agents.
- **Prevention of Asthma Attacks:** Regular use of long-term control medications helps to prevent the onset of asthma symptoms and reduce the frequency and severity of exacerbations.
- **Relief of Acute Symptoms:** Rescue medications provide rapid relief from sudden worsening of asthma symptoms.

Drugs used in the management of COPD (Chronic Obstructive Pulmonary Disease):

COPD (Chronic Obstructive Pulmonary Disease)

1. Introduction:

- Chronic Obstructive Pulmonary Disease (COPD) is a common lung disease that obstructs airflow and causes breathing difficulties.
- It's often referred to as emphysema or chronic bronchitis. In COPD, the lungs can become damaged or clogged with mucus, leading to persistent respiratory problems.
- While there's no cure, treatments can help manage symptoms and slow disease progression.
- It includes two main conditions:
    - **Chronic bronchitis** – long-term inflammation of the bronchi with cough and mucus.
    - **Emphysema** – damage to the alveoli causing breathlessness.
- COPD is **irreversible** and mostly caused by **smoking**, air pollution, or long-term exposure to irritants.

2. Signs And Symptoms:

- Common symptoms include shortness of breath (especially during activity), wheezing, a persistent cough that may produce mucus, chest tightness, fatigue, frequent lung infections, and unintentional weight loss in later stages.

3. Causes Of COPD:

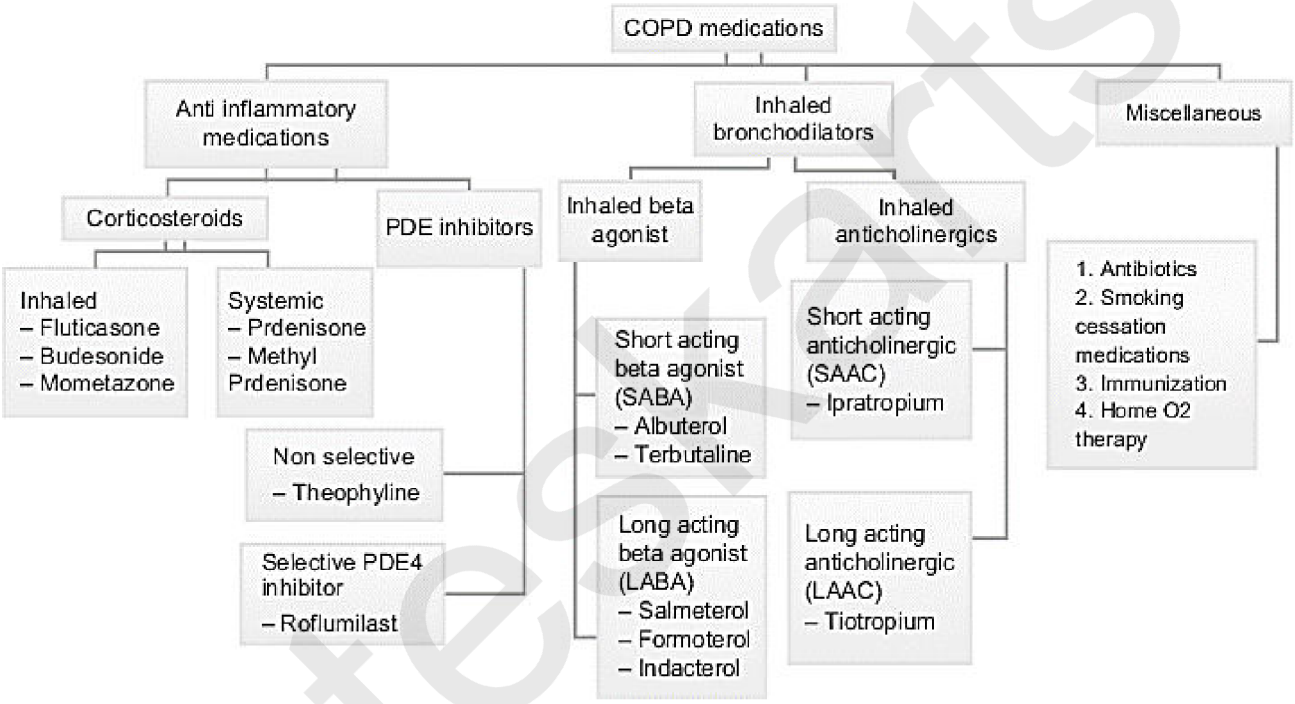
- The primary cause of COPD is long-term exposure to irritants that damage the lungs and airways.
- The most common cause is smoking (both active and passive).
- Other causes include occupational exposure to dusts, fumes, or chemicals and air pollution.

4. Treatment Of COPD: Treatment strategies aim to relieve symptoms, slow the disease's progression, reduce the frequency and severity of flare-ups, and improve overall quality of life. Key components of COPD treatment include:

- **Smoking Cessation:** This is the most crucial step for individuals with COPD who smoke.
- **Medications:** As mentioned above, various inhaled and oral medications help manage symptoms.
- **Pulmonary Rehabilitation:** This program includes exercise training, education about COPD, and counseling to help individuals manage their condition.
- **Oxygen Therapy:** Supplemental oxygen may be necessary for individuals with low blood oxygen levels.

- **Vaccinations:** Regular flu and pneumonia vaccines are recommended to prevent respiratory infections.
- **Avoiding Irritants:** Minimizing exposure to air pollution and other lung irritants is important.

