UNIT –I

INTRODUCTION TO PHARMACOLOGY

Introduction

Pharmacology:

- Can be defined as the study of substances that interact with living systems through chemical processes, especially by binding to regulatory molecules and activating or inhibiting normal body processes.
- **Pharmacology** comes from two Greek words “pharmacon” (poison) and “logus” (study).

- The two main divisions of pharmacology are:

  Pharmacodynamics and pharmacokinetics.

- **Pharmacodynamics-** What the drug does to the body.
- This includes physiological and biochemical effects of drugs and their mechanism of action at organ system levels,

  E.g. Adrenaline → interaction with adrenoceptors

  → increased cardiac stimulation, hepatic glycogenolysis

  and hyperglycaemia, etc.

- **Pharmacokinetics-** What the body does to the drug.
- This refers to movement of the drug in and alteration of the drug by the body; includes absorption, distribution, biotransformation and excretion of the drug,

  E.g. - Paracetamol is rapidly and almost completely absorbed orally attaining peak blood levels at 30–60 min;

Definition of some Terms:

- **Drug:** Derived **from** 'drogue' French='dry herb'

➢ Defined as any substance that is used for the prevention, diagnosis or treatment of disease.

The WHO (1966) - more comprehensive definition is-

"Drug is any substance or product that is used or is intended

to be used to modify or explore physiological systems or

pathological states for the benefit of the recipient."

- **Dose**: The quantity of drug which is sufficient to diagnose, prevent, or treat a disease.
- **Dosage**: The schedule of dose, frequency and duration of administration.
- **Mechanism of Action**: “How the drug exerts its action”
- **Effects (therapeutic effects)**: “The desired results of administration of a medication”

- **Side Effects (adverse effects)**: “Effects that are harmful and undesired, and that occur in addition to the desired therapeutic effects”
- **Indications:** “The reasons for administering a medication or performing a treatment”
- **Contra-indications**: “Factors that prevent the use of a medication or treatment (e.g., Allergies)”
- **Receptor :**“A specific protein in either the plasma membrane or interior of a target cell with which the drug combines”

Sources of Medications/Drugs

- Naturally occuring compounds(oldest Source)
  - ✓ **Plants : morphine sulfate, atropine**
  - ✓ **Animals: insulin, thyroxin, heparin, ACTH**
- Modified Natural drugs
  - ✓ **Semi synthetic penicillin**
  - ✓ **Porcine insulin**
- Microbial source: eg. Penicillin
- **Minerals-**Sodium, calcium, magnesium, aluminum, sulfur…
- Synthetic (Chemical Substances) -lidocaine, diazepam,sulpha drugs
- Genetic engineering **eg.** Recombinant Insulin

Properties of an Ideal Drug-

- The ideal medication exists in theory only:

  In reality, there's no such thing as a perfect drug.

- The three most important characteristics that any drug can have are: **Effectiveness**, **Safety**, and **Selectivity**.

Effectiveness

- ✓ An effective drug is one that elicits the responses for which it is given.
- ✓ Effectiveness is the most important property a drug can have.
- ✓ If a drug is not effective (if it doesn't do anything useful) there is no justification for giving it.

Safety

- ✓ A safe drug is defined as one that cannot produce harmful effects even if administered in very high doses and for a very long time.

  There is no such thing as a safe drug.

- ✓ All drugs have the ability to cause injury, especially with high doses and prolonged use.
- ✓ The chances of producing adverse effects can be reduced by proper drug selection and proper dosing.

Selectivity

- A selective drug is defined as one that elicits only the response for which it is given.
- A selective drug would not produce side effects.
- There is no such thing as a selective drug:

All medications cause side effects.

Additional Properties of an Ideal Drug

- Reversible Action
- Predictability
- Ease of Administration
- Freedom from Drug Interactions
- Low Cost
- Chemical Stability
- Possession of a Simple Generic Name

➢ **No Drug Is Ideal …**

The “Six Rights” of Medication Administration

- ✓ Right Medication
- ✓ Right Dose
- ✓ Right Time
- ✓ Right Route
- ✓ Right Patient
- ✓ Right Documentation

- They guarantee only that a drug will be administered as prescribed.
- Cannot ensure that treatment will result in maximum benefit and minimum harm.

