Importance of Environmental Surveillance

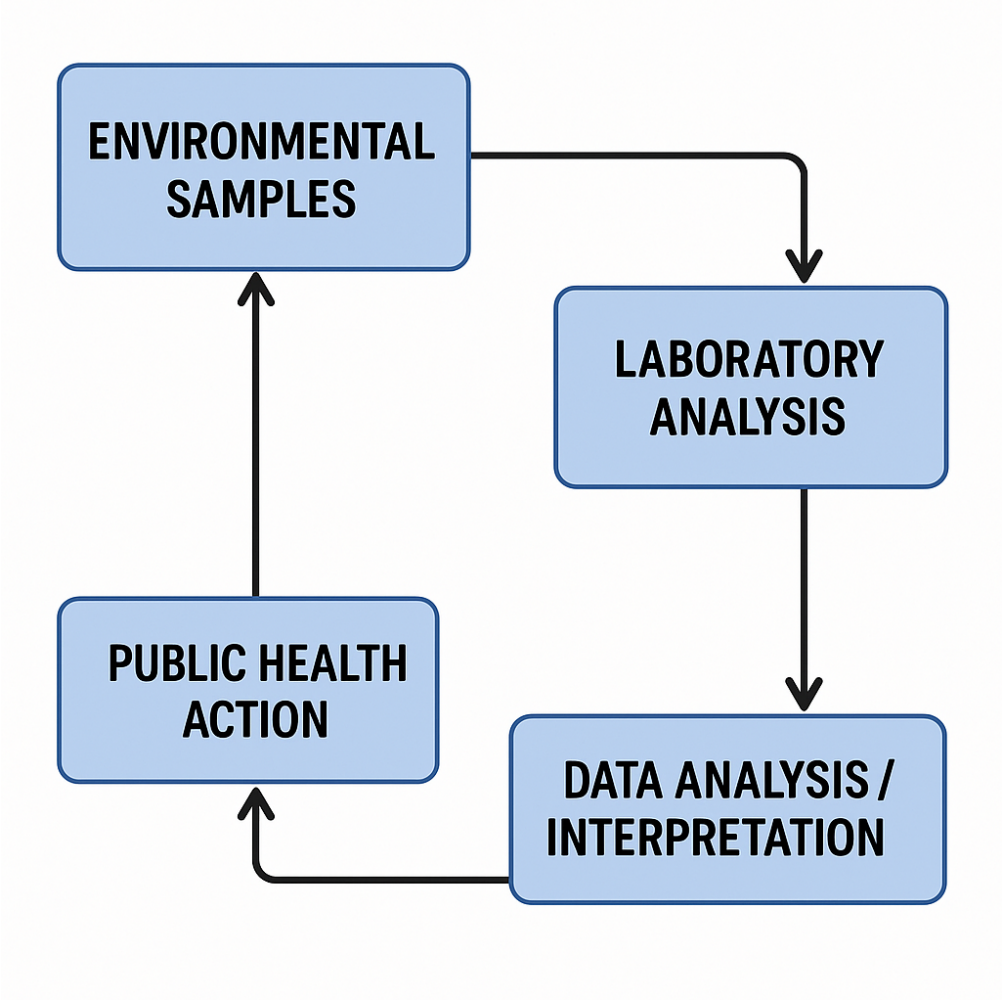
Mains: *GS III – Science and Technology*

Why in News?

Recently the Indian Council of Medical Research (ICMR) has recently said that it will initiate wastewater surveillance as a part of environment surveillance measure for 10 viruses across 50 cities.

What is environmental surveillance?

- **Environmental surveillance** – It is the systematic monitoring and collection of samples from the environment—such as air, water, and soil—to detect and track pathogens, pollutants, or radioisotopes.
- **Process**
  - **Planning & Selection of Sites** – Identify sources (air, water, soil, sewage, food, vectors) to monitor.
  - **Sample Collection** – Gather environmental samples like air filters, water, wastewater, soil, or swabs.
  - **Laboratory Analysis** – Test samples for pollutants, chemicals, pathogens, or toxins.
  - **Data Recording and Interpretation** – Document results and analyze trends or unusual findings.
  - **Early Warning and Risk Assessment** – Detect potential threats to public health or environment.
  - **Response and Control Measures** – Implement preventive actions like pollution control, vaccination, or sanitation.
  - **Reporting and Feedback** – Share findings with public health agencies, government, and communities.
  - **Continuous Monitoring** – Repeat at regular intervals for trend analysis and early outbreak detection.



- **Components of Environmental Surveillance**
  - **Air Surveillance** – Monitors air pollutants, greenhouse gases, and airborne pathogens.
  - **Water Surveillance** – Tests drinking water, wastewater, and sewage for chemicals and pathogens.
  - **Soil Surveillance** – Detects contamination from industrial effluents, pesticides, and heavy metals.
  - **Food Chain Surveillance** – Tracks pesticide residues, toxins, and pathogens in food products.
  - **Vector & Animal Surveillance** – Observes disease-carrying vectors and zoonotic pathogens.
  - **Waste Surveillance** – Monitors biomedical, industrial, and solid waste for pollutants.
  - **Radiological & Chemical Surveillance** – Measures hazardous chemicals and radiation levels.
  - **Climate & Meteorological Surveillance** – Records weather patterns and long-term climate changes.

What are the purposes of environmental surveillance?