5. Drugs Used For COPD:



Classification of Drugs Used in COPD

Class	Examples	Uses
1. **Bronchodilators**	- Salbutamol (short-acting β2-agonist) - Salmeterol (long-acting β2-agonist) - Ipratropium (short-acting anticholinergic) - Tiotropium (long-acting anticholinergic)	Relax airway muscles, improve airflow
2. **Corticosteroids**	- Budesonide - Fluticasone - Prednisolone (oral)	Reduce airway inflammation
3. **Methylxanthines**	- Theophylline - Aminophylline	Mild bronchodilator, improves diaphragm contractility

4. **Phosphodiesterase-4 Inhibitors**	- Roflumilast	Reduce inflammation in severe COPD
5. **Mucolytics/Expectorants**	- Ambroxol - Bromhexine - N-acetylcysteine	Thin and loosen mucus for easier removal
6. **Antibiotics**	- Amoxicillin - Azithromycin	Used during acute exacerbations with infection
7. **Oxygen Therapy**	- Oxygen inhalation (via nasal cannula/mask)	For hypoxemia in advanced COPD

Mechanism of Action (MOA):

A. Bronchodilators

1. **Beta-2 Agonists (Short-Acting - SABA)**
   - Example: **Salbutamol, Terbutaline**
   - Use: Quick relief of breathlessness
   - MOA: Stimulate β2 receptors → relax bronchial smooth muscle → bronchodilation
2. **Beta-2 Agonists (Long-Acting - LABA)**
   - Example: **Formoterol, Salmeterol**
   - Use: Long-term control and prevention
   - MOA: Same as above but long-acting
3. **Anticholinergics (Short-Acting - SAMA)**
   - Example: **Ipratropium**
   - Use: Acute relief
   - MOA: Block M3 muscarinic receptors → inhibit bronchoconstriction
4. **Anticholinergics (Long-Acting - LAMA)**
   - Example: **Tiotropium**
   - Use: Maintenance therapy
   - MOA: Long-acting M3 receptor antagonist → sustained bronchodilation

B. Inhaled Corticosteroids (ICS)

- Examples: **Budesonide, Fluticasone**
- Use: Reduce inflammation in airways
- MOA: Bind to glucocorticoid receptors → suppress inflammatory gene expression → reduce airway inflammation

C. Combination Therapy

1. **LABA + ICS**
   - Example: **Formoterol + Budesonide**
2. **LABA + LAMA**
   - Example: **Indacaterol + Glycopyrronium**
3. **LABA + LAMA + ICS**
   - Example: **Fluticasone + Umeclidinium + Vilanterol**

- Use: More effective in severe cases or frequent exacerbations
- MOA: Combination of bronchodilation and anti-inflammatory effects

D. Phosphodiesterase-4 Inhibitors

- Example: **Roflumilast**
- Use: Severe COPD with chronic bronchitis
- MOA: Inhibit PDE-4 enzyme → increase cAMP → reduce inflammation

E. Methylxanthines

- Example: **Theophylline**
- Use: Add-on bronchodilator therapy
- MOA: Non-selective inhibition of phosphodiesterase → increase cAMP → bronchodilation

F. Mucolytics

- Example: **N-acetylcysteine**
- Use: To thin mucus and improve clearance
- MOA: Breaks disulfide bonds in mucus → decreases viscosity

G. Antibiotics

- Example: **Azithromycin**
- Use: For bacterial infections or frequent exacerbations
- MOA: Inhibits bacterial protein synthesis

Expectorants and Antitussives

1. EXPECTORANTS (Mucokinetics)

Definition:
Expectorants are the drugs that **increase the volume** and/or **reduce the viscosity of mucus**, making it **easier to expel** from the respiratory tract through coughing.

Uses:

- Productive cough (with mucus)
- Bronchitis
- Common cold

Examples:

CLASSIFICATION OF EXPECTORANTS:

A. Based on Mechanism of Action

1. Secretomotor Expectorants

(Stimulate ciliary movement to help clear mucus)

- **Examples:**
  - **Guaifenesin**
  - **Ammonium chloride**
  - **Potassium iodide**

2. Mucolytic Expectorants

(Break down thick mucus to make it less viscous)

- **Examples:**
  - **Bromhexine**
  - **Ambroxol (active metabolite of bromhexine)**
  - **Acetylcysteine (NAC – N-acetyl cysteine)**
  - **Carbocisteine**

3. Hydrating Agents (Water-drawing agents)

(Increase water content in mucus → easier to expel)

- **Examples:**
  - **Water vapor (steam inhalation)**
  - **Saline (hypertonic)**

4. Topical Irritants (Reflex Expectorants)

(Irritate the gastric mucosa → reflex stimulation of respiratory secretions)

- **Examples:**
  - **Ipecac**
  - **Tolu balsam**
  - **Squill**

Drug	Action
Guaifenesin	Thins mucus, promotes clearance
Bromhexine	Breaks down mucus structure
Ambroxol	Stimulates mucus clearance & surfactant production
Potassium iodide	Increases respiratory tract secretions

Mechanism of Action:

- Stimulate **glands in the respiratory tract**
- Increase secretion of **thin mucus**
- Helps in **clearing thick, sticky sputum**

Expectorants – Classification, Uses & Mechanism of Action

Drug Name	Class/Type	Use	Mechanism of Action (MOA)
Guaifenesin	Secretomotor Expectorant	Common cold, bronchitis, productive cough	Stimulates **respiratory tract secretions** → loosens mucus for easy removal
Potassium iodide	Secretomotor/Reflex Expectorant	Chronic bronchitis, thick mucus	Stimulates **mucus-secreting glands** via reflex action from **gastric irritation**
Ammonium chloride	Reflex Expectorant	Productive cough	Irritates gastric mucosa → **reflex increase** in bronchial secretions
Ipecac	Reflex Expectorant	Used in cough syrups (low dose)	Stimulates **vomiting center** and **respiratory secretion** reflex
Squill	Reflex Expectorant	Productive cough (herbal origin)	Mild gastric irritant → increases bronchial secretions
Bromhexine	Mucolytic Expectorant	COPD, asthma, bronchitis, thick mucus	Breaks **acid mucopolysaccharide fibers** → reduces mucus viscosity

