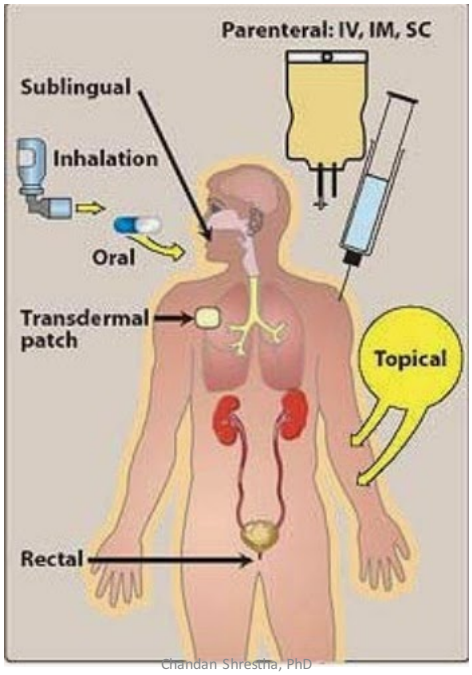
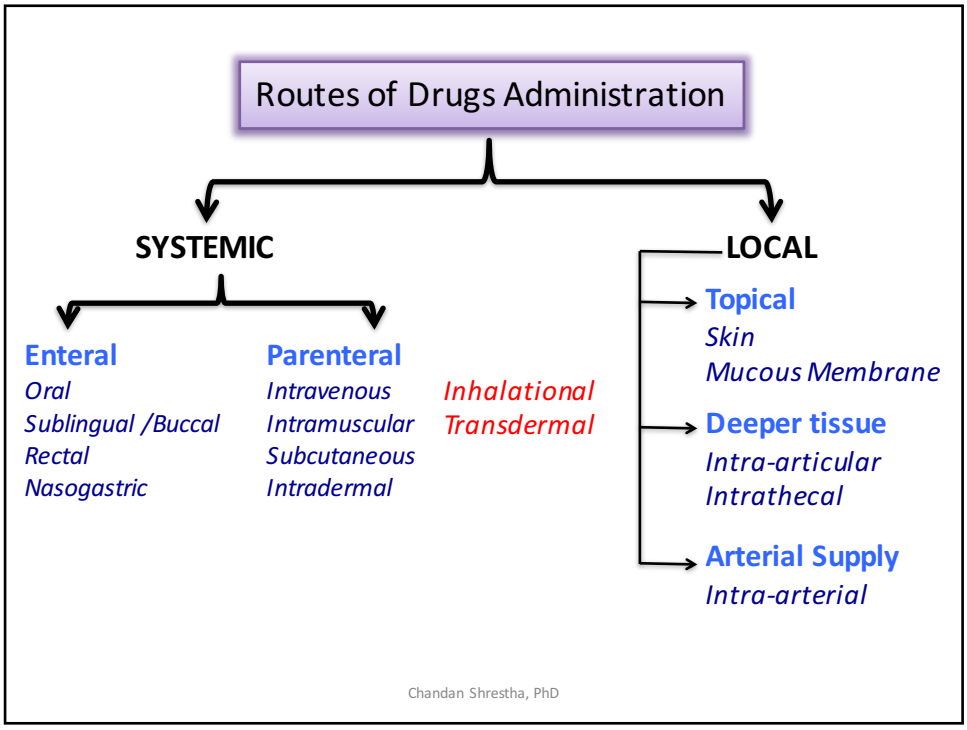


Routes of Drug Administration

- **A route of administration** is the path by which a drug, fluid, poison or other substance is brought into contact with the body.
- Drugs are introduced into the body by several routes.
- Routes can be broadly divided into those for
  - Local action: Drug act on site of administration (e.g. eyes, ears, skin, nose)
  - Systemic action: Drug act on whole body

Drugs administered through systemic routes is intended to be absorbed into the blood and distributed all over, including site of action through circulation



Enteral Administration

- Drug placed directly in the GIT
- **Enteral routes include:**
  - Oral administration
  - Sublingual administration
  - Buccal administration
  - Nasogastric route
  - Rectal administration

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Oral Route

- The most common route of administration.
- By swallowing
- are absorbed in the GIT and have a peak time of between 1 - 3 hours.
- Oral medications are in the form of tablets, capsules, solution and suspensions.

