

Genome India Project

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Genome India Project: A Landmark in India's Biotechnology Revolution

Context : Prime Minister Narendra Modi has announced the successful completion of the **Genome India Project**, describing it as a major milestone in India's biotechnology sector. Speaking via a video message at the **Genomics Data Conclave**, organized by the **Department of Biotechnology**, the Prime Minister also unveiled a sequencing database of **10,000 Indian genomes**, which will be accessible through the **Indian Biological Data Centre (IBDC)**.

This project is a significant step towards understanding India's vast genetic diversity and addressing pressing healthcare challenges through precision medicine.

What is Genome Sequencing?

Human Genome

1. The **human genome** is the complete set of DNA in the nucleus of every cell in the human body.
2. It carries all the genetic information necessary for the development and functioning of an organism.
3. DNA is composed of **four bases**:
 - **Adenine (A)**
 - **Thymine (T)**
 - **Cytosine (C)**
 - **Guanine (G)**
4. These bases form approximately **3.05 billion base pairs**, structured in a double helix.

Genome Sequencing Process

- **Genome sequencing** determines the precise order of these base pairs, revealing the unique genetic makeup of an individual.
 - While human genomes are largely similar, small variations account for individuality and susceptibility to diseases.
 - The most common method, **Next-Generation Sequencing (NGS)**, is known for its speed, accuracy, and cost-effectiveness.
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What is the Genome India Project?

Overview

- Approved in **2020**, the project aims to **sequence the genomes of over 10,000 Indians** across diverse regions and ethnicities.
- Sanctioned by the **Department of Biotechnology**, it will create a **reference genome** for India's population.

Significance

1. Identifying Unique Genetic Traits

- India's population of **1.4 billion** includes over **4,600 distinct population groups**, many of which are **endogamous**.
- This genetic diversity is a treasure trove for research and innovation.

2. Understanding Disease Susceptibility

- The project enables researchers to study genetic risk factors for chronic diseases like:
 - **Diabetes**
 - **Hypertension**
 - **Cancer**
 - **Neurodegenerative disorders**

3. Personalized Medicine and Drug Development

- Insights from this project will help design therapies and medications specifically tailored to the Indian population.

How Does Genetic Research Benefit India?

1. Understanding Genetic Risk Factors

- Specific genetic mutations prevalent in India can inform preventive measures:
 - The **MYBPC3 mutation**, linked to early cardiac arrest, affects **4.5%** of Indians but is rare globally.
 - The **LAMB3 mutation**, causing a fatal skin condition, affects **4%** of a population near Madurai but is absent in global databases.

2. Developing Targeted Treatments

- Genome data enables:
 - Creation of **mRNA vaccines** for conditions like **pancreatic cancer**.
 - Development of therapies for rare genetic disorders specific to Indian populations.

3. Enhancing Drug Efficacy and Safety

- Genetic studies can identify resistance-indicating variants to improve treatment outcomes.
 - Example: Some members of the **Vaishya community** in South India lack a gene essential for processing anaesthetics, necessitating alternative drugs.
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Key Data on Genome India Project

1. Database Creation:

- The genomes of **10,000 Indians** from **99 distinct populations** have been sequenced.
- Data storage: **8 petabytes** at the **Indian Biological Data Centre (IBDC)**.

2. Data Access and Security:

- **Managed Access:** Only approved researchers from partner institutes can access the data.
- **Anonymisation:** Genetic data is encrypted to ensure privacy and prevent identity breaches.

Conclusion

The **Genome India Project** marks a transformative moment in India's scientific and healthcare landscape. By decoding the genetic blueprint of India's diverse population, this initiative will:

- Propel advancements in **personalized medicine**.
- Address **genetic disorders and chronic diseases** effectively.
- Strengthen India's position in the global **biotechnology and biopharma** sectors.

This groundbreaking achievement is a testament to India's scientific prowess and its commitment to leveraging cutting-edge technology for the well-being of its people.

