



**UNIT 1**  
**CONTROLLED DRUG DELIVERY**  
**SYSTEMS**

**Dr. Meenakshi Gupta**  
**Senior Assistant Professor**  
**University Institute of Pharmacy**  
**C. S. J. M. University Kanpur U.P**

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- **Physicochemical and biological properties of drugs relevant to controlled release formulations**



**INTRODUCTION  
TO  
NOVEL DRUG DELIVERY SYSTEMS**



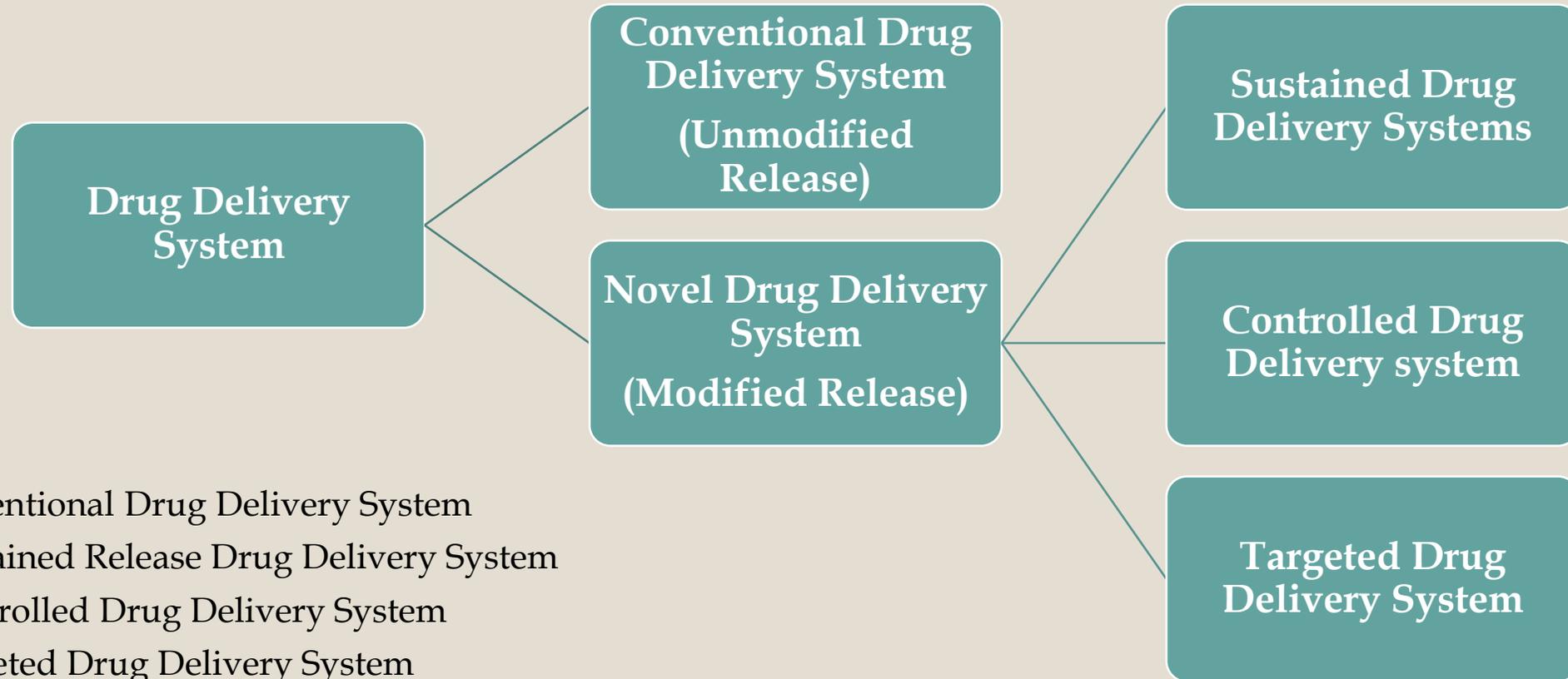
## DISEASE

- A **diseases** is a specific abnormal condition that negatively affects the structure or function of all or part of an organism.
- **Diseases** are often known to be medical conditions that are associated with specific symptoms and signs.
- **Acute disease** last for short time and person recover completely within short duration of time (eg. Cold, flu, cough etc.) whereas
- **Chronic disease** last for long time and patient do not recover completely(diabetes, cancer, rheumatic arthritis etc.)

