Novel Drug Delivery Systems: - A Modern Approach to Targeted Therapy

Ms. Rutuja Sanjay Gadhave
Sakeshwar Collage of Pharmacy

***Abstract*—Novel Drug Delivery Systems (NDDS) are transforming the way medicines are delivered in the body. Traditional drug delivery methods often lack precision, which can lead to side effects and reduced effectiveness. NDDS focus on delivering drugs directly to the targeted site, improving therapeutic outcomes and minimizing harm to healthy tissues. These systems use advanced technologies such as nanoparticles, liposomes, and controlled-release formulations to enhance drug stability, absorption, and efficiency. This review highlights the basic concepts, advantages, types, and recent advancements in novel drug delivery systems, emphasizing their role in targeted therapy and future potential in modern healthcare.**

***Index Terms*—Novel Drug Delivery Systems (NDDS), Targeted Therapy, Controlled Drug Release, Nanotechnology, Liposomes, Drug Carriers, Therapeutic Efficiency, Drug Targeting**

I. INTRODUCTION

In recent years, the field of pharmaceutical science has seen rapid advancements aimed at improving the effectiveness and safety of drugs. One of the major developments is the introduction of Novel Drug Delivery Systems (NDDS). Unlike conventional methods, which distribute drugs throughout the body, NDDS are designed to deliver drugs specifically to the required site of action. To overcome these limitations, NDDS use innovative approaches such as nanoparticles, microspheres, transdermal patches, and liposomal carriers. These systems help in controlling the rate, time, and place of drug release, thereby improving patient compliance and therapeutic outcomes. Targeted therapy is a key advantage of NDDS, as it ensures that the drug reaches only the diseased area without affecting healthy tissues. This approach is especially useful in the treatment of chronic diseases like cancer, diabetes, and cardiovascular disorders.

Overall, Novel Drug Delivery Systems represent a modern and promising approach in healthcare, offering better treatment efficiency, reduced side effects, and improved quality of life for patients. This review aims to provide an overview of NDDS, their importance, types, and applications in targeted therapy.

❖ Simple definition NDDS

- It ensures the drug reaches the right place, at the right time, in the right amount.
- Drug delivery is the method or process of administering a drug to achieve its therapeutic effect in the body.
- Meaning of Novel Drug Delivery System (NDDS)
- It is the process of taking a drug into the body and transporting it to the target site to produce its effect.
- NDDS are advanced methods of delivering drugs in the body in a controlled and targeted way.

II. NEED FOR NDDS

- Problems with Conventional Drug Delivery:
- Drug spreads throughout the body
- Causes side effects
- Requires frequent dosing
- Low efficiency

❖ NDDS solves these by:

- Targeting only diseased area 🎯
- Reducing side effects
- Improving drug action
- Increasing patient comfort

