



Genomics Democracy

For Prelims: Genome, Genomics, Biotechnology, WHO, Science Council, Applications of Genomics, DNA, RNA

For Mains: Science behind Genome, Evolution of Genomics, Application of Genomics in human life, Measures for global cooperation in Genomics

Why in News?

Recently, [WHO](#) Science Council has released a report “**Accelerating access to genomics for global health**” advocating for passing on [Genomic](#) Technologies to developing countries.

- The report followed **WHO’s 10-year strategy for genomic surveillance of pathogens.**
 - Genomic surveillance has **played a crucial role in the global Covid -19 response**, with countries like South Africa able to make essential contributions in detecting variants due to their capacities in this area.

What is WHO Science Council?

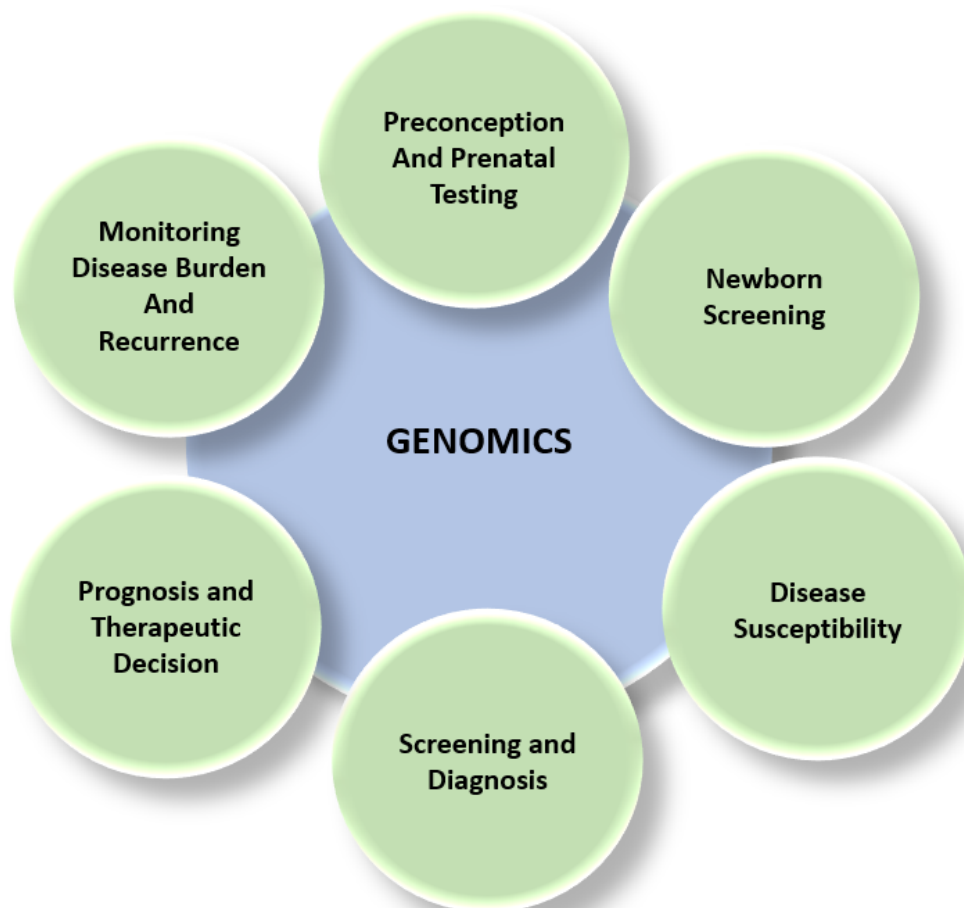
- Established in April 2021 by WHO Director. It is composed of 9 leading **scientists and public health experts from around the world.**
- The council advises the Director on high-priority issues and advances in **science and technology** that could directly improve [global health](#).
- It identified **genomics as the focus of its first study**, given the significant implications for public health.

What are the Highlights WHO's Report?

- **Access to genomic technologies needs to be expanded**, especially for Low- and Middle-Income Countries (LMIC).
- it is not **ethically or scientifically justifiable** for countries with fewer resources to gain late access to such technologies.
- **Shortfalls in financing, laboratory infrastructure, materials and highly trained personnel** need to be addressed to expand access to genomic technologies.
- The benefits will not be fully realized **unless deployed worldwide.**
 - Only through equity can science reach its full potential impact and improve health for everyone, everywhere.
- **The report recommended addressing four themes:**
 - Advocacy, implementation, collaboration and associated ethical, legal and social issues.
- The report also recommended WHO create a **Genomics Committee** to take forward the recommendations and monitor their applications.

What do we need to know about Genomics?

