

Targeted Breast Cancer Therapy

Prelims: Current events of national and international importance | Health

Why in News?

Recently, researchers at the Institute of Nano Science and Technology (INST), Mohali, in collaboration with BARC, Mumbai, developed advanced light-driven multifunctional nanobots for targeted breast cancer therapy.

- **Breast Cancer** - Leading cause of cancer mortality among women worldwide.
- **Limitations of Chemotherapy** - Severe side effects, drug resistance, damage to healthy tissues due to poor tumor penetration and non-specific drug distribution.
- **Current Nanomedicines** - Passive tumour accumulation, limited tissue penetration and poor spatial control.
- **Innovation** - Stimulus-responsive nanorobots controlled by near-infrared (NIR) light, pH, or enzymes → precise therapy with minimal toxicity.

Research Highlights

- **Nanobot Design**
 - These nanobots are built using upconversion nanoparticles (UCNPs).
 - UCNPs change near infrared (NIR) light into heat energy.
 - The heat allows nanobots to move in a specific direction, a process called phototaxis (movement guided by light).
- **Photosensitizer** - Produces harmful oxygen molecules (ROS) when exposed to near infrared (NIR) light.
- **Folic Acid** - Helps nanobots target breast cancer cells with folate receptors.

Mechanism

- A 980 nm NIR laser heats polydopamine, creating a temperature gradient.
- Nanobots move toward the laser source.
- Heat plus ROS (Reactive Oxygen Species) generation together kill cancer

cells.

Results

- **Therapeutic Efficacy** - Proven in cell studies and breast tumour mice.
- **Outcome** - Stronger tumour inhibition than single treatments.

Significance

- **Fuel-Free Nanobot** - NIR-responsive, integrates active light-guided movement with targeted delivery.
- **Precision Medicine** - Externally controlled, minimally invasive, localized therapeutic action.
- **Future Potential** - Platform for advanced cancer therapies with reduced systemic toxicity.

Reference

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