

Drug delivery systems.

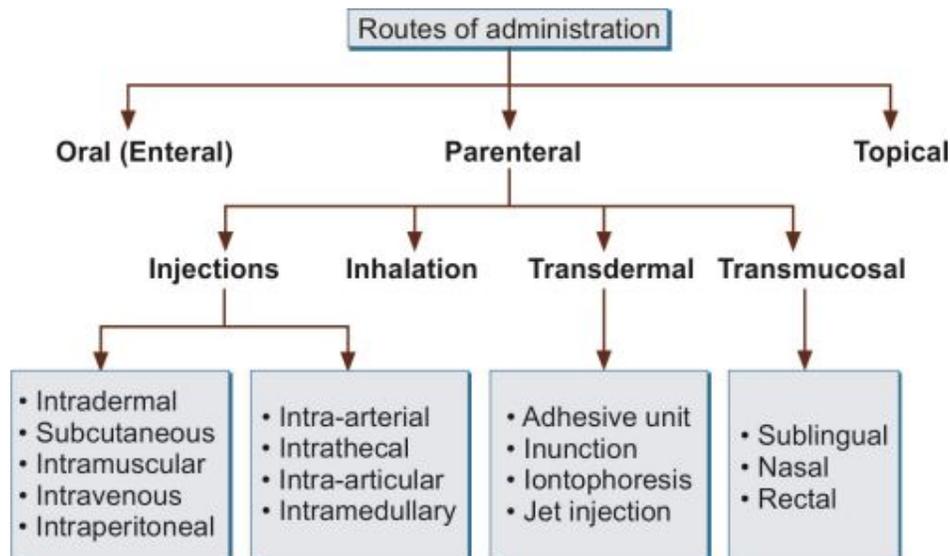
A drug delivery system refers to the method or process used to introduce a drug into the body and ensure that it reaches its target site in the right concentration, at the right time, and for the desired duration.

The goal of a drug delivery system is to maximize therapeutic effects while minimizing side effects. A well-designed delivery system can improve patient compliance, control drug release, reduce dosing frequency, and target specific organs or tissues.

Drug delivery systems are not just about the drug itself but also include the formulation (tablet, capsule, injection, patch, etc.) and the route of administration (oral, intravenous, topical, etc.).

Routes of Drug Delivery

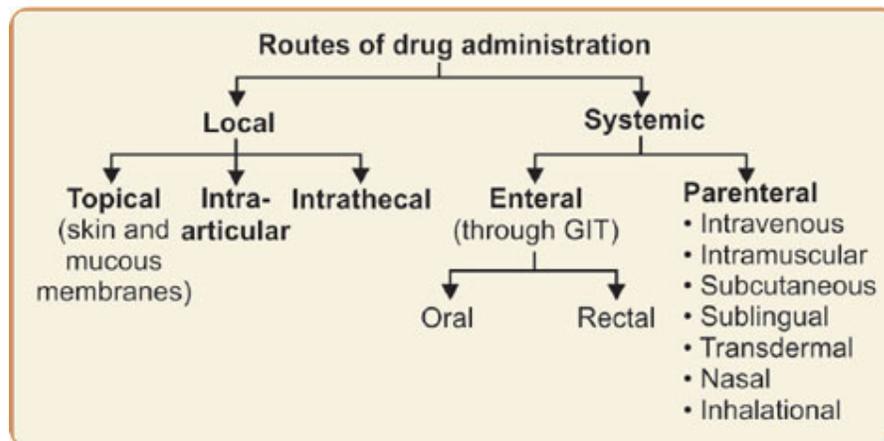
The route of administration determines how a drug enters the body, how fast it acts, and how much of it reaches the target site. It can be categorized in different way based on distributing like local or systemic or where it applied. The common routes include:



1. **Oral:** Most common route; convenient for patients. Drugs must survive the acidic environment of the stomach and be absorbed in the intestines.

2. **Parenteral:** Includes intravenous (IV), intramuscular (IM), and subcutaneous (SC) injections. Drugs act faster because they bypass the digestive system.
3. **Topical:** Applied on the skin or mucous membranes; used for local or systemic effects (e.g., creams, patches).
4. **Inhalation:** Drugs delivered directly to the lungs, useful for respiratory diseases.
5. **Transdermal:** Drugs are absorbed through the skin for systemic effect (e.g., nicotine or hormone patches).
6. Other specialized routes: Intranasal, ocular, rectal, and vaginal delivery are used when oral or injectable routes are unsuitable.

Or like this



Conventional Drug Delivery Systems

Traditional or conventional drug delivery methods include tablets, capsules, and injections. These systems deliver the drug immediately after administration, and the drug concentration in the body rises quickly, and then gradually falls as it is metabolized and eliminated.

Advantages

- Simple and widely used
- Easy to manufacture and store

Limitations

- Fluctuating drug levels in blood may cause side effects or reduce effectiveness
- Frequent dosing is often required
- Some drugs are unstable in the digestive system or poorly absorbed

Modern Drug Delivery Systems

Modern drug delivery systems are designed to overcome the limitations of conventional methods. These include:

Controlled-Release Systems

These systems release the drug slowly over time, maintaining a constant drug concentration in the body. This reduces dosing frequency and improves patient compliance.

Examples: Extended-release tablets, implants, or depot injections.

Targeted Drug Delivery

These systems deliver drugs directly to the site of action, minimizing side effects and maximizing effectiveness.

Examples:

- Liposomes carrying anticancer drugs to tumors
- Nanoparticles targeting specific cells

Transdermal Delivery Systems

These deliver drugs through the skin for systemic effects. The patch provides a continuous drug release over hours or days.

Examples: Nicotine patch, hormone replacement patches

Oral Modified-Release Systems

These include enteric-coated tablets (resistant to stomach acid) or sustained-release capsules, designed to release the drug gradually or in specific parts of the digestive tract.

Factors Influencing Drug Delivery

Several factors affect how effectively a drug reaches its target site:

- Drug properties: Solubility, stability, molecular size, and chemical structure
- Formulation: Type of recipients, coatings, or encapsulation
- Route of administration: Oral, injectable, topical, etc.
- Biological barriers: Digestive enzymes, blood-brain barrier, liver metabolism
- Patient factors: Age, disease, and organ function

Advantages of Modern Drug Delivery Systems

Modern systems offer several benefits over conventional methods:

- Controlled or sustained drug release
- Targeted delivery to specific organs or tissues
- Reduced side effects and toxicity
- Improved patient compliance due to less frequent dosing
- Protection of unstable drugs from degradation

Challenges in Drug Delivery

Despite advances, there are challenges:

- Ensuring drug stability during storage and delivery
- Avoiding rapid clearance or breakdown by the body
- Developing cost-effective and patient-friendly systems
- Overcoming biological barriers to reach target sites
- Minimizing immune reactions to carriers like nanoparticles or liposomes