# What is drug delivery?

- Drug delivery is the method of administering pharmaceutical compound(drugs) as formulation to achieve a therapeutic effect in humans or animals to cure disease safely.
- used to improve health and to extend lives

# Drug Delivery System



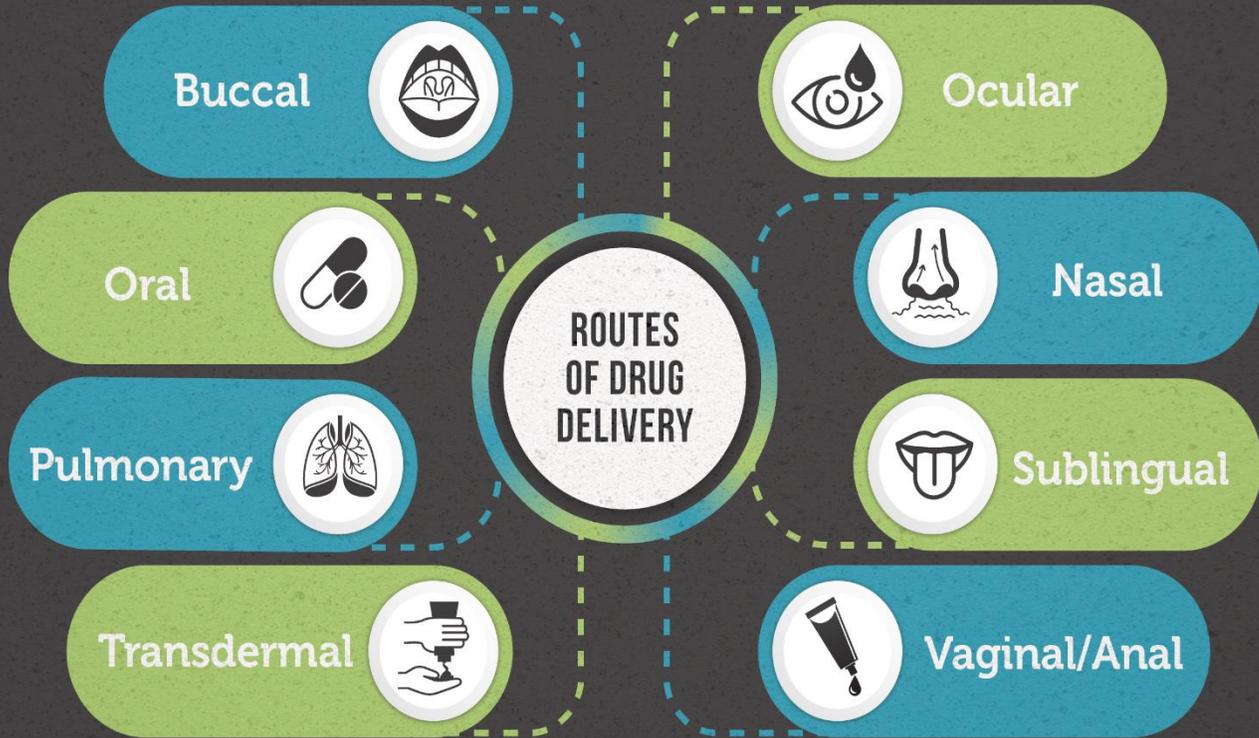
1<sup>st</sup> gen. – Conventional Drug Delivery System