Application of Pharmacology In Patient Care

- **The two major areas are:**
  1. **Patient care ,and**
  2. **Patient education.**
- **Seven aspects of drug therapy:**

- **Pre administration assessment,**
- **Dosage and administration,**
- **Evaluating and promoting therapeutic effects,**
- **Minimizing adverse effects,**
- **Minimizing adverse interactions,**
- **Making PRN decisions, and**
- **Managing toxicity.**

Preadministration Assessment:

- Is the beginning step of all drug therapy
- Has three basic goals:

1. **Collecting baseline data:**

   Needed to evaluate therapeutic and adverse responses,

2. **Identifying High-Risk Patients:**

   Help us to identify important predisposing factors such as:

- ✓ Path physiology (especially liver and kidney impairment),
- ✓ Genetic factors, drug allergies, pregnancy, old age, and extreme youth.

3. **Assessing the patient's capacity for self-care**

Nomenclature of drugs (Drug Names)

- **Chemical Name**
  - ✓ Precise description of the drug's chemical composition and molecular structure

    E.g. 7-chloro-1, 3-dihydro-1methyl-5-phenyl-2H-1, 4-benzodiazepin-2-one
- **Generic Name (Non-proprietary Name)**
  - ✓ Official name approved by the FDA
  - ✓ Usually suggested by the first manufacturer

    E.g. Diazepam

- ✓ Official Name
  - ✓ The name assigned by the USP - diazepam, USP
- Trade Name (Proprietary Name)
  - ✓ The brand name registered to a specific manufacturer or owner

E.g. **Altol, atcardil, atecor, aten, betacard, lonol, tenolol, tenormin - Are trade names** for **Atenolol** from different manufacturers.

Routes of Drug Administration (RDA)

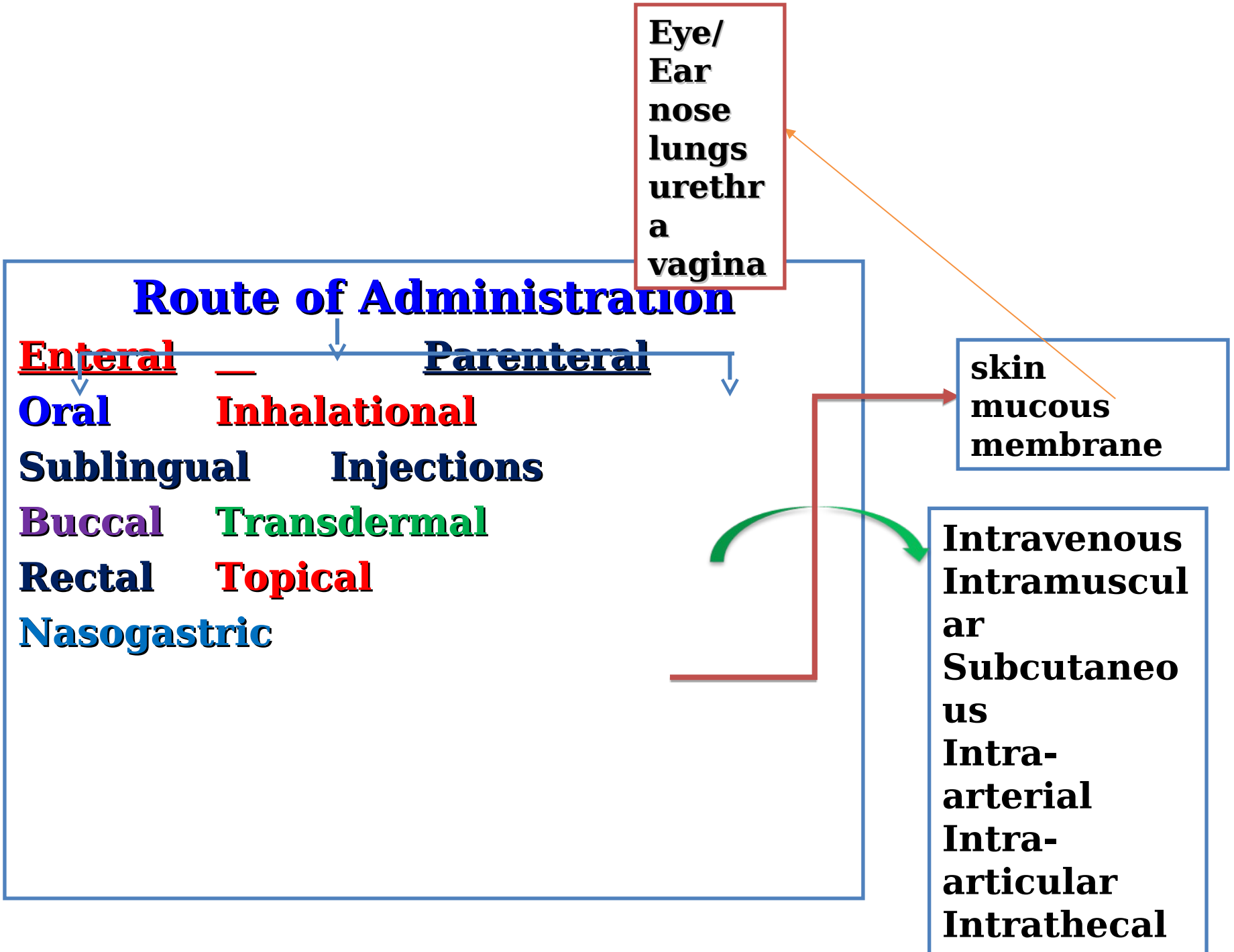
- Drugs can be administered in to the body via different routes:

✓ **Enteral**: enters the body by way of alimentary canal or digestive system

✓ **Parenteral:** All drugs given by injection and other extra alemenrtary tract

✓ **Topical**

✓ **Inhalations**


Eye/
Ear
nose
lungs
urethr
a
vagina
Route of Administration
Enteral
Parenteral
Oral
Sublingual
Buccal
Rectal
Nasogastric
Inhalational
Injections
Transdermal
Topical
skin
mucous
membrane
Intravenous
Intramuscul
ar
Subcutaneo
us
Intra-
arterial
Intra-
articular
Intrathecal

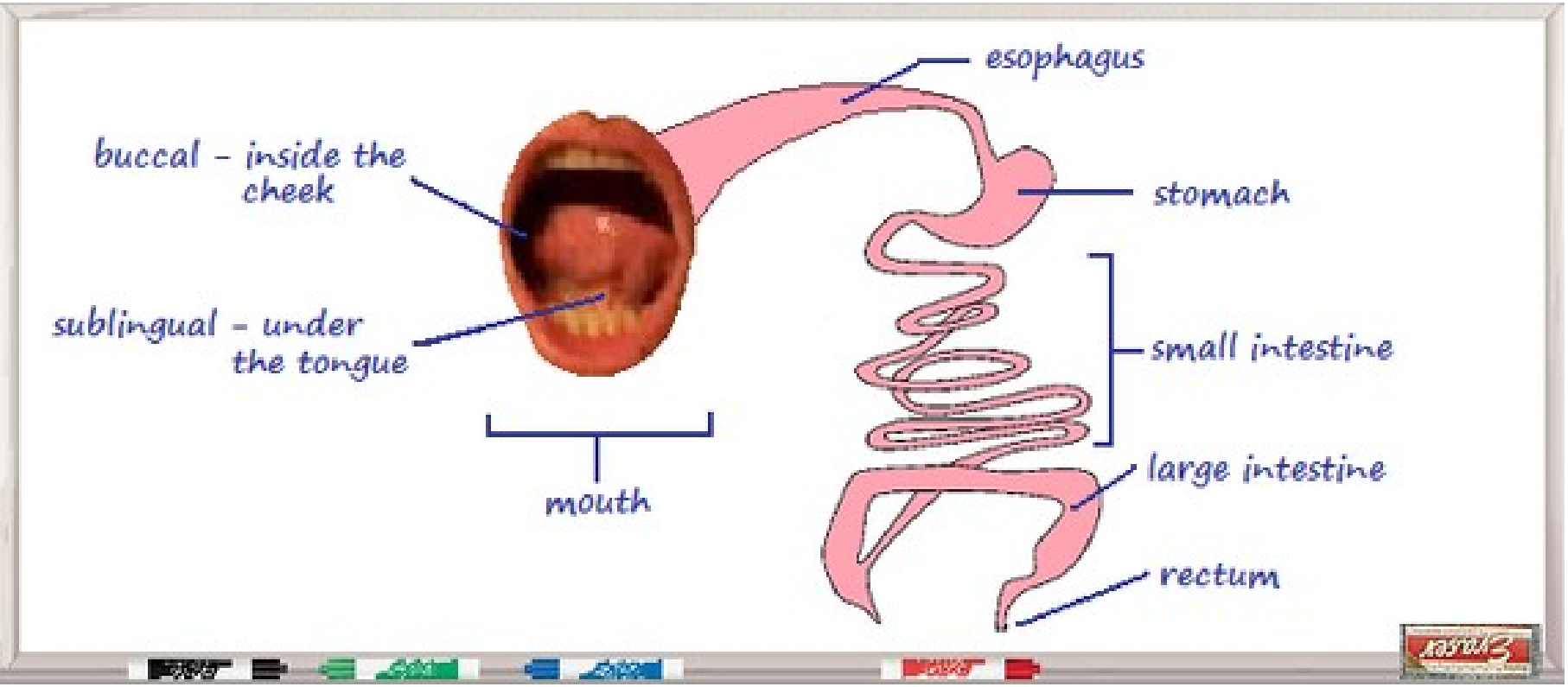


Fig. Enteral routes of drug administration