Ambroxol	Mucolytic & surfactant enhancer	Productive cough with sticky mucus	Enhances mucus clearance by **breaking mucus** and stimulating surfactant production
Acetylcysteine (NAC)	Mucolytic	COPD, cystic fibrosis, thick mucus	Breaks **disulfide bonds** in mucus → decreases viscosity
Carbocisteine	Mucolytic	Chronic bronchitis, sinusitis	Alters **mucus composition** to make it thinner and easier to expel
Steam inhalation	Hydrating agent	Thick sputum, congestion	Inhaled water vapor **moistens mucus** → easier to cough out
Hypertonic saline	Hydrating agent	Cystic fibrosis, thick mucus	Draws water into mucus by **osmosis**, making it thinner

2. ANTITUSSIVES (Cough suppressants)

Definition:
Antitussives are drugs that **suppress the cough reflex**, usually by acting on the **cough center in the brain (medulla)**.

Uses:

- Dry (non-productive) cough
- Night-time coughing
- Irritative cough due to cold or throat irritation.

Classification of Antitussives:

1. Centrally Acting Antitussives

(Act on the **cough center in medulla** of the brain to suppress cough reflex)

a) Narcotic (Opioid) Antitussives:

- Codeine
- Pholcodine
- Morphine (used only in severe cases)

b) Non-Narcotic (Non-Opioid) Antitussives:

- Dextromethorphan
- Noscapine
- Butamirate

2. Peripherally Acting Antitussives

(Act on the **respiratory tract**, reduce local irritation of cough receptors)

- Benzonatate
- Menthol (lozenges/vapor)
- Honey, Syrups (demulcents)
- Glycerin

3. Miscellaneous Agents:

- Antihistamines (e.g., Diphenhydramine, Chlorpheniramine) – useful in allergic cough
- Bronchodilators (e.g., Salbutamol) – if cough is due to bronchospasm

Mechanism of Action (MOA):

Type	Mechanism
Centrally Acting	Suppress the **cough center** in the **medulla oblongata** (brain)
Peripherally Acting	**Soothing or numbing** effect on **irritated mucosa or cough receptors**
Antihistamines	Block **H1 receptors**, reduce allergic irritation and post-nasal drip

Uses of Antitussives:

- Dry or **non-productive cough**
- Cough disturbing **sleep or rest**
- Cough due to **irritation of throat**, **allergy**, or **cold**
- **Post-operative cough** suppression
- **Whooping cough** (some cases)

Antitussive Drugs – Classification, Uses & Mechanism of Action

Drug Name	Class	Use	Mechanism of Action (MOA)
Codeine	Narcotic (Central acting)	Dry cough, chronic non-productive cough	Acts on **μ-opioid receptors** in the **medulla**, suppresses **cough center activity**
Pholcodine	Narcotic (Central acting)	Persistent dry cough, less sedative than codeine	Suppresses the **cough center** in the medulla, **long-acting**
Morphine	Narcotic (strong)	Severe dry cough (e.g., in terminal illness)	Suppresses **cough center**, used only in **severe cases** due to strong **CNS depression**
Dextromethorphan	Non-narcotic (Central acting)	Common cold, dry cough	Suppresses cough center via **NMDA receptor**

			antagonism in medulla, **non-opioid**
Noscapine	Non-narcotic (Central acting)	Dry cough	Acts on **cough center** in medulla without respiratory depression
Butamirate	Non-narcotic (Central acting)	Dry and irritating cough	Inhibits cough center by **direct action on medulla**, no opioid properties
Benzonatate	Peripheral acting	Cough due to throat or airway irritation	**Anesthetizes stretch receptors** in the lungs, bronchi, and pleura → suppresses reflex
Menthol	Peripheral (mild agent)	Sore throat, dry cough, cold	Provides a **cooling, soothing effect** on the throat, reduces irritation
Glycerin	Demulcent	Used in cough syrups to coat throat	Forms a **soothing film** over throat mucosa, reducing cough receptor stimulation
Honey	Demulcent/Natural agent	Dry cough, throat irritation	Coats throat, **soothes mucosa**, reduces cough reflex stimulation
Diphenhydramine	Antihistamine (H1 blocker)	Allergic cough, cold, post-nasal drip	Blocks **H1 histamine receptors**, **reduces allergic irritation** and secretions
Chlorpheniramine	Antihistamine (H1 blocker)	Allergy-associated cough	Similar to diphenhydramine; **reduces histamine-induced cough**

Nasal Decongestants

Definition:

- Nasal decongestants are **medications that relieve nasal congestion** (blocked nose) by reducing the swelling of nasal mucosa, thereby **improving airflow through the nasal passages**.
- They are commonly used in conditions such as **common cold, allergic rhinitis, sinusitis**, and **upper respiratory tract infections**.

Nasal Congestion

Definition:
Nasal congestion, also called **"stuffy nose"**, refers to the **blockage or obstruction of the nasal passages**, usually due to inflammation of the nasal tissues and blood vessels, often with excess mucus.

Causes of Nasal Congestion:

- **Common Cold** – Viral infection (e.g., Rhinovirus).
- **Allergic Rhinitis** – Due to allergens like pollen, dust, animal dander.
- **Sinusitis** – Infection or inflammation of the sinuses.
- **Flu (Influenza)** – Viral infection with nasal involvement.
- **Nasal Polyps** – Growths in the nasal cavity.
- **Deviated Nasal Septum** – Structural abnormality.
- **Environmental Irritants** – Smoke, perfumes, pollution.
- **Hormonal Changes** – During pregnancy or due to medications.
- **Overuse of Nasal Decongestant Sprays** – Rebound congestion (Rhinitis medicamentosa).