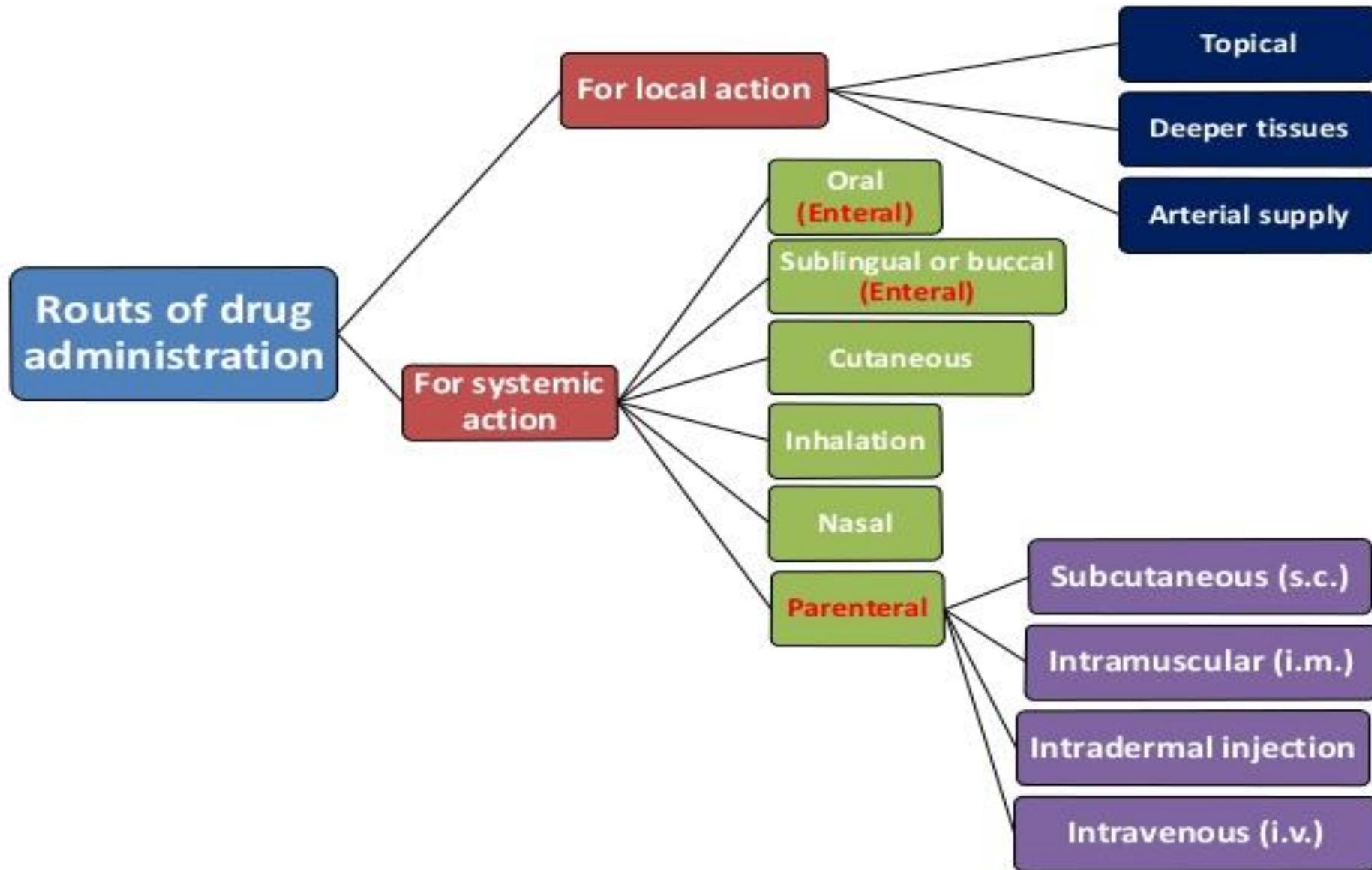
2<sup>nd</sup> gen. – Sustained Release Drug Delivery System

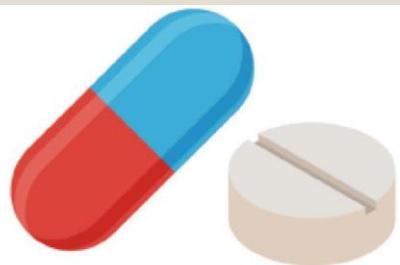
3<sup>rd</sup> gen. – Controlled Drug Delivery System