- **Disease monitoring –** This is a primary function, as seen during the COVID-19 pandemic, where wastewater was tested for viral loads.
- It can also detect pathogens like poliovirus, influenza, and bacteria in a community,

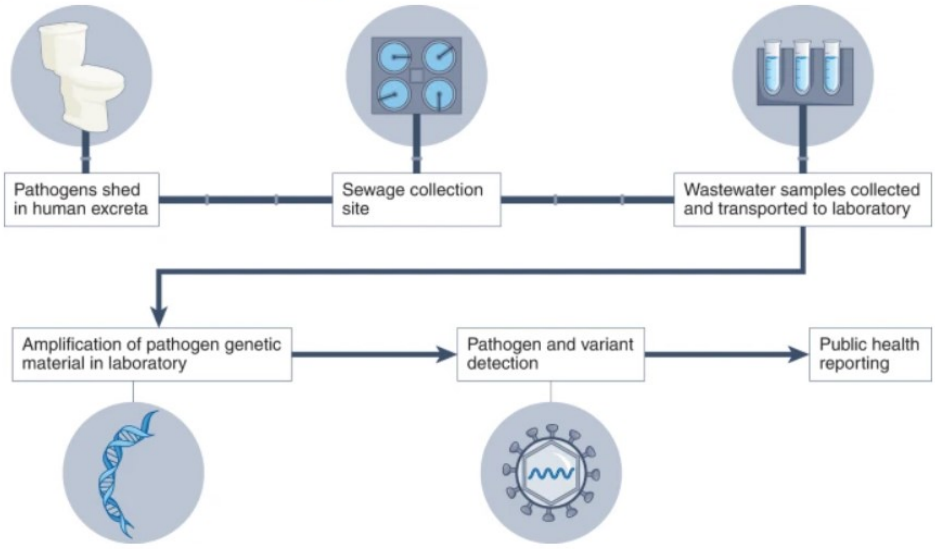
including from asymptomatic individuals who don't show up in clinical data.

- **Early warning system –** Environmental monitoring can detect the presence of pathogens in a community days to weeks before individuals show symptoms and are clinically tested.
- This provides public health officials with valuable lead time to prepare for and mitigate potential outbreaks.
- **Environmental hazard tracking –** The process is used to monitor for chemical spills, radiation, and pollution.
    - **For instance**, air and water quality can be continuously checked for hazardous pollutants.
- **Assessing public health interventions –** By monitoring pathogen levels over time, public health officials can evaluate the effectiveness of interventions like vaccination campaigns or pollution control measures.
- **Resource allocation –** Data from environmental surveillance helps local governments and public health providers make evidence-based decisions on how to allocate resources, such as testing and vaccines.
- **Traditional monitoring method** – For long time the only way to figure out levels of infection in a community was to detect infections in patients, called clinical case detection.
- **Issue with traditional method** – Not all infected people might show symptoms, or might not choose to be tested if symptoms are mild.
- The number of people who are tested might not reflect the true numbers of those infected.
- **Potential of Environmental surveillance** – Environmental surveillance can thus provide important early warning signals of an impending outbreak.
- It is now known that the levels of pathogen in wastewater can precede, often by more than a week, a rise in infections.

How Environmental surveillance of waste water work?

- **Collection of samples** – Samples taken from sewage treatment plants, effluents from hospitals and from public spaces such as railway stations and toilets in airplanes, can be studied to see how the pathogens they contain change from day-to-day.

Fig. 1: Wastewater-monitoring pathway.



- It works because pathogens of interest are shed in the stools or urine of infected individuals.
- **Monitoring of pathogens** – Diseases transmitted by parasitic worms such as roundworms and hookworms can be monitored through wastewater and soil samples.
- **Diseases information** – Information about the burden of the disease and the effectiveness of control measures will be gathered.
- **Rigorous protocol development** – These protocols detail how samples must be collected and processed, and how pathogens are detected and analysed.
- **Comparison of pathogens** – By following these protocols, comparisons of pathogen load become possible, and whole-genome sequencing enables the identification of variants of the same pathogen.

Why do early-warning signals matter?

- **Public health planning** – Understanding how many infected people there are is important for public health planning.
- The more the amounts of pathogen that circulate, the more likely it is that people will be infected.
- **Mitigation of diseases** – Preparing for a disease outbreak becomes much easier if there's more notice.
- **Tracking of diseases** – Wastewater-based epidemiology has been used for over 40 years to track several diseases such as measles, cholera and polio.
- Such disease surveillance in India, through wastewater, was first initiated in Mumbai for polio in 2001.
- During the COVID-19 pandemic, similar surveillance programs for COVID-19 were started in five cities, and they continue to this day.
- **Initiative of ICMR** – The Indian Council of Medical Research (ICMR) has recently said that it will initiate wastewater surveillance for 10 viruses across 50 cities.
- This will enable public health surveillance to pick up any increase in viral load within community settings.
- This extends ICMR's involvement in establishing environmental surveillance for viruses, including avian influenza virus, particularly in areas with outbreaks.

How the surveillance could be improved further?

- **Data sharing** – The sharing of data and protocols across institutions and reaching common agreements on templates for surveillance frameworks that are disease specific is important.
- **Change in approach** – Programmatic approaches, rather than project-driven approaches, must be developed that integrate waste-water and other environmental surveillance with routine disease surveillance.
- **National system for surveillance** – Developing a national wastewater surveillance system for India is important.
- **Emerging methodologies** – Audio samples of people coughing in public places can be used to examine the prevalence of respiratory conditions, through refined machine learning methods.

Reference

[The Hindu| Environmental surveillance]