Signs and Symptoms of Nasal Congestion:

- Stuffy or blocked nose
- Difficulty breathing through the nose
- Runny nose (Rhinorrhea)
- Sneezing
- Facial pain or pressure
- Headache
- Decreased sense of smell and taste
- Nasal voice
- Snoring (due to blockage)

Classification of Nasal Decongestants:

1. Sympathomimetic Nasal Decongestants (α-adrenergic agonists):

- **Topical (nasal sprays/drops):**
  - Oxymetazoline
  - Xylometazoline
  - Phenylephrine
  - Naphazoline
- **Oral:**
  - Pseudoephedrine
  - Phenylephrine

2. Steroidal Nasal Decongestants (Intranasal corticosteroids):

- Beclomethasone
- Fluticasone
- Budesonide
- Mometasone

3. Antihistamines (with decongestant properties):

- Diphenhydramine
- Chlorpheniramine (combined with phenylephrine)

4. Others:

- Ipratropium bromide (anticholinergic)
- Saline nasal sprays (non-pharmacological decongestants)

Mechanism of Action & Uses:

Drug/Class	Mechanism of Action	Uses
Oxymetazoline, Xylometazoline (Topical α1-agonists)	Constrict blood vessels in nasal mucosa → reduces edema and nasal congestion	Acute nasal congestion, allergic rhinitis, sinusitis
Phenylephrine (Topical/Oral)	Selective α1-agonist → vasoconstriction in nasal mucosa	Common cold, allergic rhinitis
Pseudoephedrine (Oral)	Mixed-acting sympathomimetic → vasoconstriction of nasal blood vessels	Nasal and sinus congestion due to cold/allergy
Beclomethasone, Fluticasone, Budesonide (Corticosteroids)	Anti-inflammatory → reduces nasal mucosal inflammation and congestion	Allergic rhinitis, chronic sinusitis, nasal polyps
Diphenhydramine, Chlorpheniramine (Antihistamines)	Block H1 receptors → reduce histamine-induced nasal congestion	Allergic rhinitis, hay fever

Ipratropium bromide (Anticholinergic)	Inhibits nasal gland secretions by blocking muscarinic receptors	Rhinorrhea (runny nose), non-allergic rhinitis
Saline nasal sprays	Moisturize nasal mucosa, help clear mucus	Dry nose, mild congestion, post-surgery care

Respiratory stimulants

- **Respiratory stimulants** are drugs that **stimulate the respiratory center in the brainstem (medulla oblongata)** to increase the **rate and depth of breathing**.

- These are used in conditions of **respiratory depression** caused by overdose of CNS depressants, anesthetics, or in conditions like **neonatal apnea**.

Classification of Respiratory Stimulants:

1. Cortical Stimulants (Analeptics acting on higher centers):

- Caffeine
- Amphetamine
- Theophylline

2. Medullary (brainstem) Respiratory Stimulants:

- Doxapram
- Nikethamide *(obsolete now in many countries)*

3. Spinal Cord Stimulants:

- Strychnine *(historical, now obsolete due to toxicity)*

Mechanism of Action (MOA):

Drug	Site of Action	Mechanism
Doxapram	Medulla oblongata	Stimulates carotid chemoreceptors and respiratory center to increase respiratory rate
Caffeine	Cortex + Medulla	Blocks adenosine receptors → CNS stimulation, mild respiratory stimulation
Theophylline	Medulla + Bronchi	Inhibits phosphodiesterase → ↑ cAMP → bronchodilation & mild respiratory stimulation
Nikethamide	Medulla oblongata	Stimulates respiratory and vasomotor centers (rarely used now)