4<sup>th</sup> gen. – Targeted Drug Delivery System

# Conventional Drug Delivery System







## DOSAGE FORM

Oral administration  
↓  
Disintegration

Drug in the  
gastrointestinal tract

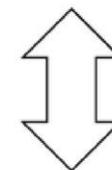
Dissolution  
↓  
Absorption

Drug in blood  
plasma

Drug in the  
tissues and fluids

↑  
Distribution

Free drug



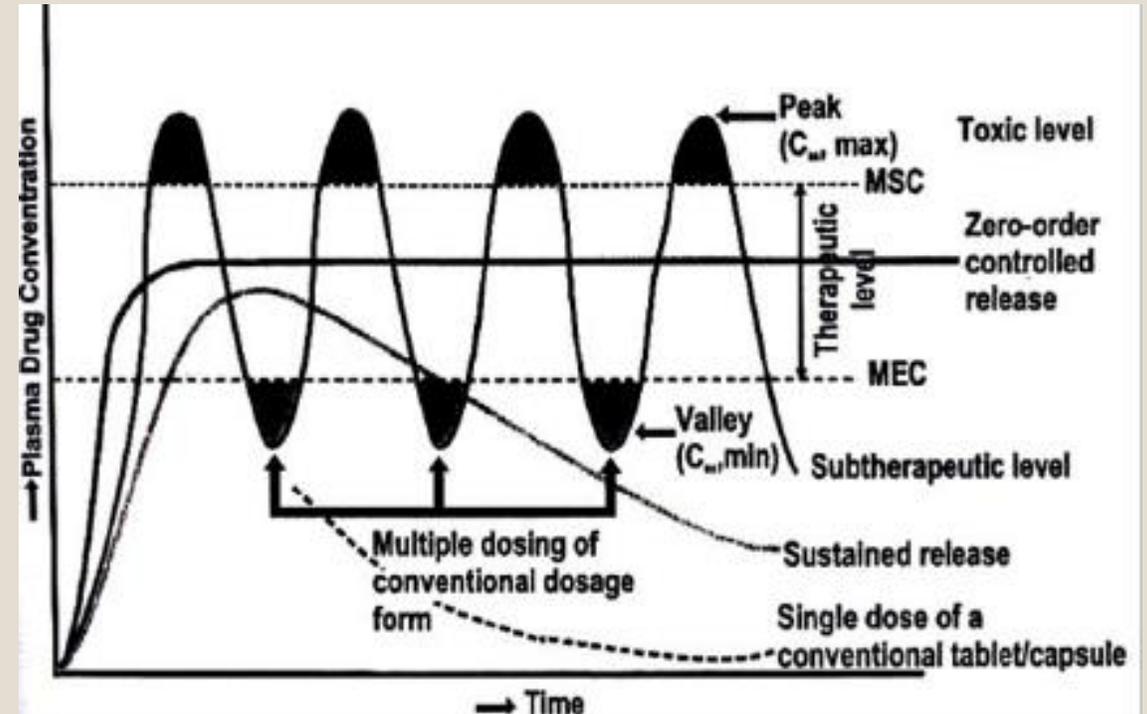
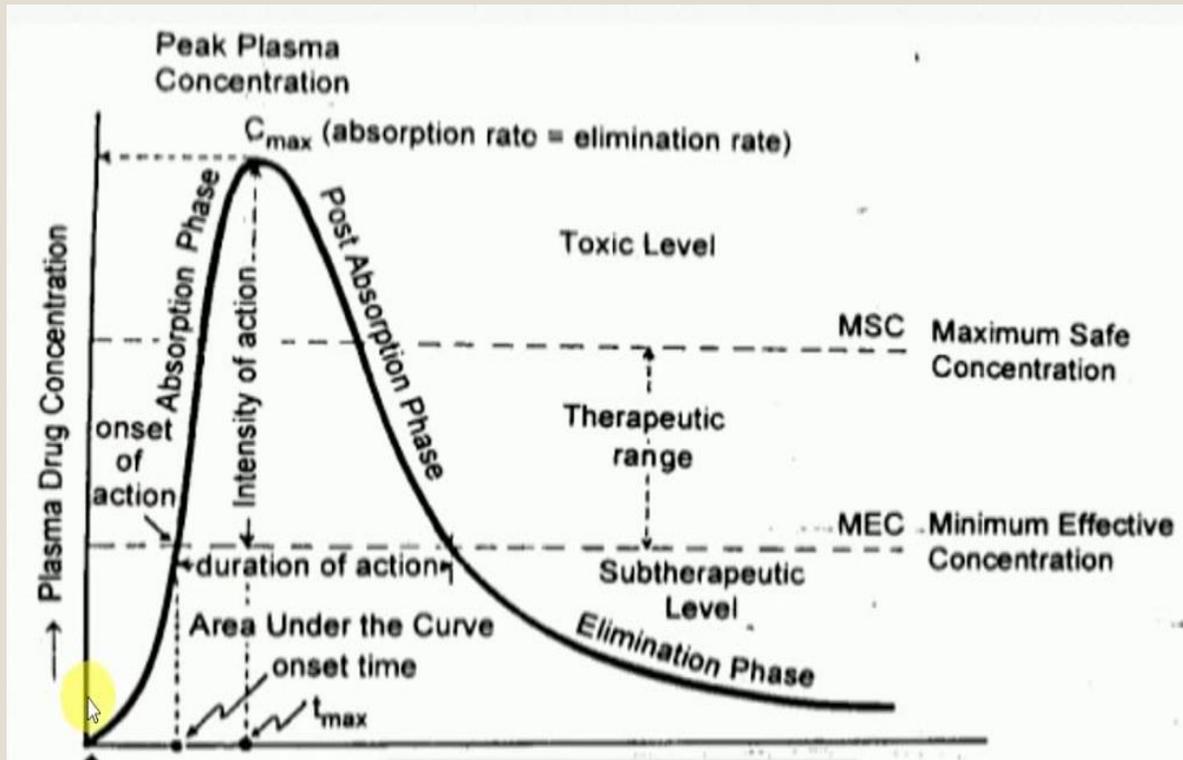
Drug bound to plasma  
proteins

