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Editorial

Future of genome sequencing in clinical microbiology

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COVID-19 disease pandemic taught us so many important lessons!! A key role of genome sequencing in pandemic control was one of them. During the Ebola outbreak in West Africa, the decision-making process regarding the control of the disease was based on the epidemiological information gathered from the affected regions. In the current pandemic of SARS-CoV-2 disease, whole genome sequencing has been used to analyze the various routes of transmission and the mutations that occurred during the transmission.[1] This method has allowed us to gain a deeper understanding of the dynamics of the infection and the impact of the disease on the contact tracing networks. In addition to being able to identify the most effective ways to prevent the spread of the virus, the sequencing of the genome has also allowed us to quickly disseminate the information about the disease to the public. This process was carried out through the use of large-scale data collection and dissemination.[2–6]

Previously, the epidemiology and genome sequencing of a pathogen were working in different ways to understand the disease. Through the use of next-generation sequencing tools, the field of Genomic Epidemiology has gained a significant advantage by allowing the scientists to identify the exact genetic details of the SARS-CoV-2 virus.[7] This has allowed them to develop targeted probes and primers for the treatment of the disease. The availability of the genome sequence data has also helped in the development of vaccines, development of different molecular diagnostics and anti-virals for COVID-19.[8,9]

One of the leading causes of morbidity and mortality in the world is infectious diseases. The microbiology laboratory is a vital part of the fight against these diseases. It can perform various tasks such as identifying and preventing infections, as well as providing drug sensitivity and microscopic examination.[10] However, due to the limitations of molecular diagnosis and gene sequencing, it is not always possible to detect pathogens in 60% of cases.[11–13] Due to the limitations of molecular diagnosis and gene sequencing; it is not always possible to identify pathogens in time to treat them. This can lead to the overuse of antibiotics and the development of resistance.[14,15] Advances in genomics are helping develop more effective and personalized treatment strategies for infectious diseases. Newer genome sequencing methods are not only helping us to understand the relation between humans and genomic factors of pathogens in reference to production of vaccines and therapeutic options but also in identification of antibiotic resistance mechanism.[16,17]

This article aims to explore the various perspectives on the development and use of genomic sequencing in the clinical microbiology field. In May 2021, the WHO launched a process to develop a global strategy to improve the efficiency and effectiveness of the surveillance of pandemics and emerging threats. The organization conducted a series of stakeholder consultations to gather feedback and inform the development of the strategy.[18–21]

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The goal of the global genomic surveillance strategy is to improve the quality of surveillance and provide timely and appropriate response to the potential pandemic of pathogens. This strategy is carried out through the establishment of a resilient and sustainable global surveillance system. Five main objectives are (i) To improve access to tools for better geographical representation;(ii) To strengthen the workforce to deliver at speed, scale and quality;(iii) To enhance data sharing and utility for streamlined local to global public health decision-making; (iv) To maximize connectivity for timely value-add in the broader surveillance architecture; and (v) To maintain a readiness posture.[19] The (G7) and G20 have supported and increased political awareness about the revolutionary opportunities for genomics.[22,23] Through its global presence, the WHO will help countries develop a comprehensive surveillance architecture that includes the necessary tools and resources to support their efforts in addressing the challenges of genomics. The organization will also provide them with training and support. The development of the strategy has highlighted the importance of having a adaptable and well-resourced end-to-end laboratory and surveillance system.

There are different challenges to fulfill the requirement of WHO strategy.

1. Availability of well resourced genomic sequencing laboratories,
2. Lack of automation & standardized technical protocols,
3. Limited reference databases,
4. Limited availability of proficiency testing and quality control measures.
5. Reducing cost and turnaround time.
6. The use of next generation sequencing in the clinical laboratory differs from that of the diagnostics setting. This is because the methods used in the latter are not the same.
7. In addition, the shift to molecular analysis will require a new thinking approach by healthcare professionals.[24,25]
8. Future generations of medical professionals—including clinicians and clinical microbiologists—will need to adapt to the advantages and drawbacks of these novel instruments. Molecular diagnostics, like any new, potent technology, presents difficulties in data interpretation and reporting but may be able to more accurately and quickly diagnose infections and offer vital data for clinical management.[25]
9. The rapid development of NGS puts a strain on both the regulatory framework and the creation of laboratory standards, necessitating extra funding and incentives to spur real advancements. To overcome these obstacles and realize the potential benefits of NGS for patients and their families, collaboration between the medical and research communities, industry, regulatory agencies, and professional associations is necessary.[25]
10. Insufficiently skilled employees.
11. Analysis of this steadily increasing volume of genetic data necessitates significant computational effort.[17]

According to the ICMR website as of March 23, 2022, India is having 63 operational next-generation sequencing (NGS) sites spread among 24 States and 3 UTs. Additionally, the Indian SARS-CoV-2 Genomics Consortium (INSACOG)[26] has sites from these locations. In order to meet the goal of the Global Genomic Surveillance Strategy for Pathogens with Pandemic and Epidemic Potential, more operational sites with qualified employees will be required in the future. This will only be achievable once, 1) More stakeholders are involved, 2) Government funding is provided, 3) Strict Quality Control processes are in place for accurate analysis of the genome sequencing database, and 4) More training facilities are accessible.

Conflicts of Interest

There is no conflict of interest.

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