Advantages of Oral Route

- ✓ Convenient - can be self- administered, pain free, easy to take
- ✓ Absorption - takes place along the whole length of the GI tract
- ✓ Cheap - compared to most other parenteral routes
- ✓ Does not require maximal sterility

Note: Not to crush tablets or open capsules intended to be swallowed whole

Disadvantages of Oral Route

- ✓ Some drugs are unpalatable and cause irritation of the intestinal tract resulting in **nausea and vomiting**.
- ✓ *First-pass effect* - drugs absorbed orally are initially transported to the liver via the portal vein
- ✓ Destruction of drugs by gastric acid and digestive juices example: insulin is destroyed by intestinal enzymes.
- ✓ Effect too slow for emergencies
- ✓ Unable to use in unconscious / vomiting patient
- ✓ Drugs interaction may occur if two drugs are given concurrently or due to presence of food.

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First Pass Effect

The First Past Effect (First Past Metabolism or Presystemic Metabolism) is a phenomenon of drug metabolism whereby the concentration of a drug is greatly reduced before it reaches the systemic circulation.

It is a fraction of drugs lost during the process of **absorption**.

- ➢ After drug is swallowed, it is absorbed by the digestive system and enters the hepatic portal system.
- ➢ It is carried through the portal vein into the liver before it reaches to the rest of the body.
- ➢ The liver metabolizes many drugs, sometimes to such extent that only a small amount of active drug emerges from the liver to the rest of the circulatory system.
- ➢ This pass through the liver thus greatly reduces the bioavailability of the drugs.

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- In case of those drugs , which has high first pass effect oral administration is avoided.eg; lidocaine is given locally or IV .
- Some drugs that experience significant first pass effect are morphine, propranolol , diazepam , midazolam , pethidine , cimetidine and nitroglycerin.

Importance :

- Protects from toxic substances.
- Makes the drugs water soluble.
- Protects us from drug molecules.

Drawbacks

- Low bioavailibity.
- Short duration of action.

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Sublingual and Buccal Route

- Drug are placed under the tongue.
- Rapidly absorbed by sublingual mucosa because of the abundance of blood vessels.
- Examples: Nitroglycerin for angina

- Drug is placed between gums and inner lining of the cheek (buccal pouch)
- absorbed by buccal mucosa

Dosage form: Tablets, lozenges, gum

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Sublingual and Buccal Route

Advantages

- avoid first-pass effect: The liver is by-passed thus there is no loss of drug by first pass effect for buccal administration. Bioavailability is higher.
- rapid absorption: Because of the good blood supply to the area, absorption is usually quite rapid.
- drug stability: pH in mouth is relatively neutral. Thus a drug may be more stable

Disadvantages

- Holding the dose in the mouth is inconvenient.
- Small doses only can be accommodated easily.
- unpleasant taste of some drugs

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Administering Sublingual and Buccal Medication

- For sublingual and buccal administration, the tablet is not be swallowed but kept in the mouth.

Sublingual route

- The client should be instructed not to move the drug with tongue, nor to eat or drink anything until the medication has completely dissolved.
- When multiple drugs are ordered, the sublingual preparations should be administered only after administration oral medications.

Buccal route

- The client must be instructed not to manipulate the medication with tongue; otherwise it could get displaced to the sublingual area, where it would be more rapidly absorbed or to the back of throat , where it could be swallowed.