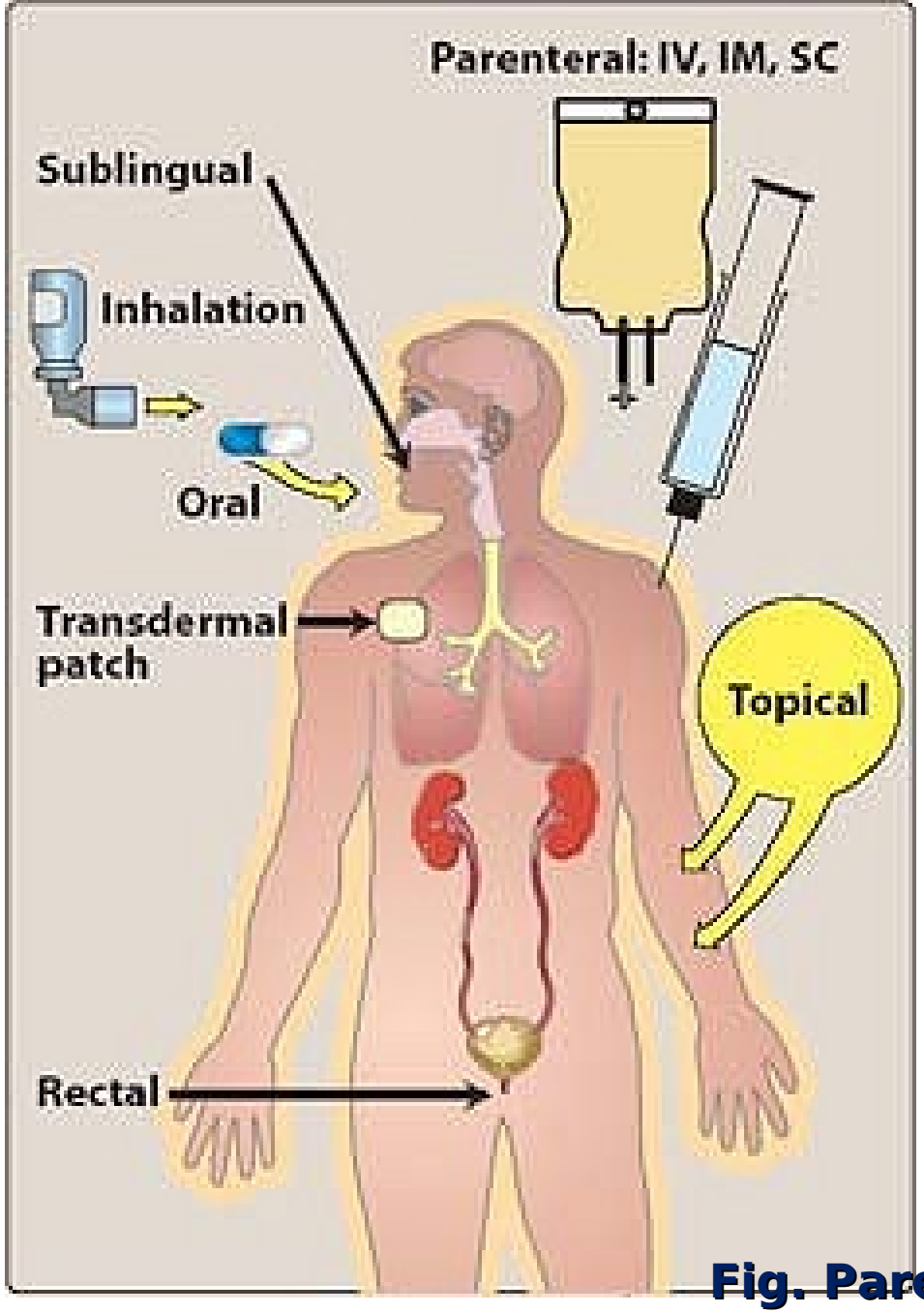


Fig. Parentral and other routes of drug administration

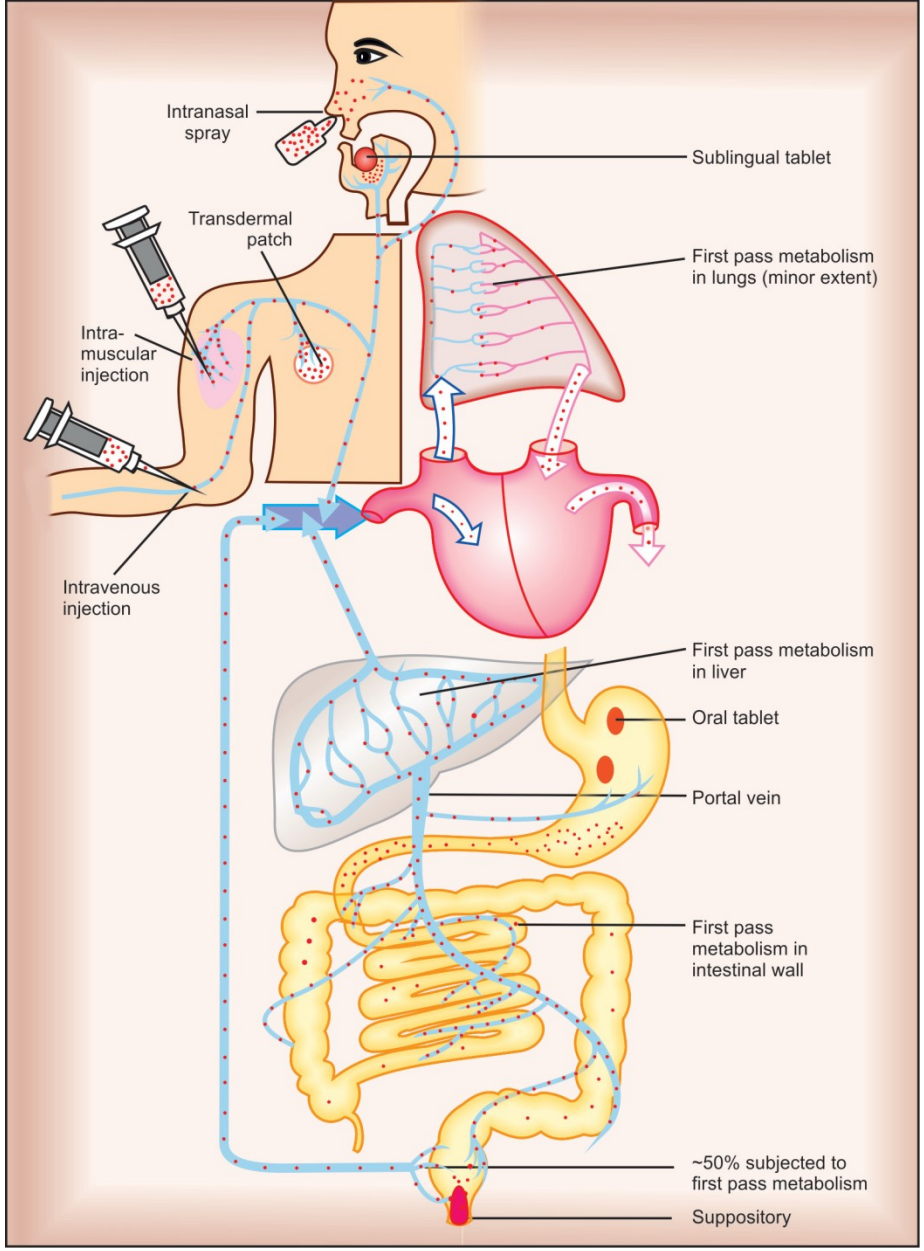


Fig. Vascular pathway of drugs absorbed from various systemic routes of administration and sites of first pass metabolism.

