Vaccines and Related Biological Products Advisory Committee Meeting

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Continuing SARS-CoV-2 evolution under population immune pressure

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Vaccines and Related Biological Products Advisory Committee Meeting
FDA

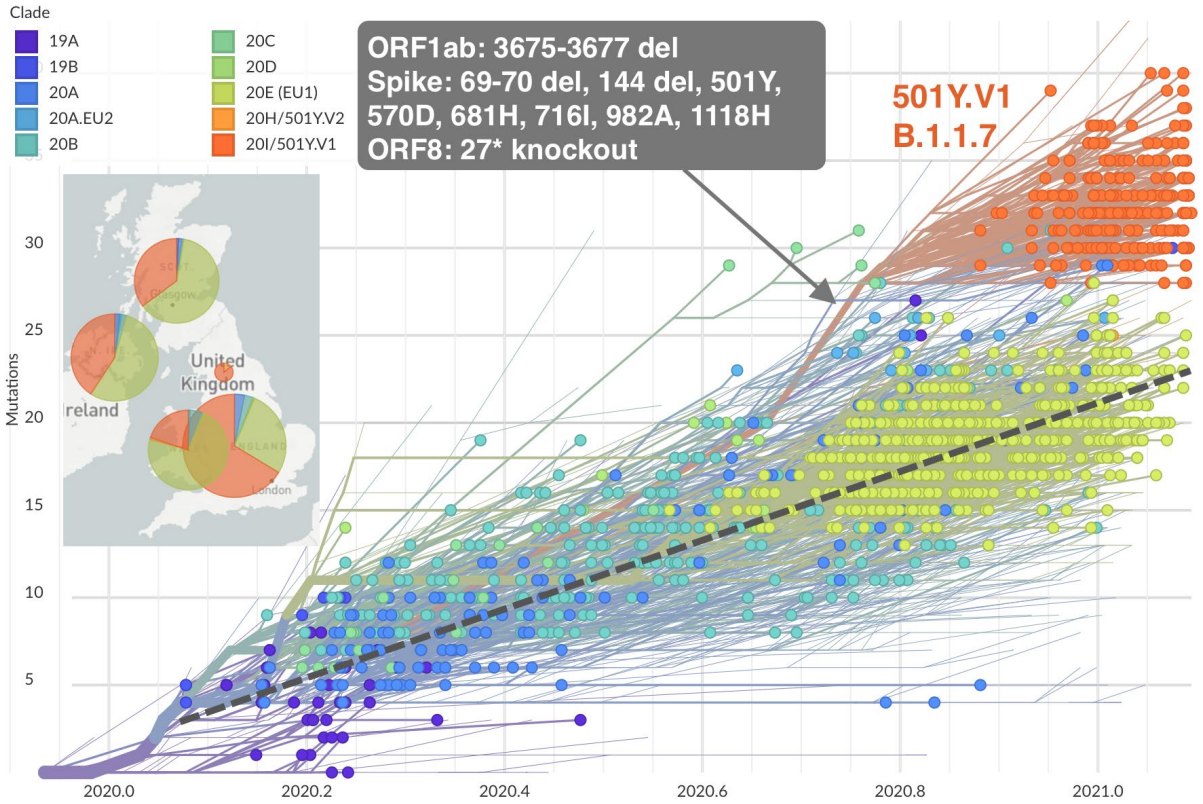
Slides at bedford.io/talks

Disclosures

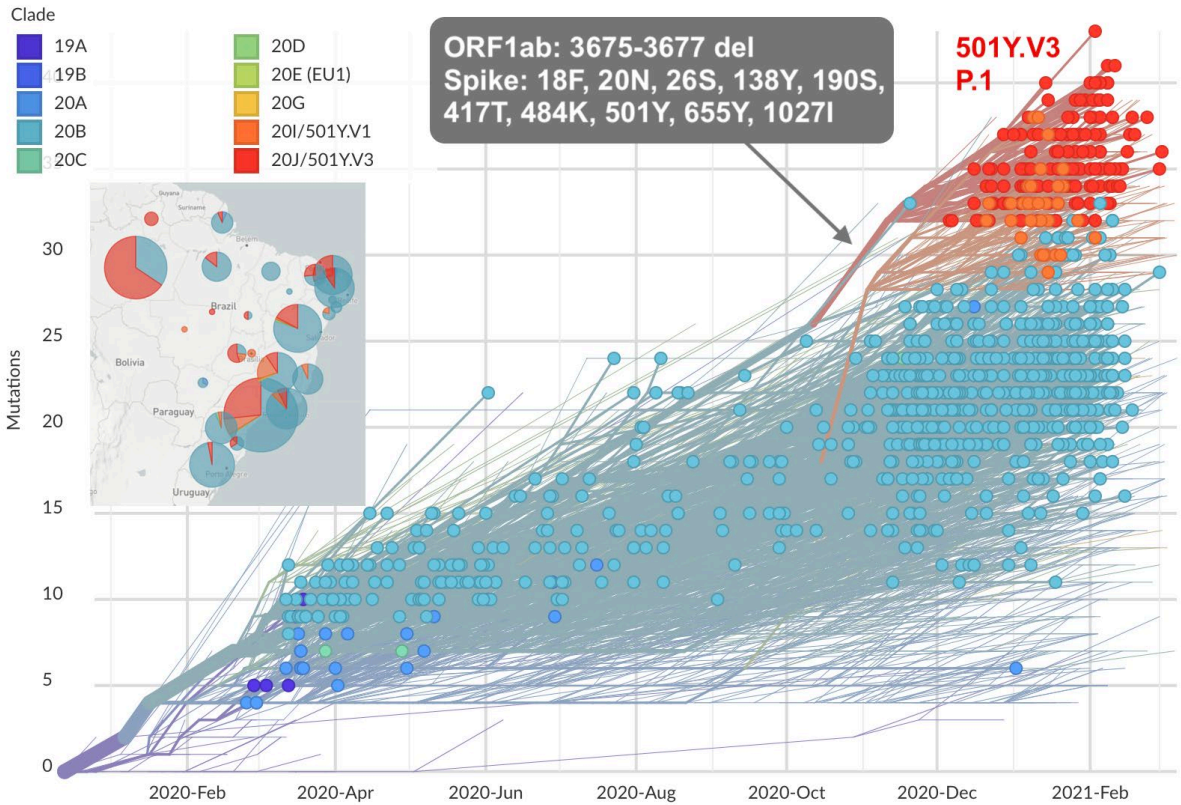
- I receive grant support from the National Institutes of Health and the Howard Hughes Medical Institute to research methods for evolutionary forecasting of SARS-CoV-2.