III. OBJECTIVES OF NDDS

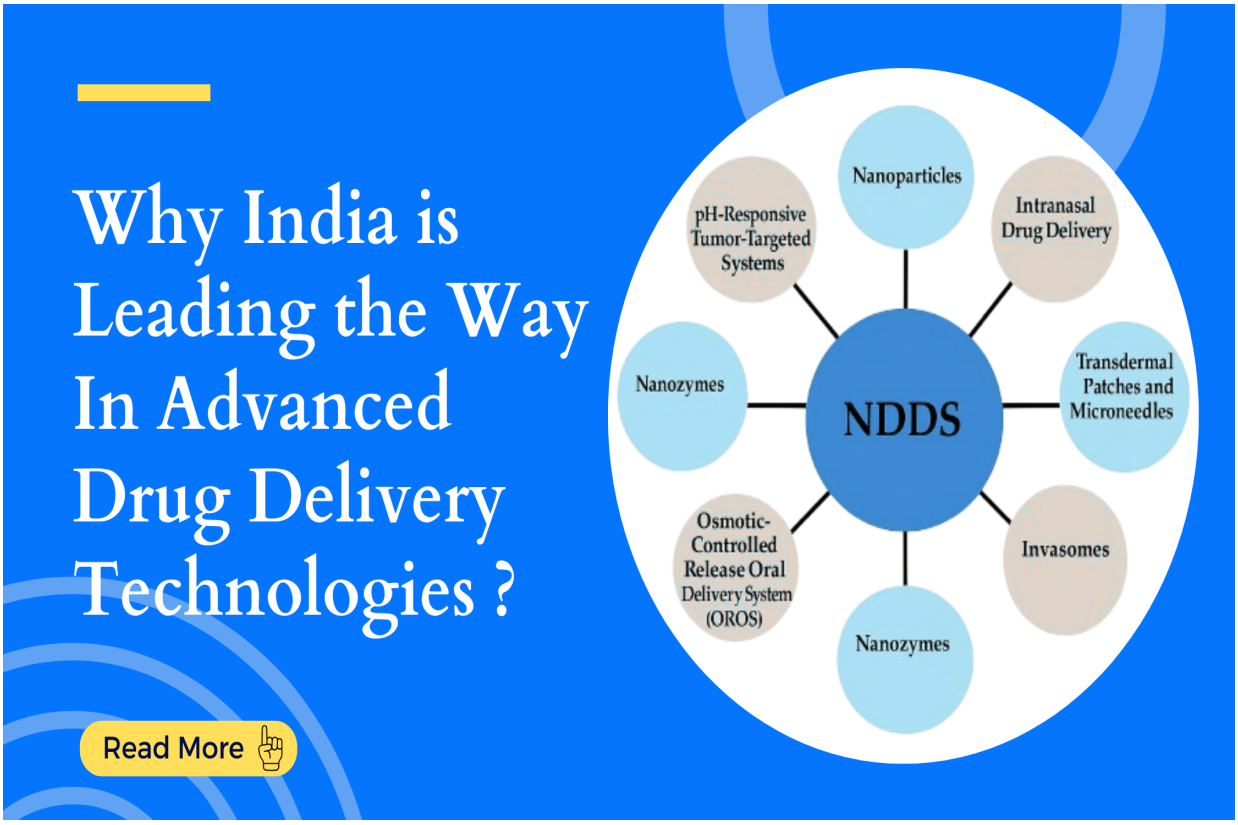
- Deliver drug to specific site
- Maintain constant drug level
- Reduce toxicity
- Improve bioavailability
- Enhance patient compliance

❖ Examples:

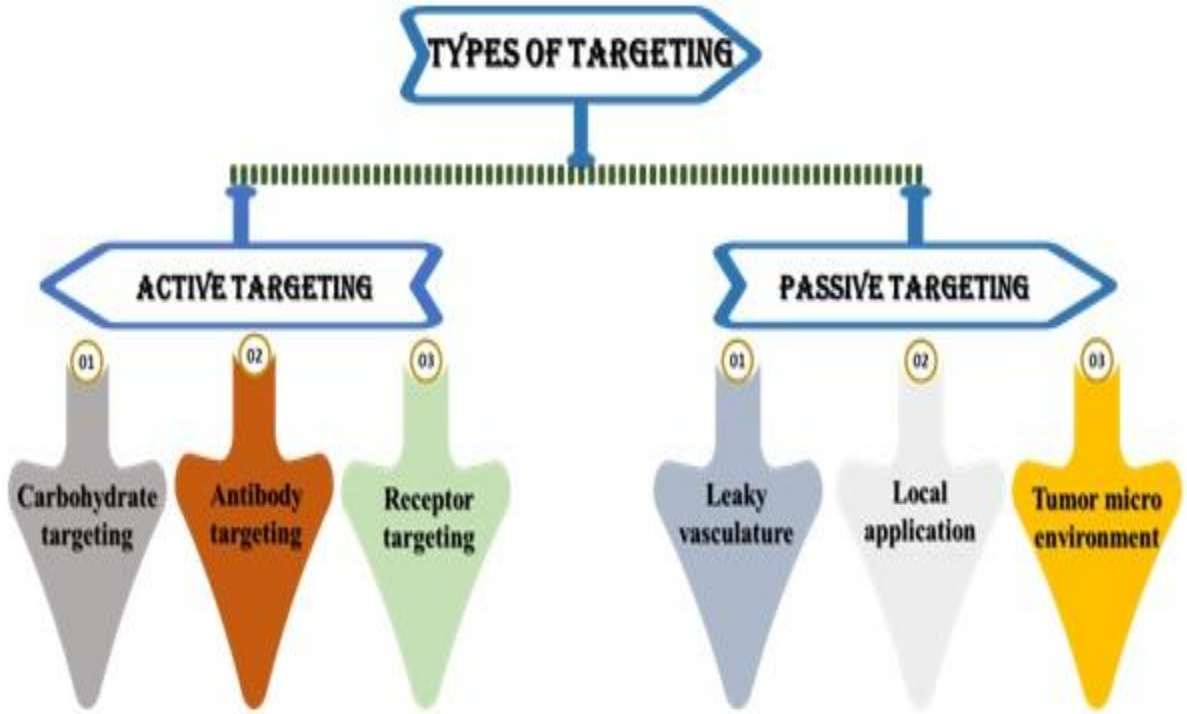
- Taking a tablet → drug goes through stomach into blood
- Getting an injection → drug directly enters bloodstream
- Using an inhaler → drug goes to lungs
- Applying a cream → drug acts on skin

