



# Nanotechnology in Drug Delivery

[Source: PIB](#)

## Why in News?

A new **drug delivery** method has been developed that can prove useful to patients suffering from asthma, cystic fibrosis, [human immunodeficiency virus \(HIV\)](#), cancer, or those exposed to corticosteroid medications for an extended duration.

- Scientists have used a **chitin** synthesis fungicide, **Nikkomycin**, to develop Nikkomycin-loaded **polymeric nanoparticles**. Nikkomycin is produced by the bacterial *Streptomyces* spp.

## Chitin

- **Chitin** is a **strong, natural material** found in the **outer shells** of **insects, crabs, lobsters**, and other [arthropods](#), as well as in the **cell walls of fungi** but **not** found in the **human body**.
- It's made up of long chains of **glucose molecules**, similar to **cellulose** in **plants**.
- Chitin provides structural **support and protection**, acting like a tough armour for these organisms.
- In insects and crustaceans, it forms a **hard exoskeleton** that helps them keep their shape and defend against predators.
- In **fungi**, chitin strengthens the **cell walls**, helping the organism maintain its **form** and protect itself from **environmental stress**.

## What are Key Facts about Nano Drug Delivery?

- **About Nanotechnology:** [Nanotechnology](#) is the science of designing, producing, and using systems by manipulating atoms and molecules at the **nanoscale** i.e. having **one or more dimensions** of the particle of **100 nanometres or less**.
- **Nano Drug Delivery:** It involves **delivering drugs** to a specific **target site**.
  - **Nanoparticles can entrap drugs or biomolecules** into their interior structures and/or absorb drugs onto their exterior surfaces to deliver drugs at a designated site in the body.
- **Recent Development in Nano Drug Delivery:** Nikkomycin-loaded polymeric nanoparticles were found to disrupt the growth of ***Aspergillus* spp** and were found effective against fungal infection known as [Aspergillosis](#).
- **Significance:** The use of polymeric nanoparticles is the **most advanced** method of drug delivery.
  - The resistance to the existing [Azole drugs \(antifungal drugs\)](#) is a matter of concern and hence we need better methods of drug delivery for effective medication.
- **Future Prospects:** It can help in the development of inhalation **nanoformulations** against **pulmonary aspergillosis**.
  - Scientists are optimistic about expanding antifungal nanoformulations and exploring [public-private partnerships](#) for future commercialization.

## What is the Role of Nanotechnology in the Healthcare Sector?

- **Precision Medicine:** Nanoparticles are engineered to deliver drugs directly to disease sites like **cancer cells**, reducing the damage to healthy tissues. e.g., **liposomes**, a type of nanoparticle, are used to deliver **chemotherapy drugs** more precisely, minimising side effects.
  - Nanoparticles are being investigated for their ability to improve **vaccine efficacy** by delivering antigens directly to **immune cells**
- **Improved Diagnostics and Imaging:** **Gold nanoparticles** are used as probes for detecting specific **DNA or RNA sequences**, enhancing the sensitivity and accuracy of diagnostic tests.
- **Regenerative Medicine:** Nanomaterials are used to create scaffolds that mimic the **structure of bone**, promoting the growth of new bone **tissue** in patients with fractures or bone loss.
- **Gene Therapy:** Advanced nanopore technologies are being developed for **gene sequencing**, allowing for rapid, low-cost, and accurate **DNA analysis**.
- **Antimicrobial Treatments:** Silver nanoparticles are incorporated into wound dressings and **coatings for medical devices to prevent infections** due to their strong antimicrobial properties.

### UPSC Civil Services Examination, Previous Year Questions (PYQs)

#### Prelims

**Q. With reference to the use of nanotechnology in health sector, which of the following statements is/are correct? (2015)**

1. Targeted drug delivery is made possible by nanotechnology.
2. Nanotechnology can largely contribute to gene therapy.

**Select the correct answer using the code given below:**

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

**Ans: (c)**

**Q. With reference to carbon nanotubes, consider the following statements: (2020)**

1. They can be used as carriers of drugs and antigens in the human body.
2. They can be made into artificial blood capillaries for an injured part of the human body.
3. They can be used in biochemical sensors.
4. Carbon nanotubes are biodegradable.

**Which of the statements given above are correct?**

- (a) 1 and 2 only
- (b) 2, 3 and 4 only
- (c) 1, 3 and 4 only
- (d) 1, 2, 3 and 4

**Ans: (c)**

**Q. There is some concern regarding the nanoparticles of some chemical elements that are used by the industry in the manufacture of various products. Why?(2014)**

1. They can accumulate in the environment, and contaminate water and soil.
2. They can enter the food chains.
3. They can trigger the production of free radicals.

**Select the correct answer using the code given below:**

**(a)** 1 and 2 only

**(b)** 3 only

**(c)** 1 and 3 only

**(d)** 1, 2 and 3

**Ans: (d)**

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