FROM THE LAB

The COVID-19 Pandemic:

Variants, Vaccines, & the Future of COVID

We are now well into the second year of the COVID-19 pandemic that has relentlessly impacted the lives of millions in the United States and globally. The pandemic has created social strife, income loss, physical disability, and most importantly, loss of life. Recent data collected by the Johns Hopkins Coronavirus Resource Center shows that more than forty million Americans have become infected and that this devastating disease mortally struck 650,838 individuals.[1] Data collected by the Center for Disease Control shows that more than 2 million Americans required hospitalization between August 01, 2020, and September 05, 2021, due to COVID-related complications.[2] With progressive mutagenicity of COVID-19, these numbers are likely to continue increasing.

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2 MILLION

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Contributing Viral Traits

Phylogenetic studies of COVID-19 lineage (clades) strongly support viral adaptation as the rationale for greater transmissibility and infectivity of the newer SARS-CoV-2 variants.[3] Since March 2020, the clades that showed greater adaptability and fitness are categorically placed into the known Alpha, Beta, Gamma, or Delta strains. The Delta strain is a phenotypic consequence of S protein mutation D614D, which conferred greater transmissibility and higher secondary attack rates. Mutations within the receptor-binding domain of the S protein increase binding affinity to the angiotensin-converting enzyme 2 (ACE2) receptor. Recently, the Delta strain has evolved into the Delta Plus strain that contains an S protein K417N mutation that may aid in viral escape from natural immunity and vaccine-induced immunity.[3-6]

Vaccination vs. Non-Vaccination

Due to the alarming number of infected individuals, high disease mortality, and residual complications seen in post-infected survivors, a challenge presented itself to government and commercial agencies to develop innovative technology for dynamic diagnostic testing, treatment, and methods for disease prevention. This dire need resulted in an unprecedented level of cooperation between the federal government and commercial agencies to rapidly create and produce new treatments and vaccines against COVID-19.

Since Louis Pasteur developed the first laboratory vaccine in 1879, vaccines have historically established their value in controlling disease outbreaks.[7] However, given the high mutagenicity of the delta strain, the medical community has expressed concerns with vaccine efficacy in reducing the transmission and infectivity. The vaccines can protect an individual from severe viral pathology that correlates with a reduced risk of hospitalization and death but fail to maintain a reduction in transmissibility required to achieve herd immunity. Determining viral load can objectively determine the direct potential for transmissibility and thus infectivity. Several investigators have explored the levels of viral load in both the vaccinated and unvaccinated populations. Studies have demonstrated that relative to an unvaccinated population, asymptomatic fully vaccinated (2 doses) individuals showed a reduction in viral load 30 days after the second dose. However, after 2-3 months,

the viral load in the asymptomatic vaccinated population did not significantly differ from the unvaccinated population. This finding indicates that fully vaccinated individuals have a small window of time where the risk for viral transmission is low.[8,9] However, afterward, those individuals can potentially transmit the virus to an unvaccinated population.

Future Expectations

Since ongoing studies show a reduced humoral response to viral infectivity over time, the concern is that new variants will cause breakthrough infections. However, T cell-mediated immunity is a critical component of the immune response to a viral infection that has not had a full accounting. Geers and colleagues investigated CD4 T cell activation on previously infected and fully vaccinated individuals. They found a robust response to the S protein in B.1.1.7 and B.1.351 variants, even though there was a reduced humoral response.[8] This potentially implies that reducing neutralizing antibodies may predispose an individual to breakthrough infection by future variants. However, the study findings suggest that cross-reactive SARS-CoV-2-specific T cell-mediated immunity can potentially continue to be protective against severe disease.

As mutagenicity of the delta virus continues to progress clinicians are concerned with the ability to detect future variants. The process of viral genome sequencing is not only expensive, but has limited availability, is technically difficult to perform, and has a long turnaround time. A new method that is cheaper than genome sequencing involves the use of single-nucleotide polymorphism RT-PCR.[9] It is the rapid development and distribution of diagnostics that have been an integral component of the SARS-CoV-2 pandemic response. It continues to remain the objective of Assurance Scientific Laboratories to assist clinicians in maintaining the highest quality and timely care for patients.

Conclusion

Throughout the COVID-19 pandemic, Assurance Scientific Laboratories has been a key contributor to the testing and research of COVID-19. As one of the first commercial labs in the U.S. to test for COVID-19, our lab utilizes PCR technology to deliver fast, accurate results to help inform and safeguard our communities. Our lab embraces its role alongside clinicians to maintain the principles of antibiotic stewardship. Assurance Scientific Laboratories is operating around the clock to meet demand and produce quick results.

References

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