



A traveller checks in at a KLM counter at Amsterdam's Schiphol Airport.

DELTA CORONAVIRUS VARIANT: SCIENTISTS BRACE FOR IMPACT

The rapid rise of the highly transmissible strain in the United Kingdom has put other countries on watch.

By Ewen Callaway

When the first cases of the SARS-CoV-2 Delta variant were detected in the United Kingdom in mid-April, the nation was getting ready to open up. COVID-19 case numbers, hospitalizations and deaths were plummeting, thanks to months of lockdown and one of the world's fastest vaccination programmes. Two months later, the variant, which was first detected in India, has catalysed a third UK wave and forced the government to delay the full reopening of society that it had originally planned for 21 June.

After observing the startlingly swift rise of the Delta variant in the United Kingdom, other countries are bracing themselves for the variant's impact – if they aren't feeling it already. Nations with ample access to vaccines, such as those in Europe and North America, are hopeful that the shots can dampen the inevitable rise of Delta. But in countries without large vaccine stocks, particularly in Africa, some scientists worry that the variant could be devastating.

"In my mind, it will be really hard to keep out this variant," says Tom Wenseleers, an

evolutionary biologist and biostatistician at the Catholic University of Leuven (KU Leuven) in Belgium. "It's very likely it will take over altogether on a worldwide basis."

Delta, also known as B.1.617.2, belongs to a viral lineage first identified in India during a ferocious wave of infections there in April and May.

Delta data

The Delta variant has been linked to a resurgence of COVID-19 in Nepal, southeast Asia and elsewhere, but its UK spread has given scientists a clear picture of the threat it poses. Delta seems to be around 60% more transmissible than the already highly infectious Alpha variant (also called B.1.1.7) identified in the United Kingdom in late 2020.

Delta is moderately resistant to vaccines, particularly in people who have received just a single dose. A Public Health England study published on 22 May found that a single dose of either Oxford–AstraZeneca's or Pfizer–BioNTech's vaccine reduced a person's risk of developing COVID-19 symptoms caused by the Delta variant by 33%, compared with 50% for the Alpha variant (see go.nature.com/35p-bpwr). A second dose of the AstraZeneca

vaccine boosted protection against Delta to 60% (compared with 66% against Alpha), whereas two doses of Pfizer's jab were 88% effective, compared with 93% against Alpha.

Preliminary evidence from England and Scotland suggests that people infected with Delta are about twice as likely to end up in hospital as are those infected with Alpha.

"The data coming out of the UK is so good that we have a really good idea about how the Delta variant is behaving," says Mads Albertsen, a bioinformatician at Aalborg University in Denmark. "That's been an eye-opener."

Denmark, which, like the United Kingdom, is a world leader in genomic surveillance, has also seen a steady rise in cases caused by the Delta variant – although it has had far fewer than most other European countries. It is only a matter of time before the variant becomes dominant in Denmark, says Albertsen, but the hope is that its expansion can be slowed through vaccination, surveillance and enhanced contact tracing. "It's going to take over," he says, but "hopefully in a few months and not too soon."

Meanwhile, the Danish government is easing restrictions, not reimposing them. "It is looking good now in Denmark, and we are keeping a close eye on the Delta variant," says Albertsen. "It can change quite fast, as it has done in the UK."

UK cases of the Delta variant are doubling roughly every 11 days. But countries with ample vaccine stocks should be reassured by the slower uptick in hospital admissions, says Wenseleers. A recent Public Health England study found that people who have had one vaccine dose are 75% less likely to be hospitalized, compared with unvaccinated individuals, and those who are fully protected are 94% less likely to be hospitalized (J. Stowe *et al.* Preprint at <https://go.nature.com/3gnqwxr>; 2021).

US spread

Delta is also on the rise in the United States, particularly in the Midwest and southeast. The US Centers for Disease Control and Prevention declared it a variant of concern on 15 June. But patchy surveillance means the picture there is less clear. According to nationwide sampling conducted by the genomics company Helix in San Mateo, California, Delta is rising fast, while Alpha fell from more than 70% of cases in late April to around 42% by mid-June (A. Bolze *et al.* Preprint at medRxiv <https://doi.org/gkv8>; 2021).

Jeremy Kamil, a virologist at Louisiana State University Health in Shreveport, expects Delta to eventually become dominant in the United States, "but to be somewhat blunted by vaccination". However, vast disparities in vaccination rates could lead to regional and local variation in cases and hospitalizations caused by Delta, says Jennifer Surtees, a biochemist at the University at Buffalo, New York, who is conducting regional surveillance.

News in focus

She notes that 70% of eligible New Yorkers have received at least one dose of vaccine – a milestone that triggered the lifting of most COVID-19 restrictions last week – but that figure is below 40% in some parts of the state. Communities with high proportions of African American and Hispanic individuals, where vaccination rates tend to be low, could be especially hard hit by Delta.

Data from Helix on nearly 20,000 samples sequenced since April suggest that the Delta variant is spreading faster in US counties where less than 30% of residents have been fully vaccinated than in ones with vaccination rates above that threshold.

Africa at risk

Delta poses the biggest risk, scientists say, to countries that have limited access to vaccines, particularly those in Africa, where most nations have vaccinated less than 5% of their populations. “The vaccines will never come in time,” says Wenseleers. “If these kinds of new variant arrive, it can be very devastating.”