- **Via alimentary canal**

✓ Buccal cavity ,(sublingual) e.g. nitrates

✓ Intestine e.g. most drugs

✓ Rectum e.g. suppositories, enema

Advantage of oral root

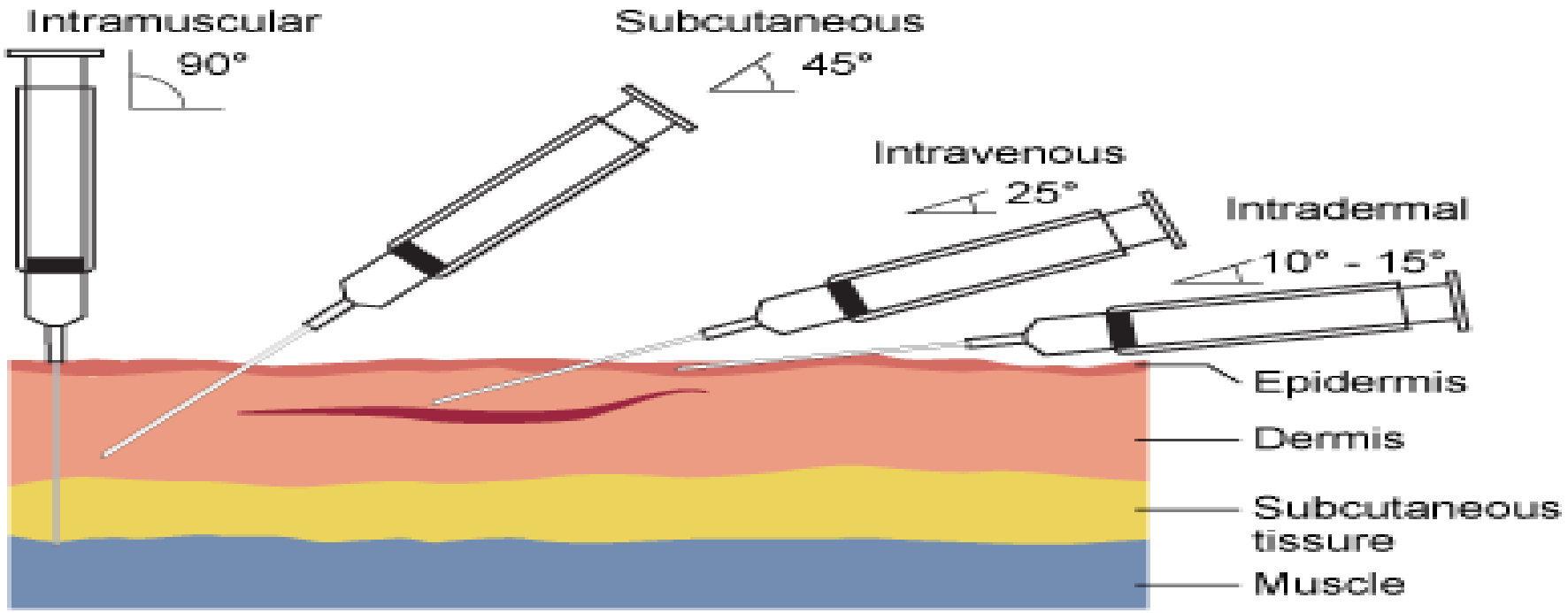
✓ Safe , Convenient ,Economical

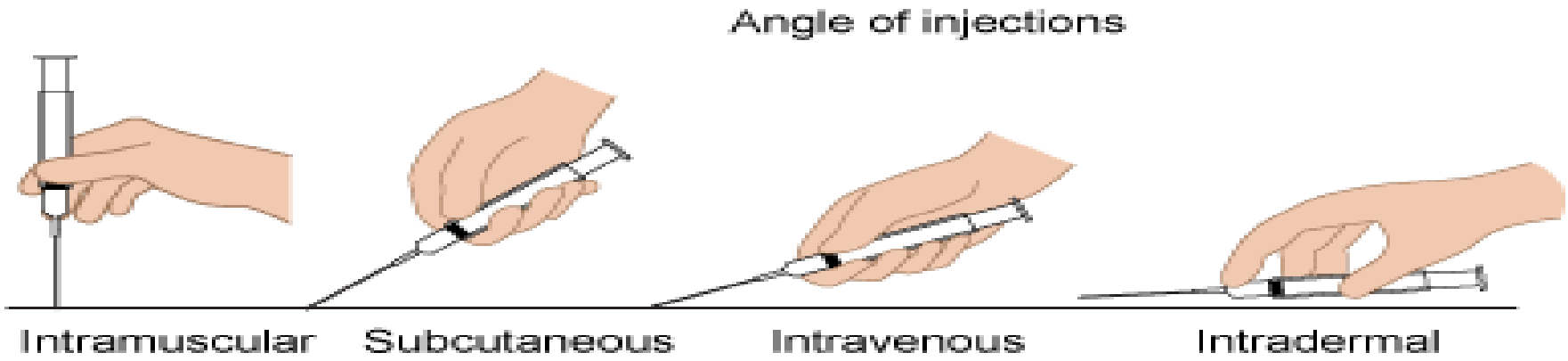
Limitations of Oral Route of Administration;

1. Action of drugs is slower and thus not suitable for emergencies.
2. Unpalatable drugs (chloramphenicol) are difficult to administer; drug may be filled in capsules to circumvent this.
3. May cause nausea and vomiting (emetine).
4. Cannot be used for uncooperative/unconscious/ vomiting patient.
5. Absorption of drugs may be variable and erratic; certain drugs are not absorbed (streptomycin).
6. Others are destroyed by digestive juices (penicillin G, insulin) or in liver (GTN, testosterone, lidocaine).