Repeated emergence of variant of concern viruses

Alpha

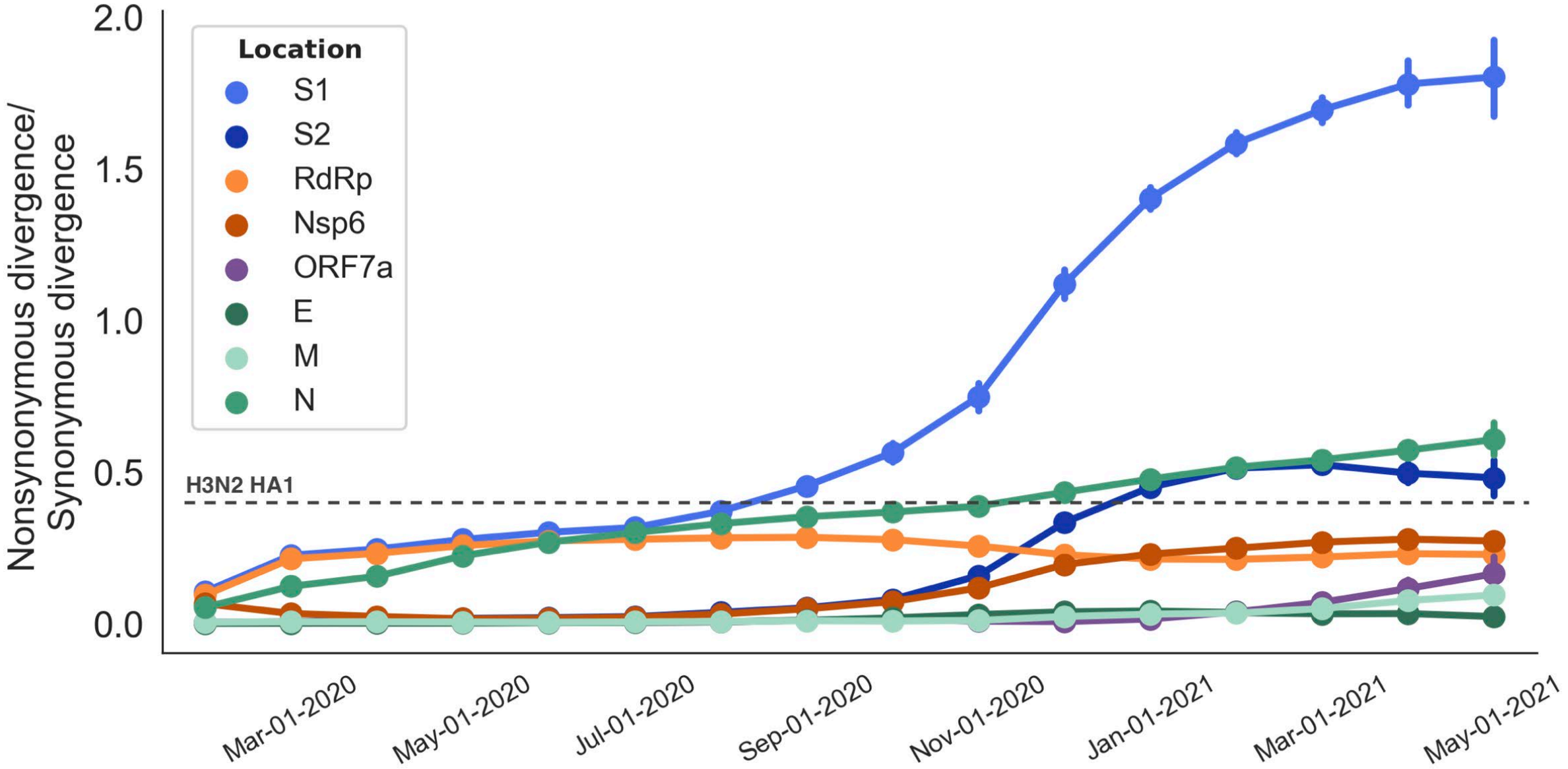


Gamma



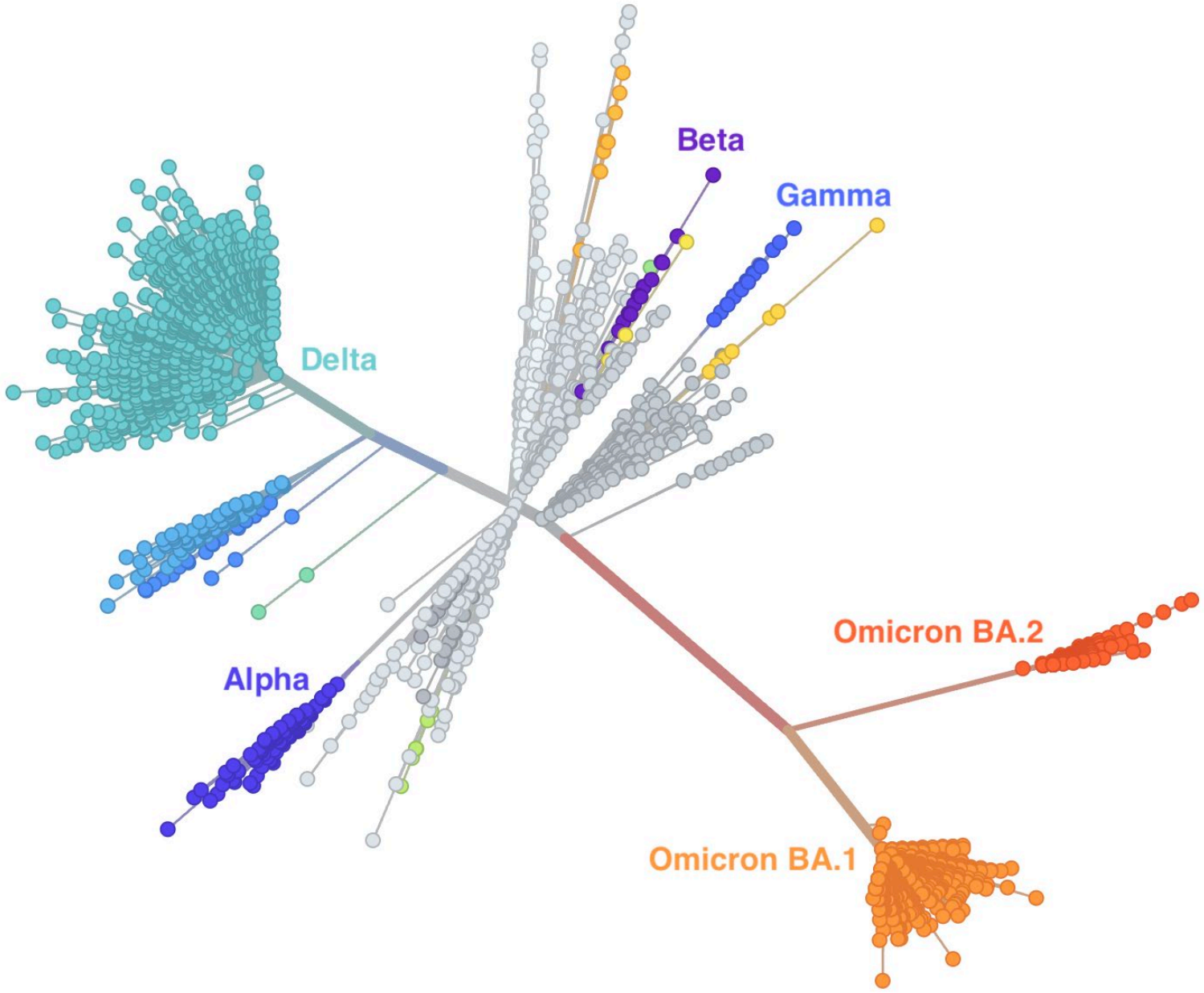
nextstrain.org