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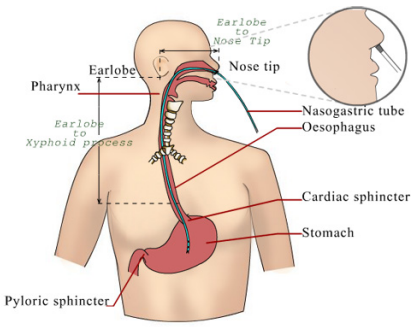
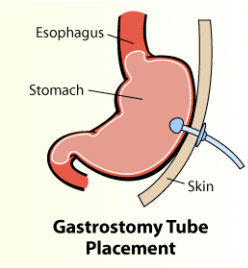
Nasogastric and Gastrostomy Drug Administration

- Generally liquid form are given.
- solid drugs can be given by crushed or dissolved





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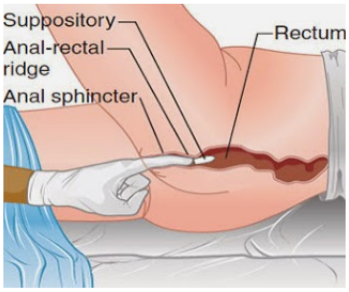
Rectal Route

- Drugs given by the rectal route a most commonly given as suppository or enema.
- Good for the drugs affecting the bowel such as laxatives.
- Examples of drugs administered via this route include Diazepam, indomethacin, paraldehye, ergotamine.



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Rectal Route

Advantages:

- unconscious / vomiting Patient
- Useful –for patients unable to take drugs orally or with younger children.

Disadvantages:

- Not well accepted. May be some discomfort
- Absorption is slower, irregular and often incomplete.
- may cause irritation of rectal mucosa
- Also 50% of the drug absorbed from rectum passes through liver before entering the systemic circulation thus first-pass effect cannot be fully avoided.

Cutaneous

- Highly lipid soluble drug can be applied over the skin for slow, constant and prolong absorption.
- Drugs usually in the form of ointment , cream, or in the form of specially designed device like transdermal drug delivery system are given in this route.
- Liver is by passed.

Local action: Absorption can be enhanced by rubbing the drugs over the skin.

Transdermal Delivery System

- This route of administration achieves systemic effects by application of drugs to the skin in the form of adhesives patches of various shapes and sizes (5-20 cm^2).
- deliver drugs at a predetermined and controlled rate for prolonged period of time (1-7 days).
- Examples: antianginal drug nitroglycerin, antiemetic scopolamine; contraceptive patch (Ortho Evra)
- Site of application: chest, abdomen, upper arm, lower back, buttock
- Site of administration must be rotated and relatively hair free
- Should be carefully discarded after use

Inhalation

- Used for the drugs that are gases or volatile liquid.
- absorbed by pulmonary endothelium and mucous membrane of the respiratory tract and reach circulation rapidly. Thus , this route is almost comparable to the IV route.
- Effective and convenient for patients with respiratory complaints (asthma, chronic obstructive pulmonary disease) because the drug is delivered directly to the site of action.
- Examples of drugs administered via this route include salbutamol and corticosteroids such as fluticasone.

Rectal Route

Advantages:

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Disadvantages:

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Nasal Route

- Involve administration of drugs directly into the nose.
- Nasal cavity has a very rich blood supply
- work quickly
- Applied by:
  - drops (instillation)
  - sprays
  - aerosol (spray under pressure)
- Used for:
  - relief of nasal congestion or allergy symptoms
- Drug that can be administered by nasal route include: Calcitonin for osteroporosis, Sumatriptan for migraine headache, Corticosteroids for allergies

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Parenteral

- The term *parenteral* comes from Greek words (par: meaning beyond and enteral: the intestine)
- Defined as other than through the gastrointestinal tract by injection
- Drugs are directly delivered into tissue fluid or blood.
- Used for drugs that are poorly absorbed from the GI tract (for example heparin) and for agents that are unstable in the GI tract (for example, insulin).
- used for treatment of unconscious patients and under circumstances that require a rapid onset of action.
- these routes have the highest bioavailability and are not subject to first-pass metabolism or harsh GI environments.