IV. WHY DRUG DELIVERY IS IMPORTANT

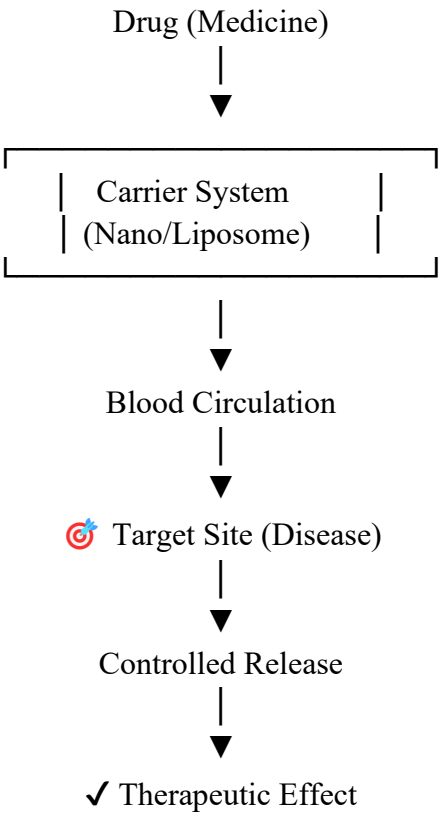
- Makes the medicine work properly
- Helps reach the right place in the body
- Reduces side effects



V. SIMPLE TARGETING DIAGRAM



VI. Diagram: Working of NDDS



VII. CLASSIFICATION OF NOVEL DRUG DELIVERY SYSTEMS (NDDS)

1. Based on Release Mechanism

a) Controlled Release Systems

- Drug is released slowly over time
- Maintains constant drug level in body
- Example: Tablets, capsules