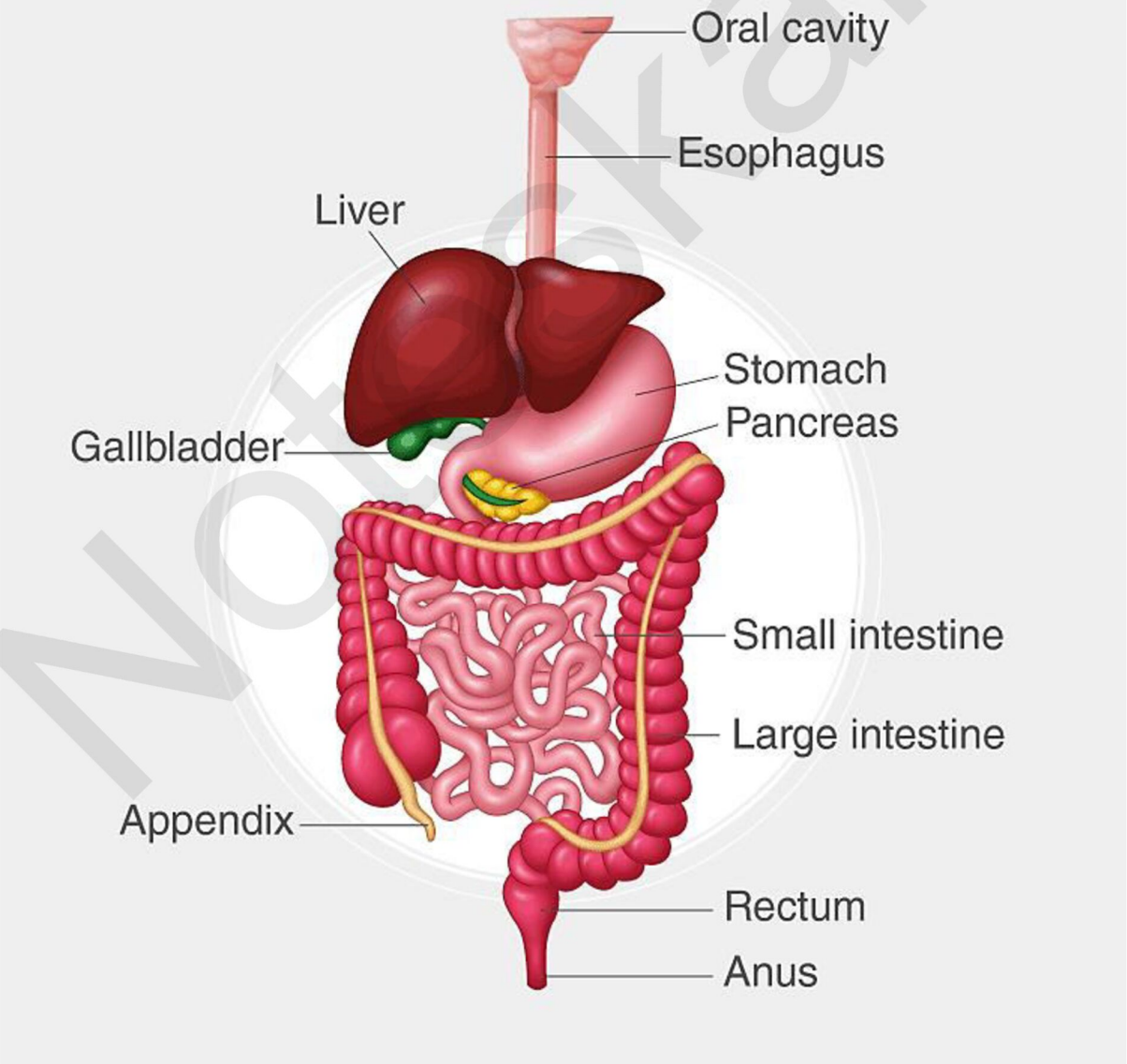
2. Pharmacology of drugs acting on the Gastrointestinal Tract

A. Antiulcer agents.
B. Drugs for constipation and diarrhoea.
C. Appetite stimulants and suppressants.
D. Digestants and carminatives.
E. Emetics and anti-emetics.

Gastrointestinal Tract (GIT)

Definition:

The **Gastrointestinal Tract (GIT)**, also known as the **digestive tract**, is a continuous hollow tube that starts from the **mouth** and ends at the **anus**. It is responsible for **digestion**, **absorption**, and **elimination** of food and waste.



Main Functions of GIT:

1. **Ingestion** – Taking food into the mouth
2. **Digestion** – Breaking down food into smaller, absorbable molecules
3. **Absorption** – Nutrients are absorbed into the blood or lymph
4. **Excretion** – Removal of undigested waste (feces) through anus

Major Parts of the GIT and Their Functions:

Part	Function
Mouth	Mechanical breakdown of food (chewing), mixes with saliva (contains amylase for starch digestion)
Pharynx	Passage for food and air
Esophagus	Transfers food to stomach via peristalsis
Stomach	Secretes acid and enzymes (pepsin), churns food into chyme
Small Intestine (Duodenum, Jejunum, Ileum)	Main site of digestion and absorption of nutrients
Large Intestine (Colon)	Absorbs water and forms feces
Rectum	Stores feces before excretion
Anus	Opening for waste elimination

Accessory Organs of Digestion:

- These organs help in digestion but are **not part of the GI tube**:

Organ	Function
Liver	Produces bile (helps in fat digestion), detoxifies substances
Gallbladder	Stores and releases bile
Pancreas	Secretes digestive enzymes and insulin
Salivary Glands	Produce saliva for moistening food and starting starch digestion

Common Disorders of GIT:

- **Gastritis** – Inflammation of stomach lining
- **Ulcers** – Open sores in stomach or duodenum
- **Diarrhea** – Loose, watery stools
- **Constipation** – Difficulty in passing stools
- **Acid Reflux (GERD)** – Acid backflow from stomach into esophagus
- **Irritable Bowel Syndrome (IBS)** – Functional disorder of intestines

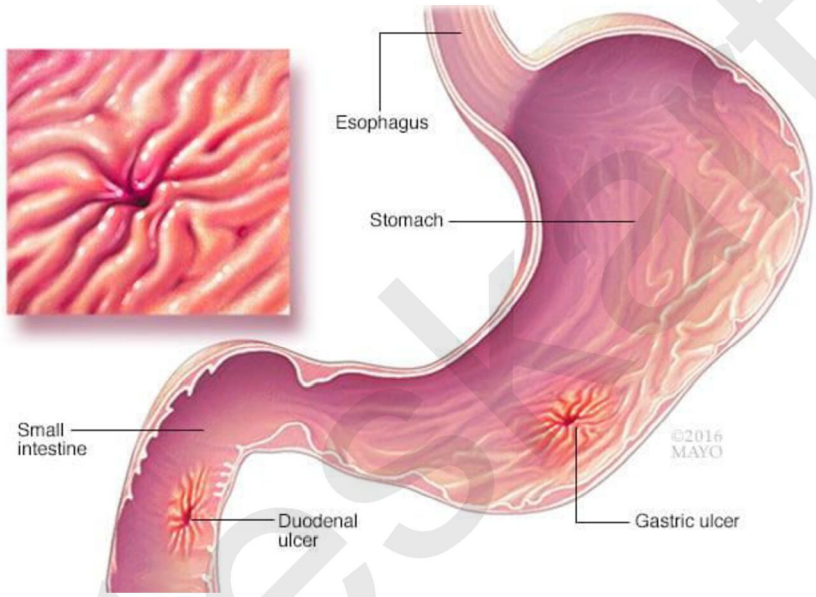
Drugs acting on the Gastrointestinal Tract

A. Antiulcer agents.
B. Drugs for constipation and diarrhoea.
C. Appetite stimulants and suppressants.
D. Digestants and carminatives.
E. Emetics an d anti-emetics.