PHARMACOLOGICAL  
EFFECT



Drug in the site  
of action

# Conventional Drug Delivery System: Drawbacks



**Bioavailability Issues**

**Drug degradation is more**

**Stability problems**

**Non – targeted approach**

**Stability problems**

**Un-equal drug distribution and metabolism**

**Therapy time is more and drug resistance issues**

**Less availability of drugs at infected site**

**Problems with conventional drug delivery systems**

# Challenges in drug delivery

1. Dosage form requires- large dose
2. Even biodistribution of pharmaceutical's throughout the body
3. frequent administration required therefore poor patient compliance
4. Fluctuations in drug plasma level
5. The lack of drug specific affinity towards a pathological site.
6. show toxicity and other adverse side effects
7. lacks extended duration
8. Poor accessibility to target receptors in some diseases like rheumatic arthritis, leishmaniasis ,BBB etc

# “Ideal” Drug Delivery System

- Inert
- Biocompatible
- Mechanically strong
- Comfortable for the patient
- Capable of achieving high drug loading
- Readily processable
- Safe from accidental release
- Simple to administer and remove
- Easy to fabricate and sterilize
- Free of leachable impurities

*“Right amount of drug at right place”*

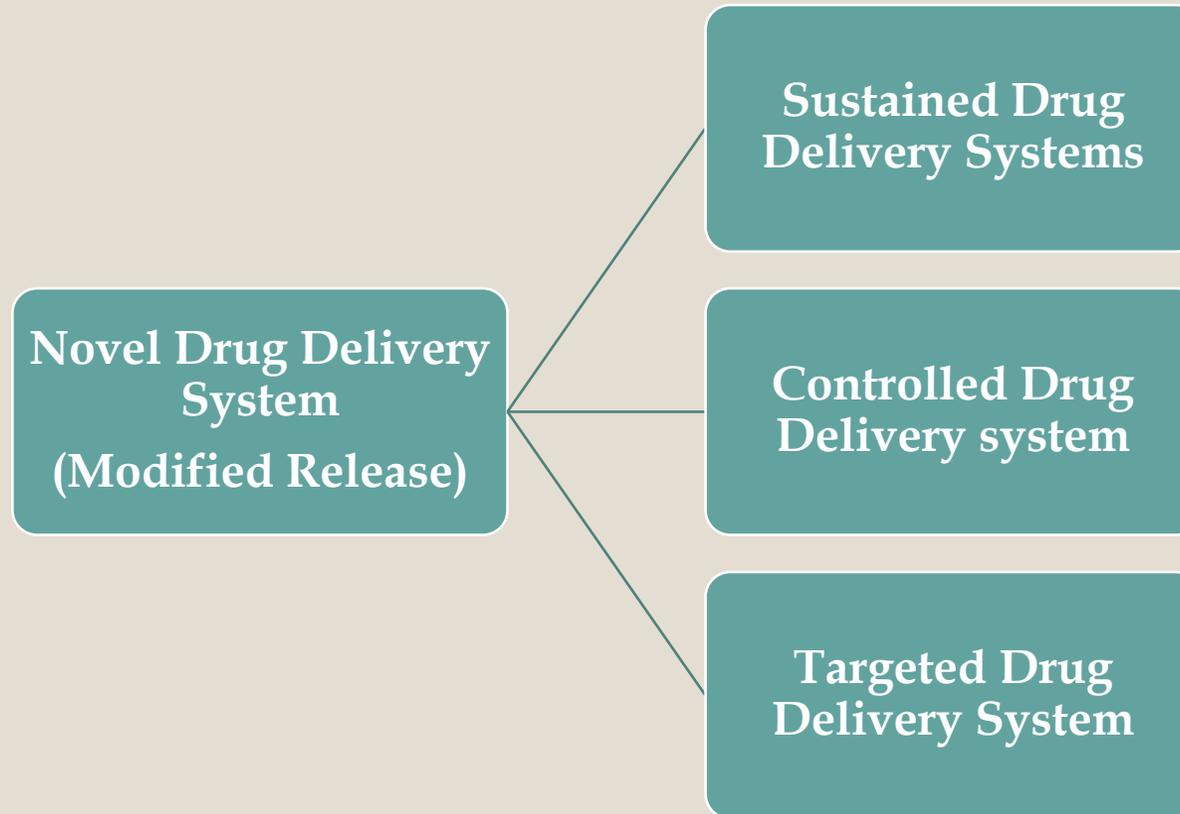
# Novel Drug delivery system (Modified Release Systems)