Parental route of Administration

- **Intra dermal:** given into the layers of skin e.g. BCG
- **Subcutaneous:** non irritant substances are given into subcutaneous tissue e.g. Insulin
- **Intra muscular**: soluble substances, mild irritants suspensions and colloid, given to deltoid or gluteal muscle e.g. Multivitamines, streptomycin


Intramuscular
90°
Subcutaneous
45°
Intravenous
25°
Intradermal
10° - 15°
Epidermis
Dermis
Subcutaneous tissure
Muscle


Angle of injections
Intramuscular
Subcutaneous
Intravenous
Intradermal

Advantages:

- ✓ Rate of absorption is uniform
- ✓ Faster onset of action than oral
- ✓ Not affected by diarrhea or vomiting

Disadvantage

- ✓ Pain at site of injection
- ✓ Large volume can’t be administered (Max of 10 ml.)

Intravenous –

- ✓ Directly given in to veins given as a bolus or continuous infusion

Advantages

- ✓ Large volume can be given
- ✓ Easy to produce desired concentration in blood
- ✓ Rapid onset of action (no absorption)

Disadvantage:

- ✓ Difficult to stop drug action
- ✓ Needs skill for administration

Intrathecal :

- ✓ Drug injected into sub arachnoids space of spinal cord

  eg. Spinal anesthesia

Intraperitonical –

- ✓ Injection given into the abdominal cavity

