

SARS-CoV-2 Delta variant: What do we know so far?

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Viruses make frequent replication errors in their genomes, and these mutations can have important effects on viral infections. As expected, new SARS-CoV-2 variants of concern (VOC) have emerged all over the world, with rising concerns about their increased virulence, increased transmissibility, higher disease severity, and inadequate protection from current vaccines.

The United States Department of Health and Human Services has established a SARS-CoV-2 Interagency Group to investigate the impact of emerging variants¹ and is monitoring the following variants of concern (VOC) in the United States. These include B.1.1.7 (Alpha), first detected in the United Kingdom and then in the United States by December 2020; B.1.351 (Beta), first detected in South Africa in December 2020 and then in the United States by end of January 2021; P.1 (Gamma), originated in Brazil in early January 2021 and detected in the United States in the same month; and B.1.617.2 (Delta), first identified in India in December 2020 and then detected in the United States in March 2021. These recent VOCs have increased transmission rates compared to the Alpha variant and decreased susceptibility to monoclonal antibodies used in the treatment of SARS-COV-2. In addition, vaccine-induced immunity may be less protective.²

Based on previous data, the Alpha variant was the most common variant across the United States,³ but this trend is starting to change. The Delta variant is now the most prevalent variant in the United Kingdom, and the Centers for Disease Control and Prevention has warned that this might also be the case in the United States. The Delta variant caused 57% of the infections in the last week of June and the first week of July.⁴

Dhar et al. reported that with the emergence of the Delta variant in India, there was a 10-fold rise in cases with a displacement of Alpha and Kappa lineages by

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Table 1. Summary of SARS-CoV-2 VOC Types and Clinical Effects⁵

Variant Type	Clinical Effects
Alpha (B.1.1.7)	Increased transmission
Beta (B.1.351)	Increased transmission and virulence
Gamma (B.1.1.28.1)	Increased transmission and virulence, decreased neutralization
Delta (B.1.617.2)	Increased transmission, decreased neutralization
Kappa (B.1.617.1)	Increased transmission, decreased virulence

Delta variants with a 3-fold increase in mortality compared to previous waves.⁶ Evidence from Delhi indicated that the Delta variant was associated with a high viral load, transmission rates, vaccination breakthrough, and reinfection. Sheikh et al. recently reported results from a Scottish cohort study using a Scotland-wide COVID-19 surveillance platform; the Delta VOC was diagnosed mainly in younger age groups and the risk of hospital admission was doubled compared to the Alpha VOC and the risk was even higher in patients with five or more comorbidities.² Both the Oxford–AstraZeneca and Pfizer–BioNTech vaccines were effective in reducing infection and hospitalization rates associated with the Delta VOC, but these vaccines are less effective against the Delta variant than the Alpha variant. The Oxford–AstraZeneca vaccine appeared less effective than the Pfizer–BioNTech vaccine in preventing SARS-CoV-2 infection with the Delta VOC. However, the observational nature of these data may limit their validity.

The Delta variant is relatively resistant to vaccines, particularly in the recipients of a single dose of the vaccine. This information is based on *in vitro* neutralization tests that used monoclonal antibodies, convalescent serum, and serum from vaccinated subjects in assays.^{7,8} This presumably reflects changes in the spike protein architecture secondary to the mutations in these proteins. Clinical data derived from

a public health study from England revealed that a single dose of either AstraZeneca's or Pfizer's vaccine reduced the risk of developing COVID-19 symptoms caused by the Delta variant by 33%, compared to 50% for the Alpha variant. A second dose of the AstraZeneca vaccine boosted immunity against the Delta virus to 60% (compared to 66% against Alpha), while two doses of Pfizer's vaccine were 88% effective (compared to 93% against Alpha).⁹ Preliminary data of vaccine breakthrough infections were analyzed by Farinholt et al. who reported six cases of SARS-CoV-2 Delta variant infection in fully vaccinated individuals with Covaxin, Pfizer, or Moderna vaccines.¹⁰ All six patients tested positive for SARS-CoV-2 Delta variant and were symptomatic. One patient who had received the Pfizer vaccine had severe symptoms, required hospital admission, and was treated with a monoclonal antibody infusion. Another patient who received the Covaxin vaccine and had no comorbidities died due to complications of SARS-CoV-2.

More research is needed to evaluate the current vaccines to determine whether they are less effective against the new variants and establish the need to modify or develop new vaccines to restore protection against emerging variants. However, to date, all current data indicate that the most effective way to lower the infection rates, even with the emerging variant, is full vaccination.

Keywords: SAR-CoV-2 variants, delta variant, mutations, vaccine efficacy

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