- Practice of drug delivery has changed
- To improve **efficacy and safety** various drug delivery approaches/technologies are being used that modify
  - drug release profile,
  - absorption,
  - distribution
  - Metabolism &
  - elimination
- Modified drug release system control
  - the **rate** at which a drug is released (Controlled Drug Delivery Systems)
  - the **location** in the body where it is released
  - Some systems can control both(Targeted Drug Delivery Systems)

# What is Novel Drug Delivery means?

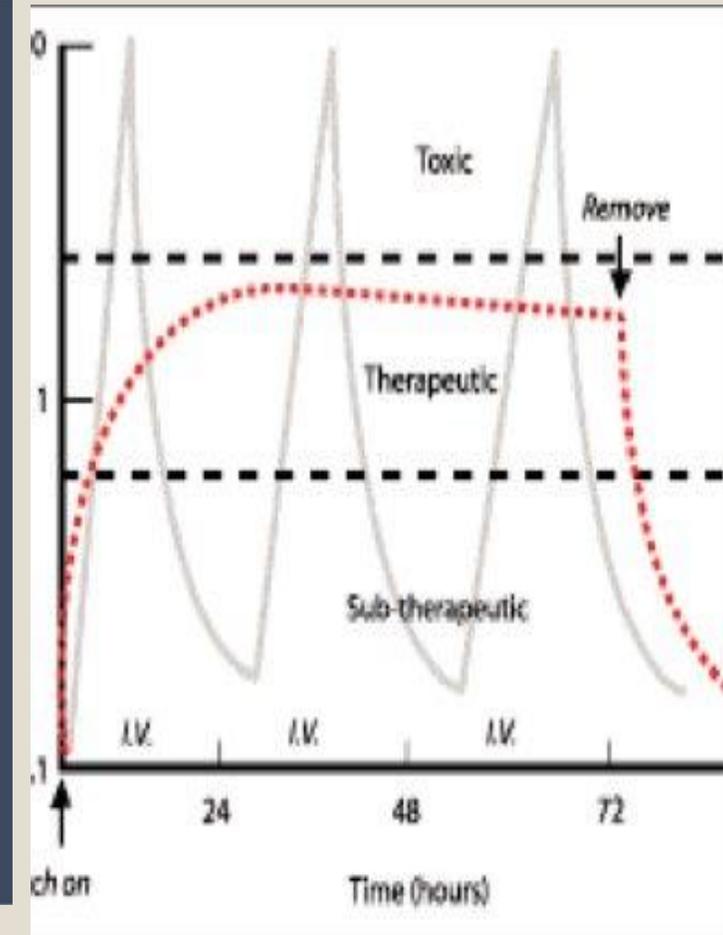
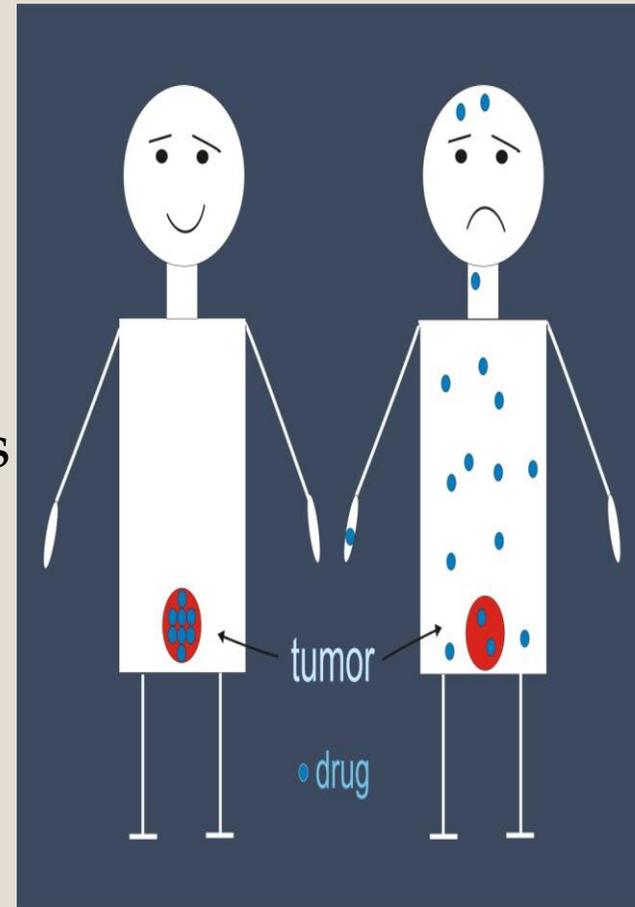
- Novel drug delivery is a method of delivering medication in a manner that **increases the concentration of the medication in certain parts of the body** and reduce the toxicity and side effects.