A. Antiulcer agents.

Peptic Ulcer:

- Characterized by excessive secretion of acid (acidity)
- Ulcers mean injuries/wounds due to long term existence of acidity
- Occurs in the areas highly exposed to gastric acid
- Stomach and duodenum are highly exposed to acid
- Ulcers in the stomach called as gastric ulcers
- Ulcers in the duodenum called as duodenal ulcers.



It can be of three type:

1. **Gastric ulcers** that occur on the inside of the stomach. A peptic ulcer in the stomach is called a gastric ulcer
2. **Duodenal ulcers** thatoccur on the inside of the upper portion of your small intestine (duodenum)
3. An **esophageal ulcer** occurs in the lower pai your esophagus.

Cause:

- H. Pylori
- Non-Steroidal
- Smoking Genetics
- Anti-InflammatoryDrugs
- Mental Stress
- Alcohol Consumption

Anti- Ulcers:

Anti-ulcer drugs are medications used to treat ulcers in the gastrointestinal tract, especially **peptic ulcers**, which include **gastric** and **duodenal ulcers**. These drugs aim to reduce gastric acid secretion, neutralize acid, protect the mucosal lining, or eradicate *Helicobacter pylori* infection (a common ulcer cause).

Anti-Ulcer Drugs: A Classification

Anti-ulcer drugs can be broadly categorized based on their primary mechanism of action:

1. **Agents that Reduce Gastric Acid Secretion:**
    - **Proton Pump Inhibitors (PPIs):** These are the most potent inhibitors of gastric acid secretion.
        - *Examples:* Omeprazole, Lansoprazole, Pantoprazole, Rabeprazole, Esomeprazole, Dexlansoprazole.
    - **H_2-Receptor Antagonists:** These drugs block the action of histamine on the parietal cells of the stomach, thereby reducing acid production.
        - *Examples:* Cimetidine, Ranitidine, Famotidine, Nizatidine.
2. **Agents that Neutralize Gastric Acid (Antacids):**
    - These are alkaline compounds that directly neutralize stomach acid, providing rapid but temporary relief.
        - *Examples:* Sodium bicarbonate, Calcium carbonate, Magnesium hydroxide, Aluminum hydroxide.
3. **Ulcer Protective Agents:**
    - These medications form a protective barrier over the ulcer crater, shielding it from acid and digestive enzymes to promote healing.
        - *Examples:* Sucralfate, Bismuth Subsalicylate.
4. **Prostaglandin Analogs:**
    - These synthetic versions of naturally occurring prostaglandins help protect the stomach lining and reduce acid secretion.
        - *Example:* Misoprostol.
5. **Anti-Helicobacter pylori Agents (Antibiotics):**

- Eradicating *H. pylori* infection is crucial for healing and preventing the recurrence of ulcers. This is typically achieved with a combination of antibiotics and a PPI.
    - *Examples:* Clarithromycin, Amoxicillin, Metronidazole, Tetracycline.

Mechanism of Action of Anti-Ulcer Drugs:

Class	Example	Mechanism of Action
H_2-blockers	Ranitidine	Block H_2-receptors on gastric parietal cells → ↓ acid secretion
PPIs	Omeprazole	Irreversibly inhibit H^+/K^+ ATPase (proton pump) in parietal cells → ↓ acid secretion
Antacids	$Mg(OH)_2$, $Al(OH)_3$	Neutralize existing stomach acid
Ulcer protectives	Sucralfate	Forms a protective barrier on ulcer site → prevents acid/pepsin damage
Prostaglandin analogues	Misoprostol	Mimic prostaglandin E_1 → ↑ mucus & bicarbonate, ↓ acid secretion
Anti-H. pylori drugs	Amoxicillin, Clarithromycin	Kill *H. pylori*, the bacteria responsible for ulcer formation

Drugs for constipation and diarrhea

CONSTIPATION

Definition:

- Constipation is a condition characterized by **infrequent or difficult passage of hard stools**. It may be due to poor diet, lack of exercise, medications, or underlying diseases.

Classification:

1. **Bulk-forming laxatives**
   - Psyllium husk (Isabgol), Methylcellulose, Bran
2. **Stool softeners (Emollients)**
   - Docusate sodium, Liquid paraffin
3. **Osmotic laxatives (Saline purgatives)**
   - Lactulose, Magnesium sulfate, Magnesium hydroxide, Polyethylene glycol
4. **Stimulant laxatives (Irritant purgatives)**
   - Bisacodyl, Senna, Castor oil
5. **Lubricant laxatives**
   - Liquid paraffin
6. **Prokinetic agents (increase motility)**
   - Prucalopride (5-HT4 agonist)

Mechanism of Action:

Type	Mechanism
Bulk-forming	Increase water content → stool becomes bulky → stimulates peristalsis
Stool softeners	Reduce surface tension → mix water into stool → soften stool
Osmotic	Draw water into intestines by osmosis → soften stool and increase volume
Stimulant	Stimulate intestinal mucosa → increase peristalsis and secretion
Lubricants	Lubricate stool → ease passage

Adverse Effects:

- Abdominal cramps (stimulant laxatives)
- Diarrhoea

- Electrolyte imbalance (long-term use)
- Dependence (with stimulant purgatives)
- Bloating and gas (bulk-forming)