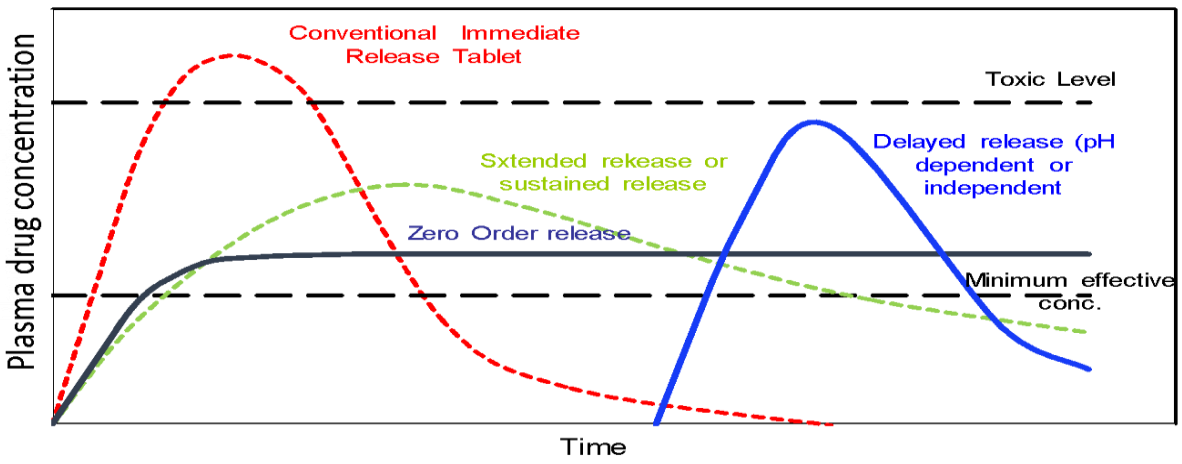
b) Sustained Release Systems

- Prolongs drug action
- Reduces frequency of dosing

c) Delayed Release Systems

- Drug is released after a certain time
- Example: Enteric-coated tablets

Type	Description
Controlled release	Drug released slowly over time
Sustained release	Prolongs drug action
Delayed release	Drug released after some time



2. Based on Route of Administration

a) Oral Drug Delivery

- Most common and convenient
- Example: Tablets, capsules

b) Parenteral Drug Delivery

- Injected directly into body
- Faster action

c) Transdermal Drug Delivery

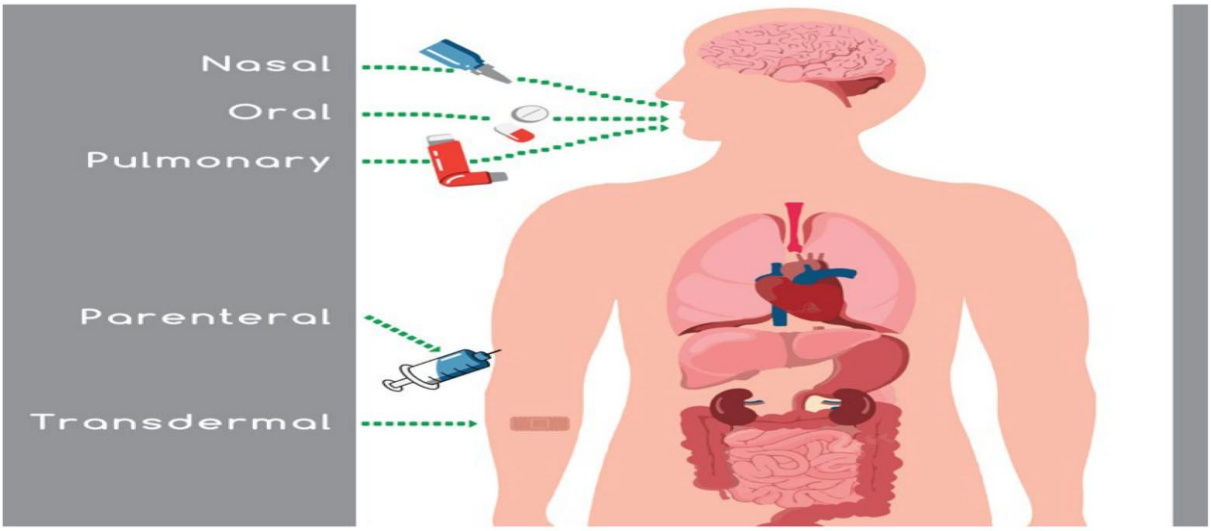
- Drug delivered through skin
- Example: Patches

d) Pulmonary Drug Delivery

- Drug delivered via lungs
- Example: Inhalers

e) Nasal Drug Delivery

- Drug absorbed through nasal cavity
- Fast absorption



Route	Example
Oral	Tablets, Capsules
Parenteral	Injections
Transdermal	Skin patches
Pulmonary	Inhalers
Nasal	Nasal sprays

3. Based on Carrier System

a) Liposomes.