# Novel Drug Delivery System



# Advantages of Novel Drug Delivery System

- Maintains drug plasma concentration within the therapeutic window.
- Eliminate over or under dosing
- Decreased in dosing frequency
- Increased patient compliance
- Reduced /Prevention of side effects
- Enhanced bioavailability
- Site specific action



# Terminology/Definitions

## Conventional Drug Delivery System

Provide a prompt release of drug and also called **Immediate Drug Delivery system**. Unable to control neither rate nor site of action

## Sustained Drug Delivery System(Prolong/Retarded Release)

Dosage form formulated to **retard the release** of drug in systemic circulation and its plasma profile is prolonged/sustained

## Controlled Released System

Advanced drug delivery system capable of controlling release rate of drug. CDDS is not only **predictable** but also **reproducible** from one unit to another.

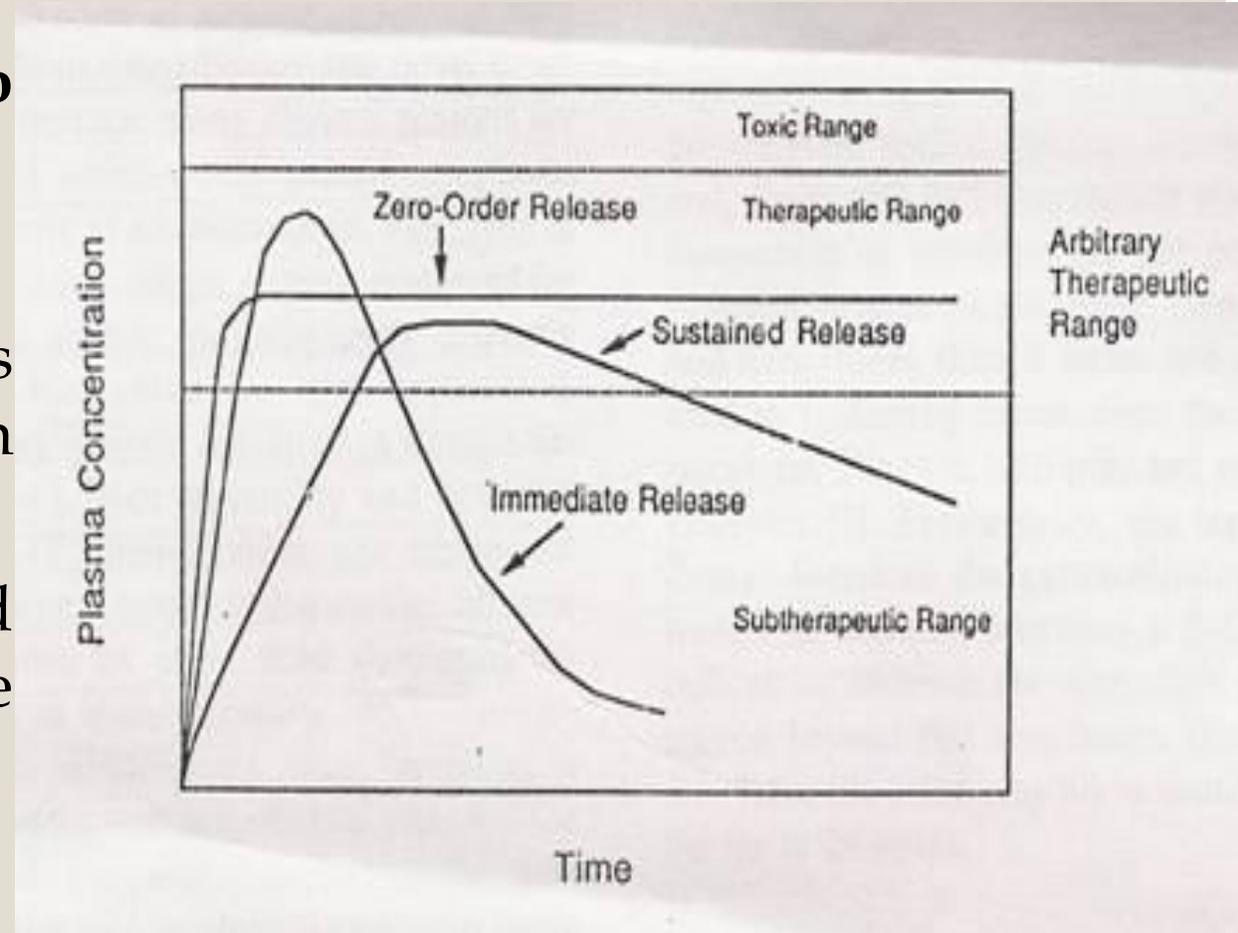
# Terminology/Definitions

- **Controlled Drug Delivery System/Zero order/Constant Release System)**

## Zero Order Release

Drug release from the dosage form is independent of amount of drug in delivery system

To maintain constant drug blood concentration for extended period of time Zero order release system is used



# Terminology/Definitions

## Targeted Drug Delivery System

- A special form of DDS where medicament is selectively targeted, delivered/released only to its site of action and absorbed and not to the non-target organs or tissues or cells.
