



Nanoplastics Causing Antibiotic Resistance

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Why in News?

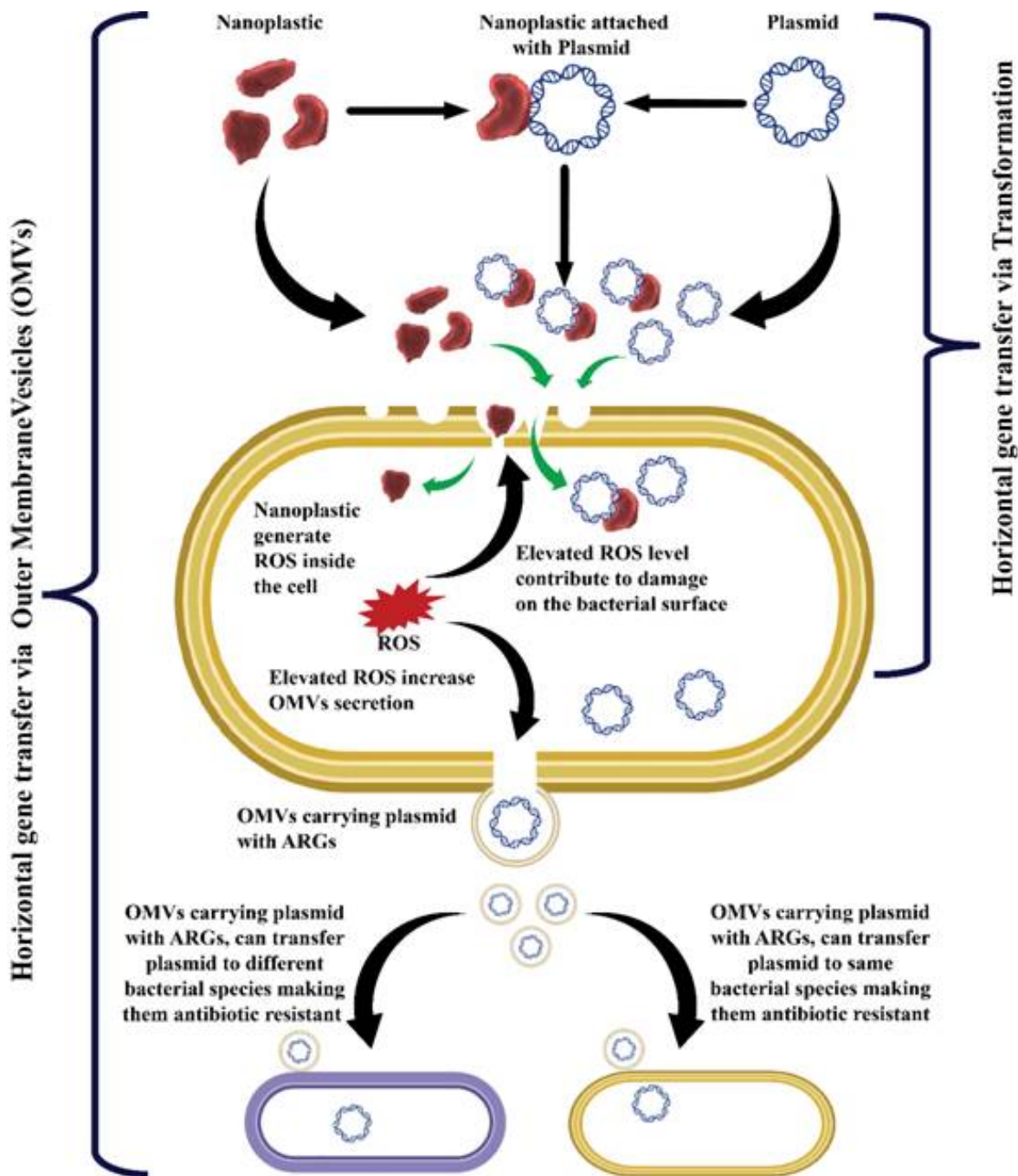
Recently, a study revealed that [nanoplastics](#) derived from **single-use plastic bottles (SUPBs)** contribute to the spread of [antibiotic resistance \(AR\)](#), presenting an overlooked public health risk.

- Antibiotic resistance, a type of [antimicrobial resistance](#), occurs when **bacteria evolve to resist** the effects of **drugs** that once killed them or inhibited their growth.

What are Key Highlights of the Study?