- Small vesicles made of lipids
- Improve drug stability

b) Nanoparticles.

- Very small particles (nano size)
- Used for targeted delivery

c) Microspheres

- Small spherical particles
- Controlled release of drug

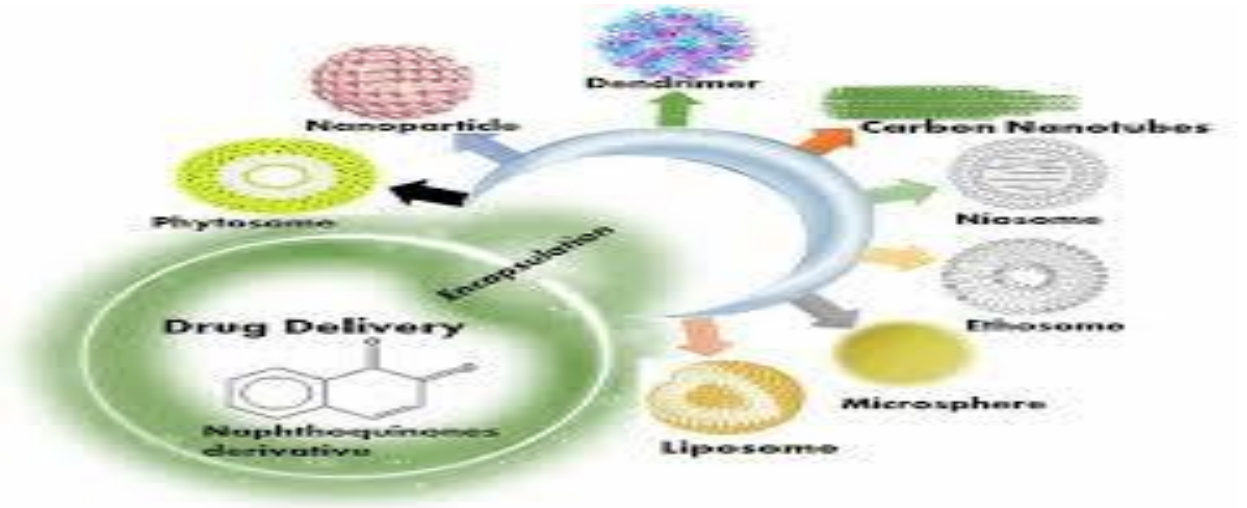
d) Niosomes

- Similar to liposomes but more stable

e) Dendrimers-

- Branched structures
- High drug-loading capacity

Carrier	Features
Liposomes	Lipid vesicles, biocompatible
Nanoparticles	Very small , targeted delivery
Microspheres	Controlled drug release
Niosomes	More stable than liposomes
Dendrimers	Branched, high drug loading