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▪ About:

- Genomics is the study of all of a person's genes (the **genome**), including interactions of those genes with each other and with the person's environment.
- The field of genomics uses **biochemistry, genetics** and **molecular biology methods** to understand and use **biological information in deoxyribonucleic acid (DNA)** and **ribonucleic acid (RNA)**.
- The technologies used in genomic science are numerous and continue to expand.
 - Those most fundamental to this field are designed to depict the biological information that is stored in **genomes**—the totality of genetic information in all animals, plants, and microbes, including viruses— as nucleotide sequences of **DNA** (or occasionally **RNA**)

▪ Application of Genomics:

- **Control Infectious Disease:**
 - Mapping the **evolution of infectious agents**.
 - Assigning **phenotypic**, such as infectivity and pathogenicity, to specific genes.
 - Evaluating an infectious agent's sensitivity or resistance to drugs.
- **Prevent and Manage Genetic Conditions:**
 - Evaluating carrier status for a **genetic disorder**.
 - Screening for and **diagnosis of single gene disorders**.
 - Assessing **disease susceptibility** or predisposition to many **chronic illnesses**.
 - Selecting medications based on **mechanism of action or genetic determinants** of metabolism to reduce toxicities.
- **Agriculture:**
 - Cataloguing of **genetic diversity** in the wild and in founder stocks
 - Assessing **genetic profiles** for health and commercial traits
 - Predicting susceptibility and responses to environmental stress

▪ Benefits of Genomics:

- **Economic:**
 - Direct stimulus to the **commercial for-profit sector** that produces machines and reagents and provides services.
 - Indirect stimulus through **improvements in population health** (improved medical care, quality of life, potentially decreased health care utilization) and the **creation of intellectual property rights**.
 - **Job creation** in academic, medical, and commercial positions
- **Social and Environment:**
 - Enabling progress in several [United Nations Sustainable Development Goals](#), especially **Goals 1-3, concerning poverty, hunger, and health, respectively**.
 - Further, it helps in national and international efforts to conserve marine and land resources (**Goals 14 and 15**).
- **Health:**
 - Genomics can make enormous contributions to human health, from **surveying populations for infectious agents** — such as the virus that causes Covid-19, to **predicting and treating** a wide variety of diseases, such as cancers and developmental disorders
- **Challenges in Genomics:**
 - In case of genomic information derived from **human subjects**, it has the potential to **violate privacy, create the possibility of discrimination in employment and insurance, confer inappropriate financial gain, or convey cultural disrespect**.
 - **Insufficient protection of participants** and the data they provide, risks the abuse of genomic information, while **unduly restrictive rules about the generation, sharing, and use of genomic information, limit the benefits** that such information can provide.

What are the Recommendations of the WHO Report?

- **Promotion of genomics through Advocacy:**
 - Promote the adoption or expanded use of genomics in all **Member States through advocacy by many parties**.
 - WHO should **use its leadership role** in global public health to advocate for the expanded use of genomics in its Member States.
 - WHO should promote **affordable access to genomic technology** globally so that all Member States, especially Low and Middle-Income Countries (LMICs), can adopt and expand the use of genomics for better health and other benefits.
- **Implementation of Genomic Methodologies:**
 - Identify and overcome the **practical issues** that impede the implementation of genomics through **local planning, financing, training of essential personnel, and the provision of instruments, materials, and computational infrastructure**.
 - WHO should provide **guidance to Member States** on best practices for implementation of national or regional genomic programmes.
 - Member States should establish **national programmes** for building or expanding genomic capabilities or join a regional programme.
- **Collaboration among Entities Engaged in Genomics:**
 - Foster **commitments to collaborative activities** to promote all aspects of national and regional programmes that advance genomics in Member States.
 - WHO should **promote international collaborations** on genomics by strengthening effective existing collaborative arrangements and by helping form new ones for specific needs.
 - **Industry, academia, and civil society** should collaborate on the use of genomics to help solve important health problems, especially those prevalent in LMICs.
- **Attention to the Ethical, Legal, and Social Issues (ELSI) raised by Genomics:**
 - Promote **ethical, legal, and equitable use** and responsible sharing of information obtained with genomic methods through **effective oversight and national and international rules and standards in the practice of genomics**.
 - **WHO's Genomics Committee** should be the custodian of guidance on how to deal with the ethical and social ramifications of genomics, including the global governance of genomic information.
 - **Organizations in Member States**, especially funding agencies, academic

institutions, and governmental units should be attentive to ELSIs and to efforts being made by WHO and other international bodies to develop solutions to outstanding issues related to genomic ELSIs.

UPSC Civil Services Previous Year Question (PYQ)

Q. With reference to agriculture in India, how can the technique of 'genome sequencing', often seen in the news, be used in the immediate future? (2017)

1. Genome sequencing can be used to identify genetic markers for disease resistance and drought tolerance in various crop plants.
2. This technique helps in reducing the time required to develop new varieties of crop plants.
3. It can be used to decipher the host-pathogen relationships in crops.

Select the correct answer using the code given below:

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

Ans: (d)

Explanation:

- Chinese scientists decoded rice genome in 2002. The Indian Agricultural Research Institute (IARI) scientists used the genome sequencing to develop better varieties of rice such as Pusa Basmati-1 and Pusa Basmati-1121, which currently makes up substantially in India's rice export. Several transgenic varieties have also been developed, including insect resistant cotton, herbicide tolerant soybean, and virus resistant papaya. **Hence, 1 is correct.**
- In conventional breeding, plant breeders scrutinize their fields and search for individual plants that exhibit desirable traits. These traits arise spontaneously through a process called mutation, but the natural rate of mutation is very slow and unreliable to produce all the plant traits that breeders would like to see. However, in genome sequencing it takes less time, thus it is more preferable. **Hence, 2 is correct.**
- The host-pathogen interaction is defined as how microbes or viruses sustain themselves within host organisms on a molecular, cellular, organism or population level. The genome sequencing enables the study of the entire DNA sequence of a crop, thus it aids in understanding of pathogens' survival or breeding zone. **Hence, 3 is correct.**
- **Therefore, option (d) is the correct answer.**

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