- **Risk to Gut Microbiome:** Nanoplastics could transform **Lactobacillus acidophilus (gut microbiota)** into a **carrier of AR genes**, which may then be transferred to pathogenic bacteria during infections, thus worsening the AR crisis.
- **Horizontal Gene Transfer (HGT):** Polyethylene terephthalate bottle-derived nanoplastics (PBNPs) **facilitate** the transfer of AR genes from **E. coli to Lactobacillus acidophilus** through **horizontal gene transfer (HGT)**.
 - In HGT, genes are **passed directly from one organism to another**, potentially across different species. (Vertical gene transfer, from parent to offspring).
- **Two Mechanisms of AR Gene Transfer:**
 - **Direct Transformation Pathway:** PBNPs act as **physical carriers**, transporting AR plasmids across bacterial membranes and promoting direct gene transfer.
 - **OMV-Induced Transfer Pathway:** PBNPs induce **oxidative stress**, triggering increased **outer membrane vesicle (OMV) secretion**.
 - These OMVs, carrying AR genes, **facilitate gene transfer** between bacterial species, including between beneficial and pathogenic bacteria.
- **AR Gene Transfer Mechanism:**

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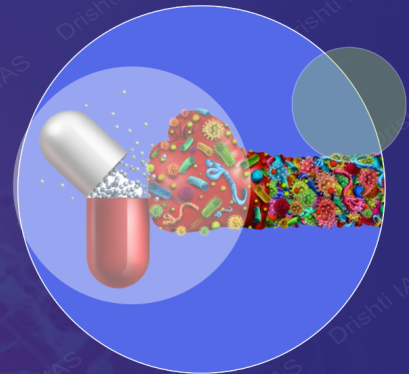


What Are Nanoplastics?

- **Definition:** Nanoplastics are **solid particles** of **synthetic or heavily modified natural polymers** with sizes ranging between **1 nm and 1000 nm**.
- **Types:**
 - **Primary Nanoplastics:** These are **intentionally produced** nanoplastics, typically for specific applications.
 - **Secondary Nanoplastics:** The majority of nanoplastics in the environment are secondary, meaning they **result from the fragmentation of larger plastic** items released unintentionally into the environment.
- **Concerns with Nanoplastics:**
 - **Environmental Presence:** Disrupts [marine food chains](#) and **ecosystems**.
 - **Bioaccumulation:** Harmful effects on health.
 - **Toxicity:** Inflammation, and disruptions in normal **cellular processes**.
 - **Gut Microbiome Disruption:** Digestive problems, **immune dysfunction**, or an increased risk of infections.

ANTIMICROBIAL RESISTANCE

The ability of microorganisms to resist the effects of antimicrobial drugs



CAUSES OF ↑ AMR

- Poor infection control/sanitation
- Antibiotic overuse
- Genetic mutations of microbe
- Lack of investment in R&D of new antimicrobial drugs

Microbes that develop AMR are called 'Superbugs'

IMPACTS OF AMR

- ↑ Risk of spreading infections
- Makes infections harder to treat; prolonged illness
- ↑ Healthcare costs

EXAMPLE

- Carbapenem antibiotics stop responding due to AMR in *K. pneumoniae*
- AMR Mycobacterium tuberculosis causing Rifampicin-Resistant TB (RR-TB)
- Drug-resistant HIV (HIVDR) making antiretroviral (ARV) drugs ineffective

RECOGNITION BY WHO

- Identified AMR as **one of the top 10 threats** to global health
- Launched **GLASS** (Global Antimicrobial Resistance and Use Surveillance System) in 2015

INDIA'S INITIATIVES AGAINST AMR

- Surveillance of AMR in microbes causing **TB, Vector Borne diseases, AIDS etc.**
- **National Action Plan on AMR (2017)** with One Health approach
- **Antibiotic Stewardship Program** by ICMR

New Delhi metallo-β-lactamase-1 (NDM-1) is a bacterial enzyme, emerged from India, that renders all current β-lactam antibiotics inactive

UPSC Civil Services Examination, Previous Year Questions (PYQ)

Prelims

Q. Which of the following are the reasons for the occurrence of multi-drug resistance in microbial pathogens in India? (2019)

1. Genetic predisposition of some people
2. Taking incorrect doses of antibiotics to cure diseases
3. Using antibiotics in livestock farming
4. Multiple chronic diseases in some people

Select the correct answer using the code given below.

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

Ans: (b)

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