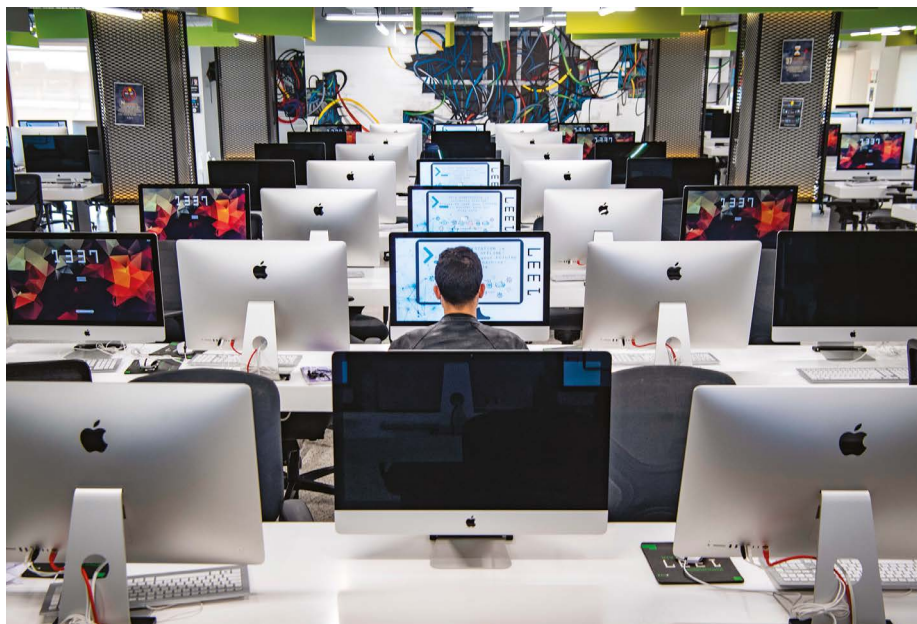
Surveillance in African countries is extremely limited, but there are hints that the variant is already causing cases there to surge. Several sequences of the variant have been reported in the Democratic Republic of the Congo, where an outbreak in the capital city of Kinshasa has filled hospitals. The variant has also been detected in Malawi, Uganda and South Africa.

Countries that have close economic links to India, such as those in East Africa, are probably at the greatest risk of seeing a surge in cases caused by Delta, says Tulio de Oliveira, a bioinformatician and director of the KwaZulu-Natal Research and Innovation Sequencing Platform in Durban, South Africa. In his country, all of the Delta cases have been detected in shipping crews at commercial ports, with no signs yet of spread in the general community.

De Oliveira expects it to stay this way. South Africa is in the middle of a third wave of infections caused by the Beta variant (also known as B.1.351) identified there last year. This, combined with a lack of travel from countries affected by Delta, should make it harder for a new variant to take hold.

Similar factors could be keeping Delta at bay in Brazil, which is battling another immune-evading variant called P.1, or Gamma, says Gonzalo Bello, a virologist at the Oswaldo Cruz Institute in Rio de Janeiro who is part of a team conducting national surveillance. So far, Brazil has sequenced just four cases of the Delta variant in the country.

While countries gird themselves against the Delta variant – or hope that it passes them by – researchers say we need to watch for even greater threats. “What most people are concerned about are the next variants – if we start to see variants that can really challenge the vaccines,” says Albertsen.



FADIEL SENNA/AFP VIA GETTY

Efforts to verify a complex mathematical proof using computers have been successful.

MATHEMATICIANS WELCOME COMPUTER-ASSISTED PROOF

Proof-assistant program handles an abstract concept, revealing a bigger role for software in mathematics.

By Davide Castelvecchi

Peter Scholze wants to rebuild much of modern mathematics, starting from one of its cornerstones. Now, he has received validation for a proof at the heart of his quest from an unlikely source: a computer.

Although most mathematicians doubt that machines will replace the creative aspects of their profession any time soon, some acknowledge that technology will have an increasingly important role in their research – and this particular feat could be a turning point towards its acceptance.

Scholze, a number theorist, set forth the ambitious plan – which he co-created with Dustin Clausen at the University of Copenhagen – in a series of lectures in 2019 at the University of Bonn, Germany, where he is based. The two researchers dubbed it condensed mathematics, and they say it promises to bring new insights and connections between fields ranging from geometry to number theory.

Other researchers are paying attention: Scholze is considered one of mathematics’ brightest stars and has a track record of introducing revolutionary concepts. Emily Riehl, a mathematician at Johns Hopkins University

in Baltimore, Maryland, says that if Scholze and Clausen’s vision is realized, the way mathematics is taught to graduate students in 50 years’ time could be very different from today. “There are a lot of areas of mathematics that I think in the future will be affected by his ideas,” she says.

Until now, much of that vision rested on a technical proof so involved that even Scholze and Clausen couldn’t be sure it was correct. But earlier this month, Scholze announced that a project to check the heart of the proof using specialized software had been successful.

Computer assistance

Mathematicians have long used computers to do numerical calculations or manipulate complex formulas.

But systems known as proof assistants go deeper. The user enters statements into the system to teach it the definition of a mathematical concept – an object – based on simpler objects that the machine already knows about. A statement can also just refer to known objects, and the proof assistant will answer whether the fact is ‘obviously’ true or false on the basis of its current knowledge. If the answer is not obvious, the user has to enter more details. Proof assistants thus force the