Uses:

- Chronic constipation
- Drug-induced constipation (e.g. opioids)
- Bowel clearance before surgery/colonoscopy
- Hemorrhoids (to ease defecation)

Drugs for Constipation: Laxatives & Purgatives

Class	Examples	Mechanism of Action	Use
1. **Bulk-forming laxatives**	Psyllium, Methylcellulose, Bran	Absorb water, increase stool bulk, and stimulate peristalsis	Chronic constipation
2. **Osmotic purgatives**	Lactulose, Magnesium sulfate, PEG	Draw water into intestine → softens stool and stimulates motility	Acute/chronic constipation, hepatic encephalopathy (Lactulose)
3. **Stimulant purgatives**	Bisacodyl, Senna, Castor oil	Directly stimulate enteric nerves and increase peristalsis	Short-term constipation
4. **Stool softeners (Emollients)**	Docusate sodium, Liquid paraffin	Soften stool by emulsifying fats and water in feces	Post-surgery, cardiac patients
5. **Lubricants**	Liquid paraffin	Lubricate stool and intestinal mucosa	Avoid straining
6. **Prokinetic agents**	Cisapride, Prucalopride	Stimulate 5-HT_4 receptors and enhance gut motility	Chronic idiopathic constipation

DIARRHOEA

Definition:

Diarrhoea is defined as **increased frequency and liquidity of stools** (more than 3 times/day), often caused by infection, food poisoning, medications, or malabsorption.

Classification of Antidiarrhoeal Agents

1. Adsorbents

- Kaolin
- Pectin
- Activated Charcoal
- Attapulgite
- Diosmectite

2. Antimotility Agents (Opioid derivatives)

- Loperamide
- Diphenoxylate + Atropine
- Difenoxin + Atropine

3. Antisecretory Agents

- Racecadotril
- Bismuth Subsalicylate

4. Probiotics

- Lactobacillus species
- Saccharomyces boulardii
- Bifidobacterium species

5. Antibiotics / Antimicrobials

(Used in infectious diarrhoea only)

- Metronidazole
- Ciprofloxacin
- Norfloxacin
- Furazolidone
- Nitazoxanide
- Doxycycline (for cholera)

6. Intestinal Microflora Modifiers

- Rifaximin

7. Astringents

- Bismuth Subsalicylate
- Tannic acid

8. Oral Rehydration Therapy (Supportive)

- WHO Oral Rehydration Solution (ORS)
- Reduced Osmolarity ORS

Antidiarrhoeal Agents – Classification, Mechanism of Action & Uses

Class	Examples	Mechanism of Action	Uses
1. Adsorbents	Kaolin, Pectin, Activated charcoal, Attapulgite	Adsorb toxins, bacteria, and fluid; coat intestinal mucosa	Mild diarrhoea, supportive therapy
2. Antimotility Agents (Opioid derivatives)	Loperamide, Diphenoxylate + Atropine, Difenoxin	Act on μ-opioid receptors in gut; decrease peristalsis and increase fluid absorption	Acute non-infective diarrhoea
3. Antisecretory Agents	Racecadotril, Bismuth subsalicylate	Inhibit intestinal secretions (Racecadotril blocks enkephalinase)	Acute diarrhoea, Traveler's diarrhoea
4. Probiotics	Lactobacillus, Bifidobacterium, Saccharomyces boulardii	Restore normal gut flora; inhibit pathogens	Antibiotic-associated and infectious diarrhoea
5. Antimicrobials	Metronidazole, Ciprofloxacin, Norfloxacin, Furazolidone, Nitazoxanide, Doxycycline	Kill or inhibit growth of causative bacteria/protozoa	Infective diarrhoea (bacterial/parasitic)
6. Microflora Modifiers	Rifaximin	Non-absorbable antibiotic; alters gut flora, reduces harmful bacteria	Traveler’s diarrhoea, hepatic encephalopathy
7. Astringents	Bismuth Subsalicylate, Tannic acid	Coagulate mucosal proteins; reduce mucosal secretion and inflammation	Mild diarrhoea, Traveler’s diarrhoea

8. Oral Rehydration Salts (ORS)	WHO ORS, Reduced osmolarity ORS	Restore fluid and electrolyte balance; use of glucose-facilitated sodium absorption	All types of diarrhoea (to prevent dehydration

Appetite Stimulants (Orexiogenics)

Definition:

Drugs that **increase appetite** are known as **appetite stimulants** or **orexiogenics**. They are used in conditions like **anorexia**, **malnutrition**, **chronic illness**, and **wasting diseases**.

Classification & Examples:

Class	Examples	Mechanism of Action
1. **Antihistamines (H_1 blockers)**	Cyproheptadine, Oxomemazine	Block H_1 receptors → increase appetite and cause sedation
2. **Corticosteroids**	Prednisolone, Dexamethasone	Increase appetite and promote weight gain via glucocorticoid action
3. **Benzodiazepines**	Diazepam	Enhance GABA action → relax anxiety and improve eating behavior
4. **Anabolic Steroids**	Nandrolone, Oxandrolone	Promote protein synthesis and appetite
5. **Vitamins and Minerals**	B-complex, Zinc, Multivitamins	Correct deficiencies that may cause anorexia
6. **Cannabinoids**	Dronabinol (synthetic THC)	Stimulate appetite via CB1 receptor in CNS
7. **Antidepressants**	Mirtazapine	Has appetite-stimulating properties (also used in depression)

Uses:

- Anorexia nervosa
- Cachexia (cancer, AIDS, TB)
- Malnutrition
- Post-illness recovery
- Elderly with poor appetite

Appetite Suppressants (Anorexiants)

Definition:

Drugs that **suppress appetite** are called **anorexiants**. They are mainly used in the treatment of **obesity** and **overweight conditions**.

