Genomics in Public Health & Pathogen Surveillance

Submitted by: Mrinal Bamhotra

Submitted to: Dr. Rintu Kutum

- # Genomics in Public Health

Introduction:

Genomics, a branch of molecular biology, is a field that encompasses not only genes but all the DNA, using techniques from various disciplines such as biochemistry, genetics, and molecular biology. It aids in understanding biological information in chemical terms (Accelerating Genomics for Global Health: WHO). On the other hand, public health genomics is the application of genomic knowledge to improve public health. This field has seen rapid growth, contributing to monitoring infectious diseases and various global projects (Expert meeting to accelerate human genomics for public health: WHO).

It gained popularity after the COVID-19 pandemic as genomics was used for diagnosing the infection and identifying the mutations in the SARS-COV-2, leading to the formation of new variants with significant public health implications (Accelerating Genomics for Global Health: WHO). Public health genomics applies the genome-level study on the population by utilising the broader view and analysis of the entire genome, which helps in identifying the risk factors, developing better preventive measures, and improving population health (Brand et al., 2008).

Applications:

1. **Disease Tracking and Outbreak Examination:**
   One of the critical applications of genomics in public health is disease tracking and outbreak examination. The advancements in molecular technology and bioinformatics have allowed for a more in-depth examination of pathogens. This has led to quicker diagnoses of infections, investigations of outbreaks, and checks on the spread pattern and pathogen antibacterial resistance. These capabilities have proven invaluable in managing public health crises.

2. **Personalized Medicine:**
   As diseases evolve in response to climatic and environmental changes, personalised or genomic medicine offers a powerful tool in our treatment arsenal. This approach, which uses a DNA-based strategy to plan medication

and treatment, empowers us to provide more reliable and effective therapies. It's a promising glimpse into the future of healthcare (Genomic Medicine).

3. **Prevention from Chronic Diseases:**
   Another significant application of genomics in public health is the prevention of chronic diseases. Examining a patient's genome can determine their likelihood of developing conditions such as cardiovascular disease, cancer, and diabetes. Armed with this genomic background, we can plan preventive and treatment methods, potentially reducing the burden of these diseases on individuals and society (Genomic Medicine).

4. **Genomic Environmental Health:**
   By checking the genes of a particular locality of the patient or the community, we can find out the pathogens responsible for the disease along with their pattern of spread, which we can use to reduce the spread, work on that particular locality to generate awareness about the disease, and work on its cure, looking forward to the course of mutation of the pathogen.

Advantages:

1. Improvement in disease surveillance and outbreak investigation.
2. Early risk detection of chronic disease in individuals.
3. Personalized medicine and treatment development.
4. Discovery of new drug targets.

Disadvantages

1. Ethical concerns regarding the data privacy of the patients
2. Challenges while interpreting the complex genetic data
3. Limited access to genomic technologies in low-resource environments.

- ## **Pathogen Surveillance**

Pathogen Surveillance is a comprehensive process involving monitoring and analysing various pathogens' genetic material, including bacteria, fungi, viruses, and parasites. The WHO has established a global network, the International Pathogen Surveillance Network (IPSN), for rapidly surveilling pathogens. This network accelerates the surveillance process, leading to better and more effective decisions for public health (International Pathogen Surveillance Network: WHO).

The procedure includes collecting, monitoring, and analysing the pathogens' genetic makeup, evolution and spread. These surveillance techniques were used widely during the COVID-19 pandemic to track and predict the virus's evolution, inform the public about the outcomes, and prepare for the future accordingly.

There are two types of surveillance: Passive and Active Surveillance. Passive surveillance depends upon third parties like healthcare providers and laboratories for pathogen data. In contrast, active surveillance involves healthcare officials investigating diseases by conducting surveys or testing people or demography for specific pathogens.

As the genomic surveillance of pathogens is a constant process of analysis of the genetic similarities and differences, WHO has created a 10-year plan, i.e., from 2022 – 2032, for a Global Genomic surveillance strategy for pathogens with the potential of causing epidemic or pandemic (Genomic Pathogen Surveillance strategy 2022-2032: WHO). This plan has specific objectives, such as:

1. Improve access tools for better geographic representation.
2. Strengthen the workforce to deliver at speed, scale and quality.
3. Enhance data utility for streamlined local to global public health decision-making and action.
4. Maximize connectivity for timely value add in the broader surveillance architecture.
5. Maintain a readiness posture for emergencies.
   (Global Genomic Surveillance 2022-2032: WHO)

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