Advantages of Parenteral routes

- ✧ Action is rapid (preferred in an emergency)
- ✧ Administered even in unconscious, uncooperative or vomiting patients
- ✧ Gastric irritant can be given parenterally.
- ✧ No chance of interference by food or digestive juices.
- ✧ No first pass metabolism
- ✧ High bioavailability
- ✧ Used in patients who are unable to swallow

Disadvantages of Parenteral routes

- ✧ Preparation has to be sterile (free of microorganisms)
- ✧ Injection may be painful
- ✧ more expensive
- ✧ need another person (Skill) to assist
- ✧ Injury to nerve may occur

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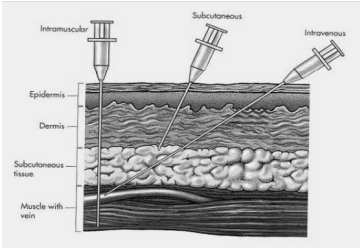
Parenteral

- ➢ The most common routes are:
  - ✓ Subcutaneous (Under the skin)
  - ✓ Intramuscular (Into a muscle)
  - ✓ Intravenous (Into a vein)
  - ✓ Intradermal [Into the dermis (skin)]



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Site of injection

- For SC:
  - ✓ upper arm
  - ✓ Thigh
  - ✓ abdomen
  - ✓ Buttock
- For IM
  - ✓ deltoid
  - ✓ Triceps
  - ✓ Gluteus maximus
  - ✓ Rectus femoris

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Local Routes

- These route can only be used for localized lesions at accessible sites.
- Substance is applied directly where its action is desired.
- Systemic absorption is minimal or absents.
- Thus, higher concentration is attained at the site of desire site without exposing the rest of the body.
- Local routes include:
  - ✧ Topical
  - ✧ Deeper tissues
  - ✧ Arterial supply

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Topical

- Refers to external application of the drug to the surface of the skin.
- Includes administration of drugs to any mucous membrane.
- It is more encouraging and often convenient.

SKIN

- Drug is applied as ointment, cream, lotion, paste, powder for local action.
- Drugs are poorly absorbed through epidermis.
- Absorption through skin can be increased by:
  - ✧ suspending the drug in an oily vehicle and
  - ✧ rubbing the preparation into the skin.

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Topical Cont..

Mucous Membrane

The dosage form depends on the site:

- Mouth And Pharynx- Paints, Lozynges, Mouthwash, Gargles.
- Eyes, Ear, Nose- Drops, Ointments, Irrigation, Spray.
- Git- Nonabsorable Drugs Given Orally.
- Bronchi And Lungs- Inhalations, Aerosols.
- Urethra- Jellys
- Vagina- Peseries, Vaginal Tablets, Cream.
- Anal Canal- Ointments.

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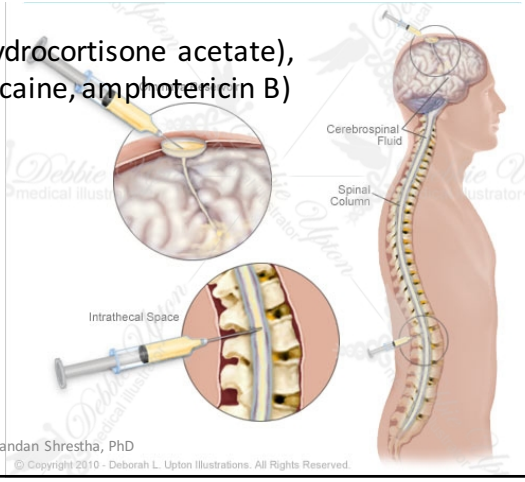
Deeper tissues

- Certain deep areas can be approached by using a syringe and needle but the drug should be such that systemic absorption is slow.
- intra-articular injection (hydrocortisone acetate), intrathecal injection (lignocaine, amphotericin B)



Arterial Supply

- Close intra-arterial injection is used for contrast media in angiography; anticancer drugs can be infused in femoral or brachial artery to localize the effect for limb malignancies.
- This route requires specialist training to administer therapeutic agents as if the artery is missed, possible damage to adjacent nerves may results.