Classification & Examples:

Class	Examples	Mechanism of Action
1. **CNS Stimulants (Sympathomimetics)**	Phentermine, Diethylpropion	Stimulate CNS → suppress hunger center in hypothalamus
2. **Serotonin-Norepinephrine Reuptake Inhibitors (SNRIs)**	Sibutramine (withdrawn), Bupropion + Naltrexone	Increase levels of serotonin and norepinephrine → appetite suppression
3. **Lipase Inhibitors**	Orlistat	Inhibits pancreatic lipase → prevents fat absorption → indirectly reduces appetite
4. **GLP-1 Agonists**	Liraglutide, Semaglutide	Delay gastric emptying and act on satiety center in brain
5. **Antidepressants**	Bupropion (combined with Naltrexone)	Reduces cravings and appetite

Uses:

- Obesity (BMI >30 or >27 with comorbidities)
- Metabolic syndrome
- Overeating disorders

Side Effects:

- **Stimulants**: Insomnia, hypertension, palpitations
- **Orlistat**: Oily stools, flatulence
- **GLP-1 agonists**: Nausea, vomiting

Digestants and Carminatives

I. Digestants

Definition:

Digestants are substances that aid or promote the process of digestion by **enhancing the enzymatic breakdown of food** in the gastrointestinal tract.

Classification of Digestants:

Class	Examples
1. **Proteolytic enzymes**	Pepsin, Papain, Trypsin
2. **Amylolytic enzymes**	Diastase, Pancreatin
3. **Lipolytic enzymes**	Lipase
4. **Mixed enzyme preparations**	Fungal diastase + Pepsin, Pancreatin
5. **Acidifiers**	Dil. Hydrochloric Acid

Mechanism of Action:

Digestants supply **digestive enzymes** that help in breaking down proteins, carbohydrates, and fats into simpler forms, aiding digestion in people with enzyme deficiency or digestive weakness.

Uses:

- Indigestion (Dyspepsia)
- Chronic pancreatitis
- Post-gastrectomy patients
- Flatulence due to maldigestion
- Elderly with low digestive enzyme production

II. Carminatives

Definition:

Carminatives are substances that **relieve flatulence** (gas in the GIT) by promoting expulsion of gas from the stomach and intestines and **relieve abdominal discomfort**.

Examples of Carminatives:

Natural (Herbal)	Synthetic/Other
Asafoetida (Hing)	Simethicone
Ginger	Dimethicone

Fennel (Saunf)	Methylpolysiloxane
Cardamom (Elaichi)	
Caraway	

Mechanism of Action:

- Reduce surface tension of gas bubbles → coalesce and expel gas
- Stimulate GI motility → promote gas movement
- Have mild spasmolytic and soothing action

Uses:

- Flatulence
- Infantile colic
- Dyspepsia
- Bloating and abdominal distension
- Functional gastrointestinal disorders

Emetics and Anti-emetics

I. Emetics

Definition:

Emetics are drugs that **induce vomiting** by acting on the vomiting center in the brain or by irritating the stomach lining.

Classification of Emetics:

Class	Examples	Site of Action
1. **Central Acting Emetics**	Apomorphine	Stimulate CTZ (chemoreceptor trigger zone) in medulla
2. **Peripheral Acting Emetics**	Ipecac syrup	Irritate gastric mucosa and reflexly activate vomiting center

Mechanism of Action:

- **Central emetics** stimulate the **CTZ** in the medulla oblongata.
- **Peripheral emetics** irritate the **gastric mucosa**, sending impulses to the vomiting center via vagus nerve.

Uses:

- **Poisoning** (only if patient is conscious and within 1 hour of ingestion)
- To empty stomach before surgery (rarely used now)
- Investigational tests (e.g. gastric emptying)

Contraindications:

- Unconscious patient
- Ingestion of corrosives (acids/alkalis) or petroleum products
- Seizures, pregnancy, or convulsions

II. Anti-emetics

Definition:

Anti-emetics are drugs that **prevent or control vomiting and nausea** by blocking different receptors in the brain and GIT.

Classification of Anti-emetics with Examples:

Class	Examples	Mechanism of Action
1. **Anticholinergics**	Hyoscine (Scopolamine)	Block muscarinic receptors in vomiting center
2. **Antihistamines (H_1 blockers)**	Promethazine, Diphenhydramine, Meclizine	Block H_1 and muscarinic receptors, especially in motion sickness
3. **Dopamine (D_2) antagonists**	Metoclopramide, Domperidone, Prochlorperazine	Block D_2 receptors in CTZ
4. **5-HT_3 antagonists**	Ondansetron, Granisetron	Block serotonin receptors in CTZ and gut
5. **NK-1 receptor antagonists**	Aprepitant	Block substance P at neurokinin-1 receptors
6. **Cannabinoids**	Dronabinol	Act on CB_1 receptors in CNS
7. **Corticosteroids**	Dexamethasone	Unknown exact action, used in chemotherapy-induced nausea

Uses of Anti-emetics:

- Motion sickness (Hyoscine, Antihistamines)
- Nausea due to chemotherapy/radiotherapy (Ondansetron, Aprepitant)
- Post-operative nausea and vomiting (Ondansetron, Metoclopramide)
- Vomiting in pregnancy (Promethazine)
- Gastroenteritis-induced vomiting (Domperidone, Metoclopramide)

Side Effects:

- Drowsiness (Antihistamines)
- Extrapyramidal effects (Metoclopramide)
- Headache, constipation (Ondansetron)