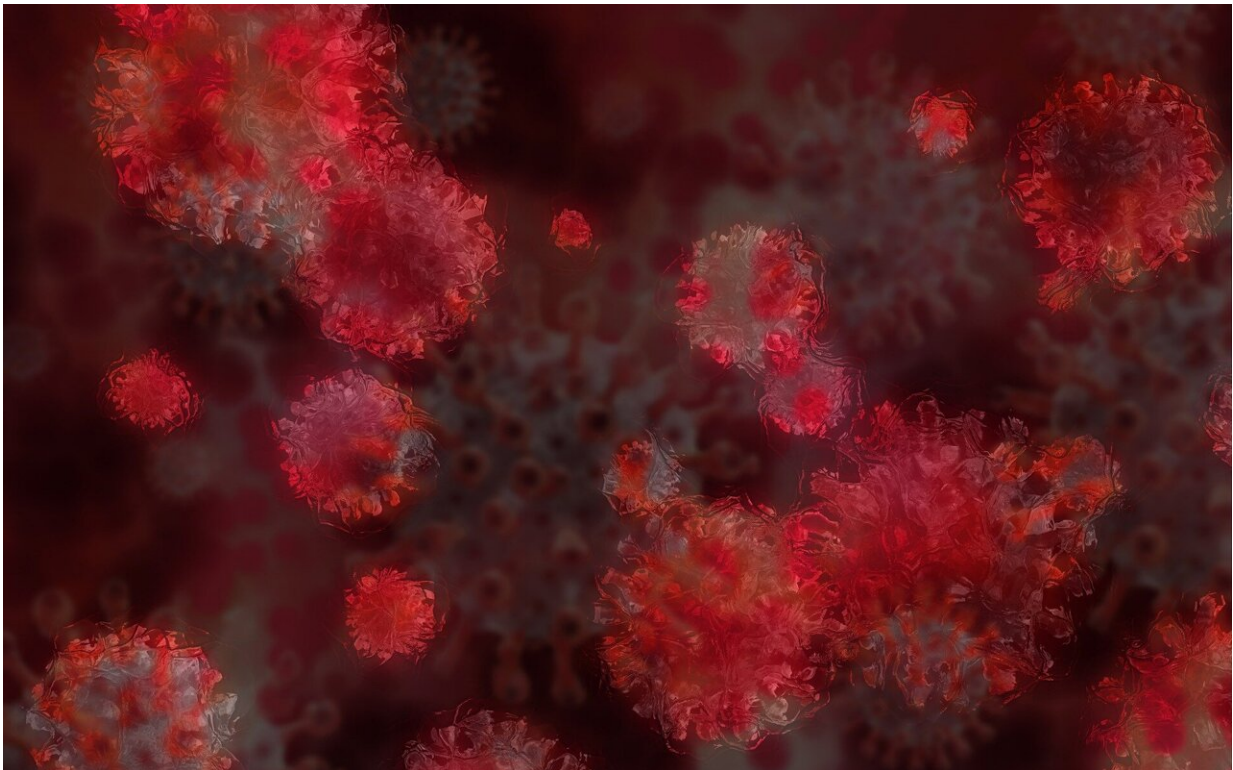


Delhi outbreak highlights challenge of reaching herd immunity in face of Delta variant

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The severe outbreak of COVID-19 in Delhi, India, in 2021 showed not only that the Delta variant of SARS-CoV-2 is extremely transmissible but that it can infect individuals previously infected by a different

variant of the coronavirus, says a team of international scientists writing in *Science*.

SARS-CoV-2 had spread widely throughout India in the first wave, with initial results from the Indian Council of Medical Research finding one in five (21%) adults and one in four (25%) 10 to 17-year-old adolescents had been infected. The figures were much higher in Indian megacities: By February 2021, over a half (56%) of the individuals in Delhi were thought to have been infected.

Since the first case of COVID-19 was detected in Delhi in March 2020, the city had experienced multiple outbreaks, in June, September and November 2020. After reaching a high of almost 9,000 cases daily in November 2020, new cases steadily declined, with very few new infections between December 2020 and March 2021.

The situation reversed dramatically in April 2021, going from approximately 2,000 daily cases to 20,000 between 31 March and 16 April. This was accompanied by a rapid rise in hospitalizations and ICU admissions, severely stressing the healthcare system, with daily deaths spiking to levels three-fold higher than previous waves.

In research published today, an international team of scientists used genomic and epidemiological data, together with mathematical modeling, to study the [outbreak](#). The work was led by the National Center of Disease Control and the CSIR Institute of Genomics and Integrative Biology, India, with collaborators from the University of Cambridge and Imperial College London, UK, and the University of Copenhagen, Denmark.

To determine whether SARS-CoV-2 variants were responsible for the April 2021 outbreak in Delhi, the team sequenced and analyzed viral samples from Delhi from the previous outbreak in November 2020 until

June 2021. They found that the 2020 outbreaks in Delhi were unrelated to any variant of concern. The Alpha variant (B.1.1.7) was identified only occasionally, primarily in foreign travelers, until January 2021. The Alpha variant increased in Delhi to about 40% of cases in March 2021, before it was displaced by a rapid increase in the Delta variant (B.1.617.2) in April.

Applying mathematical modeling to the epidemiological and [genomic data](#), the researchers found that the Delta variant was between 30-70% more transmissible than previous SARS-CoV-2 lineages in Delhi, including the Alpha variant. Importantly, the model also suggested that the Delta variant was able to infect people who had previously been infected by SARS-CoV-2—prior infection provided only 50-90% of the protection against infection with Delta variant that it provides against previous lineages.

To look for actual evidence of reinfection to support their modeling work, the researchers examined a cohort of individuals recruited by the Council of Scientific and Industrial Research (CSIR), India. In February, 42.1% of unvaccinated subjects participating in the study had tested positive for antibodies against SARS-CoV-2. In June, the corresponding number was 88.5%, suggesting very high infection rates during the second wave. Among 91 subjects with prior infection before Delta, about one-quarter (27.5%) showed increased levels of antibodies, providing evidence of reinfection.

When the team sequenced all the samples of vaccination-breakthrough cases at a single center over the period of the study, they found that among 24 reported cases, Delta was seven-fold more likely to lead to vaccination breakthroughs than non-Delta lineages.

Dr. Anurag Agrawal from the National Center of Disease Control and the CSIR Institute of Genomics and Integrative Biology, India, senior

author and co-lead investigator, said, "This work helps understand the global outbreaks of Delta, including in highly vaccinated populations, because the Delta variant can transmit through vaccinated or previously infected people to find those who are susceptible."

Co-author Professor Ravi Gupta from the Cambridge Institute of Therapeutic Immunology and Infectious Disease at the University of Cambridge, UK, said, "The concept of herd immunity is critical in ending outbreaks, but the situation in Delhi shows that infection with previous coronavirus variants will be insufficient for reaching herd immunity against Delta. The only way of ending or preventing outbreaks of Delta is either by infection with this variant or by using vaccine boosters that raise antibody levels high enough to overcome Delta's ability to evade neutralization."

[Previous research](#) led by Professor Gupta showed that the Delta [variant](#) has most likely spread through its ability to evade neutralizing antibodies and its increased infectivity.

More information: Mahesh S. Dhar et al, Genomic characterization and epidemiology of an emerging SARS-CoV-2 variant in Delhi, India, *Science* (2021). [DOI: 10.1126/science.abj9932](https://doi.org/10.1126/science.abj9932)

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