- Targeted drug delivery implies for selective and effective localization of pharmacologically active moiety at **pre identified** (preselected) target in therapeutic concentration, while restricting its access to non-target normal cellular linings, thus minimizing toxic effects and maximizing therapeutic index.
- Targeting is the ability to direct the drug-loaded system to the site of interest



- **Sustained Drug Delivery System-** do not show real zero order release
- **Controlled Released System-** show real zero order release
- **Targeted Drug Delivery System-** show controlled real zero order release and site specific release

# Rationale of CDDS

- The basic idea behind controlled drug delivery approach is to alter the pharmacokinetics and pharmacodynamics of drug using NDDS either by modifying
  - Molecular Structure or
  - Physiological parameter by changing route of administration
- Primary objective of CDDS is to
  - Ensure safety
  - Improve efficacy & patient compliance

# CDDs: Advantages & Disadvantages

## Advantages :

1. Less fluctuation in drug blood levels.
2. Frequency reduction in dosing.
3. Improved patient convenience & compliance.
4. Increased safety margin of the high potency drugs.
5. Reduction in total health care cost.

## Disadvantages :

1. Decreased systemic availability in comparison to immediate release conventional dosage forms.
2. Poor in vivo – in vitro correlation.
3. Possibility of dose dumping.
4. Retrieval of drug is difficult.
5. Higher cost of formulation

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**THANK  
YOU**

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