4. Based on Targeting Mechanism

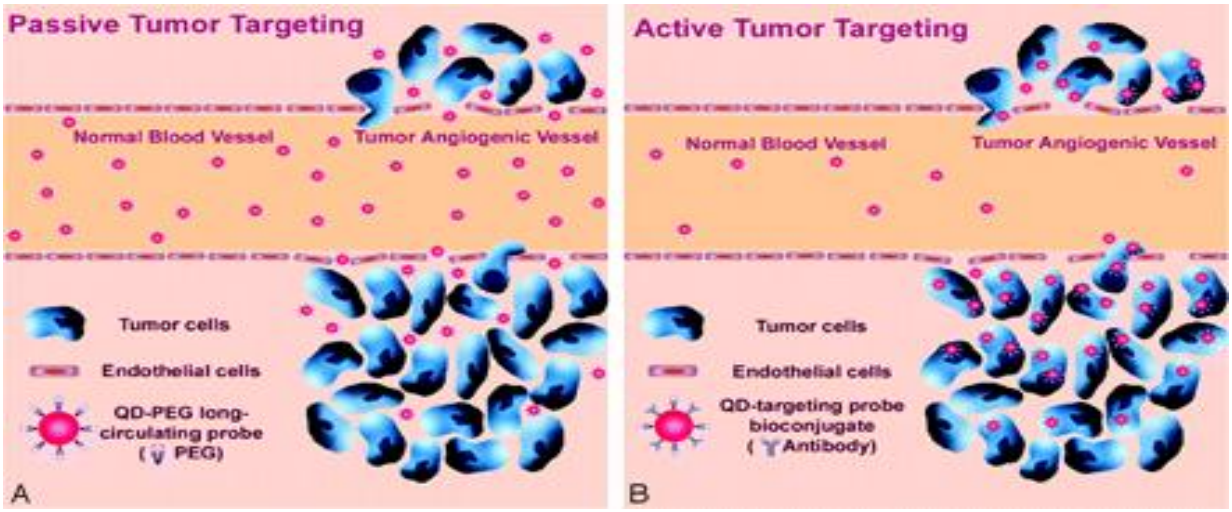
a) Passive Targeting

- Drug accumulates naturally at target site
- Common in tumor tissues

b) Active Targeting

- Uses ligands or antibodies
- Binds specifically to target cells

Type	Description
Passive targeting	Natural accumulation (tumor)
Active targeting	Ligand - receptor binding



5. Based on Stimuli-Responsive Systems

a) pH-Sensitive Systems

- Drug released at specific pH

b) Temperature-Sensitive Systems

- Drug released with change in temperature

c) Enzyme-Sensitive Systems

- Drug released in presence of enzymes.

Type	Trigger
pH- sensitive	Change in pH
Temperature- sensitive	Heat change
Enzyme-sensitive	Enzymes

VIII. REVIEW OF PREVIOUS STUDIES

1. Development of Controlled Drug Delivery

- Early research focused on controlled and sustained release systems**.**
- These systems helped maintain a constant drug concentration in the body.

2. Advancement in Nanotechnology

- Nanotechnology plays a major role in NDDS.
- Researchers developed nanoparticles for targeted drug delivery.
- Studies proved that nanoparticles can:
  - Improve drug stability
  - Enhance bioavailability
  - Deliver drugs to specific tissues

3. Liposomes and Vesicular Systems

- Liposomes were introduced as biocompatible drug carriers.
- Research showed they are useful in:
  - Cancer therapy
  - Vaccine delivery
- They help in reducing toxicity of drugs.

4. Targeted Drug Delivery Approaches.

- Two main approaches studied:
  - Passive targeting (based on natural accumulation in tumors)
  - Active targeting (using ligands and receptors)
- Studies confirmed that targeted delivery:
  - Increases drug efficiency
  - Reduces damage to healthy tissues

5. Stimuli-Responsive Drug Delivery

- Recent research focuses on smart systems that respond to stimuli.
- Examples include:
  - pH-sensitive systems
  - Temperature-sensitive systems
- These systems release drugs only under specific conditions.

6. Transdermal and Novel Routes

- Studies explored alternative routes like:
  - Transdermal patches
  - Nasal delivery
  - Pulmonary systems
- These methods avoid first-pass metabolism and improve drug absorption.

7. Applications in Disease Treatment

- NDDS has been widely studied in:
  - Cancer therapy
  - Diabetes management
  - Brain disorders
- Research shows improved therapeutic outcomes and reduced side effects.

IX. CONCLUSION

- Research shows that NDDS has great potential in modern medicine.
- Continuous advancements are making drug delivery more precise and effective.
- Research shows that NDDS has great potential in modern medicine.
- Continuous advancements are making drug delivery more precise and effective.
- NDDS is a modern and advanced drug delivery system that improves treatment by delivering drugs accurately and safely.
- It plays an important role in targeted therapy, making treatments more effective with fewer side effects.
- Future research will make these systems even more efficient and widely used.

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