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Which route to administer the drugs?

Routes of Drug Administration

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Why is selection of proper route important?

- For proper effect.
- Some drugs are effective after administration through one site but are not effective at all when administered through other sites.
- For example, insulin reduces the blood sugar level when administered subcutaneously but not effective at all after oral administration.
- Antacids do not antagonize gastric acid after parenteral administration. To get proper effect it should be administered orally.

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Factors affecting Selection of Route of Administration

- Physicochemical properties of drugs (solid/liquid/gas; solubility, pH, irritancy)
- Site of desired action (localized and approachable or generalized and non approachable)
- Rate and extent of absorption of the drug from different routes
- Effect of digestive juice and first pass metabolism of drugs
- Rapidity at which response is desired (Parenteral)
- Accuracy of dosage required (iv; inhalational)
- Condition of patients (unconscious, vomiting)
- Adverse effects
- Ease of administration

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Physicochemical properties of a drug determine which route is ideally suited for its pharmacological effect(s). For example, antacids will do well in gastric environment whereas benzylpenicillin will get inactivated at the same setup.

Site of desired action: Administration of drug to the site of action may reduce the required dose of a drug. E.g. 2 drops of timolol (0.5%) solution, one to each eye (less than 1 mg), can equate to 10 mg by mouth. 200 µg of salbutamol by inhalational route is more effective than 2 mg of the same drug by oral route.

Onset of Action: There are some clinical conditions where rapid onset of action of drugs are required. In that case, most of the drugs are administered parenterally. In case of status epilepticus, diazepam is administered by parenteral route.

Liquid solutions or suspensions work faster than tablets or capsules.

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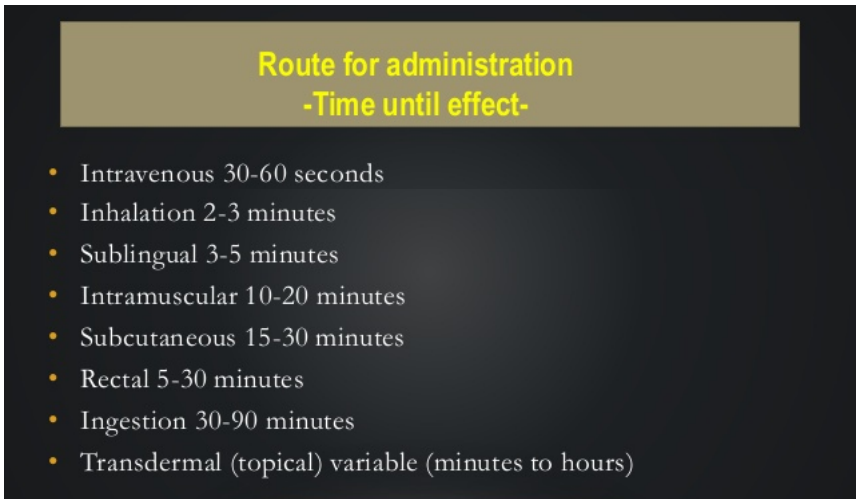
Duration of action of drugs can be modified by administering it by different routes.

- *Controlled or Extended release tablet* may last for 12-24 h compared to 4-6 h for same drug *in immediate release tablet*.
- Im or sc last longer than iv.
- For example, if soluble insulin is administered intravenously its effects will be terminated very soon. But the effects will be prolonged by subcutaneous administration of insulin.

Effect of digestive juices and first pass metabolism: these break down active drugs to inactive metabolites before reaching systemic circulation. For eg: Morphine is usually administered parenterally. It is absorbed from the GIT after oral administration but has high first-pass biotransformation. Insulin degrade by gastric pH so administer via sc route.

Adverse effects of drugs

The route selection sometimes prevents or reduces the adverse effect(s) or exaggerated response. For example, salbutamol is well tolerated inhalationally than oral route Chandan Shrestha, PhD



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