  e.g. Glucose, infant saline

Intra articular-

- ✓ Injected directly into a joint

  e.g Hydro cortisone

Topical/ local route

- ✓ Application of drugs such as powder paste, lotion, ointments etc on skin

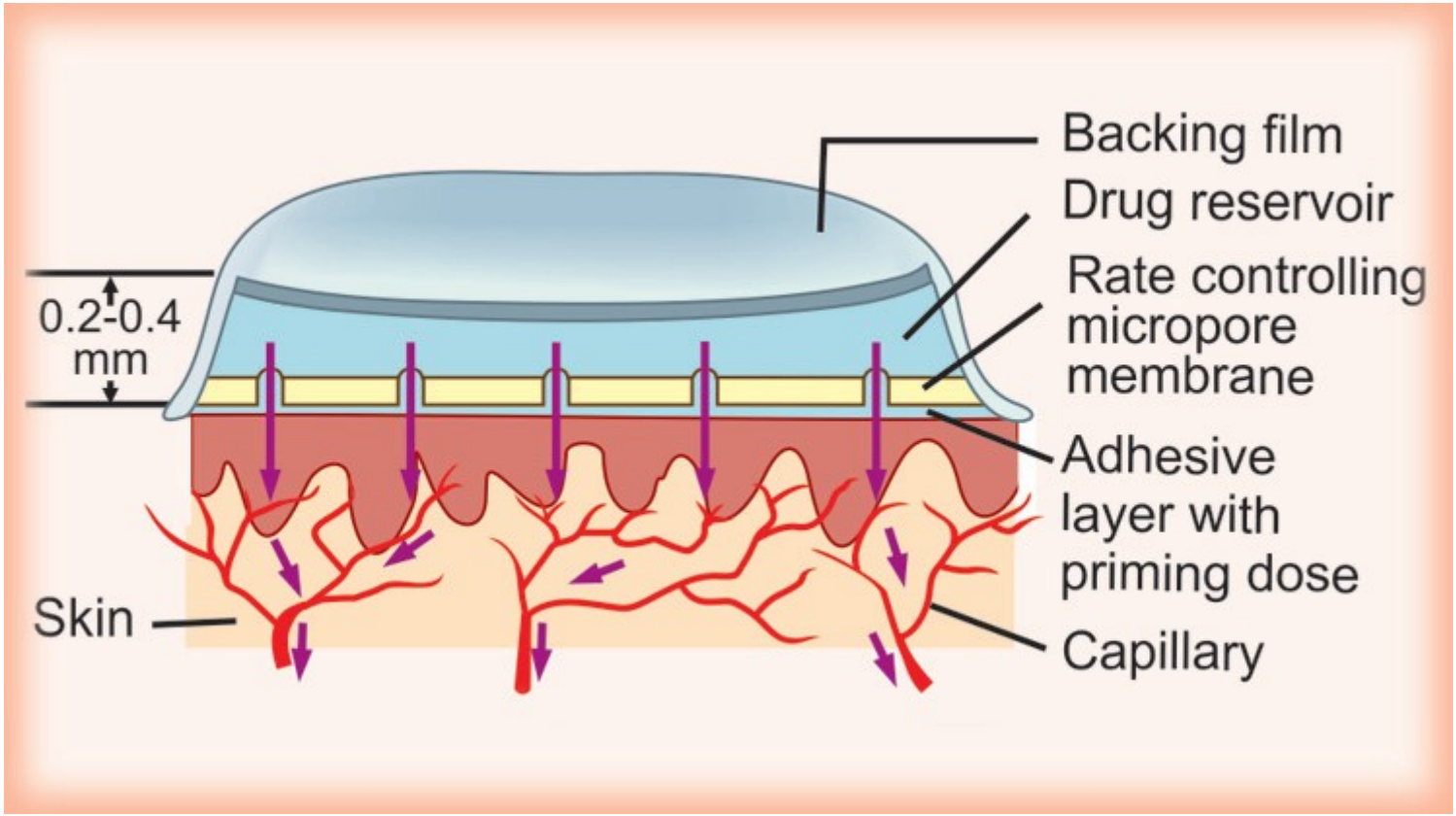


Fig. Illustration of a transdermal drug delivery system

Inhalation

- Drugs may be administered as dry powders and nebulized particles when sprayed as fine droplets (by inhalation) get deposited over the mucus membrane producing local or systemic effects

  e.g. Salbutamol spray, inhaled anesthetics

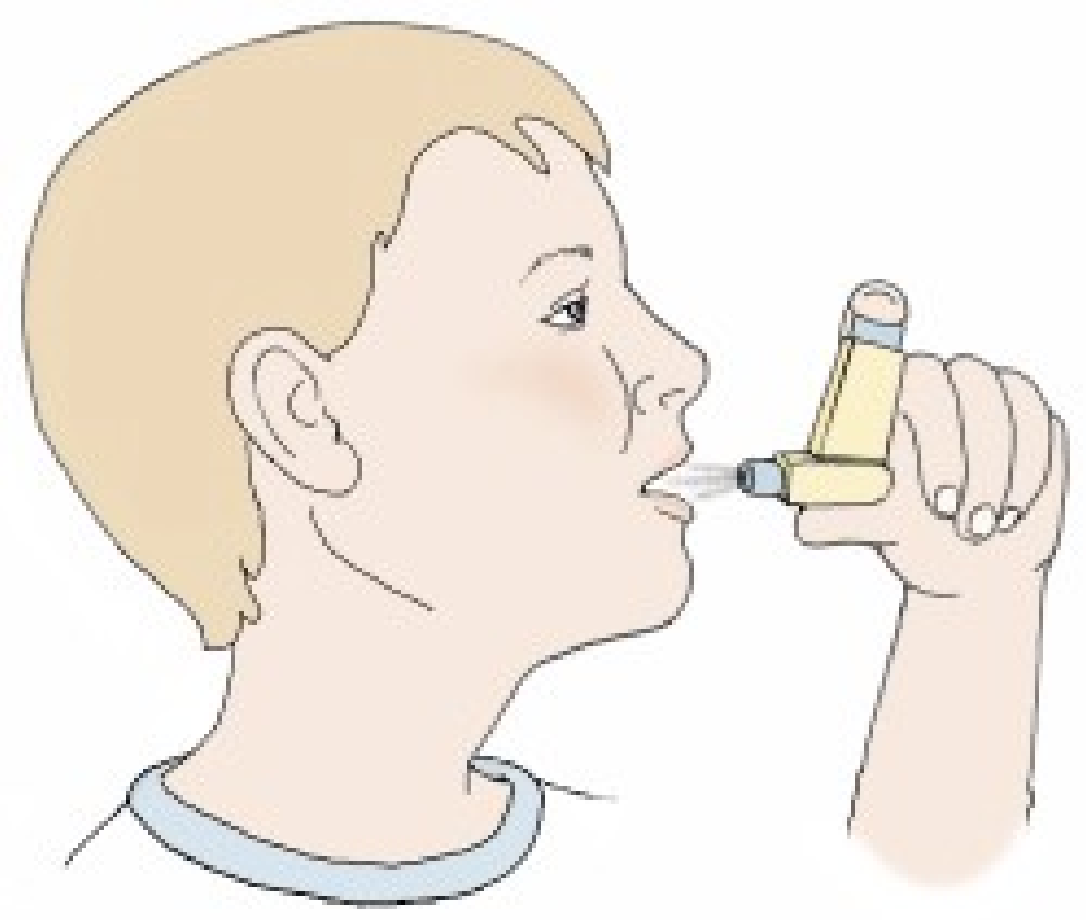


Fig. A respiratory inhalant is used to deliver a drug directly into the lungs.

Factors governing choice of route :

1. Physical and chemical properties of the drug (solid/ liquid/gas; solubility, stability, pH, irritancy).
2. Site of desired action—localized and approachable or generalized and not approachable.
3. Rate and extent of absorption of the drug from different routes.
4. Effect of digestive juices and first pass metabolism on the drug.
5. Rapidity with which the response is desired (routine treatment or emergency).
6. Accuracy of dosage required (i.v. and inhalational can provide fine tuning).
7. Condition of the patient (unconscious, vomiting