Rapid adaptive evolution focused on S1 subunit of spike protein



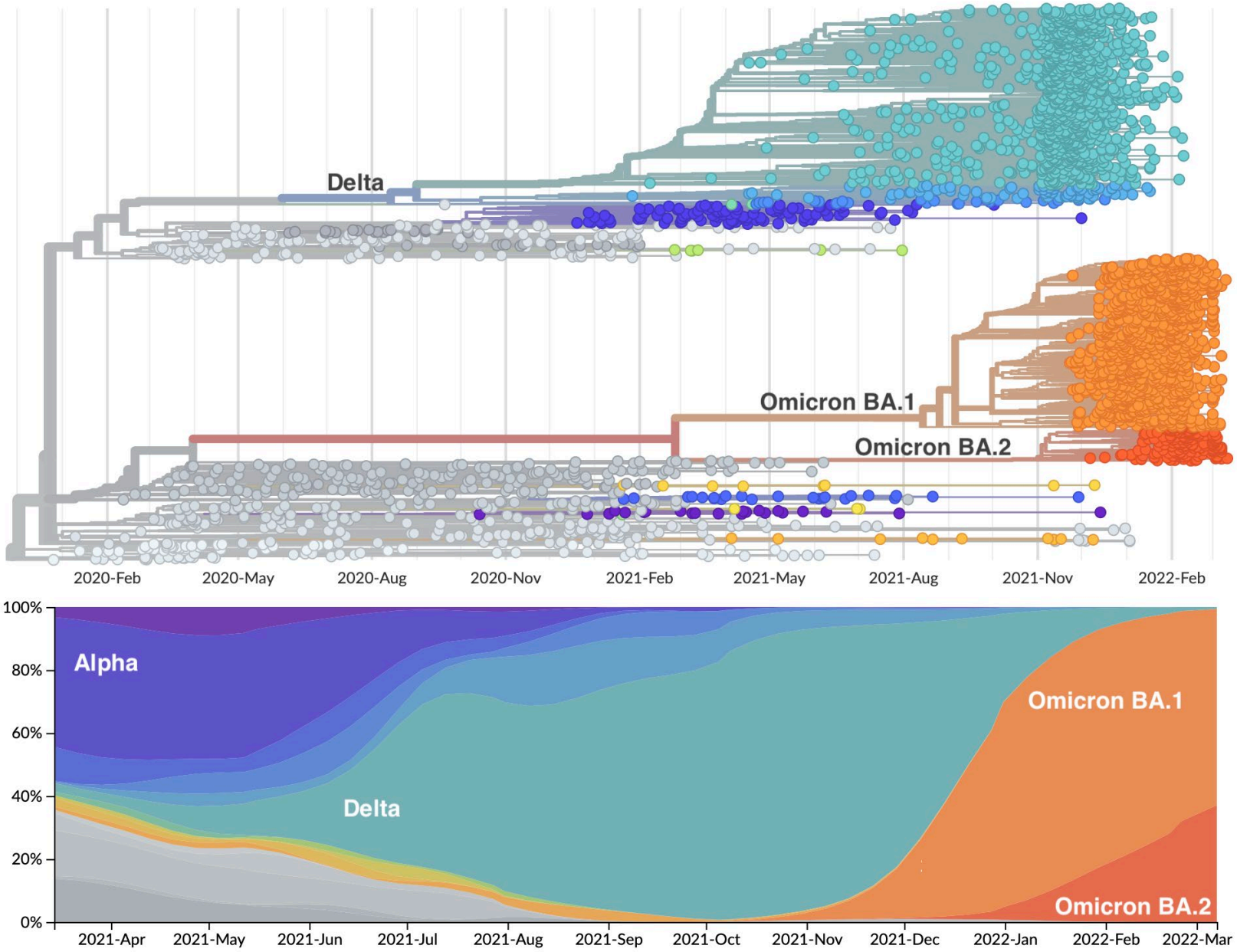
Kistler et al. 2022. Cell Host Microbe.

Genetic relationships of globally sampled SARS-CoV-2 to present



nextstrain.org

Rapid displacement of existing diversity by emerging variants



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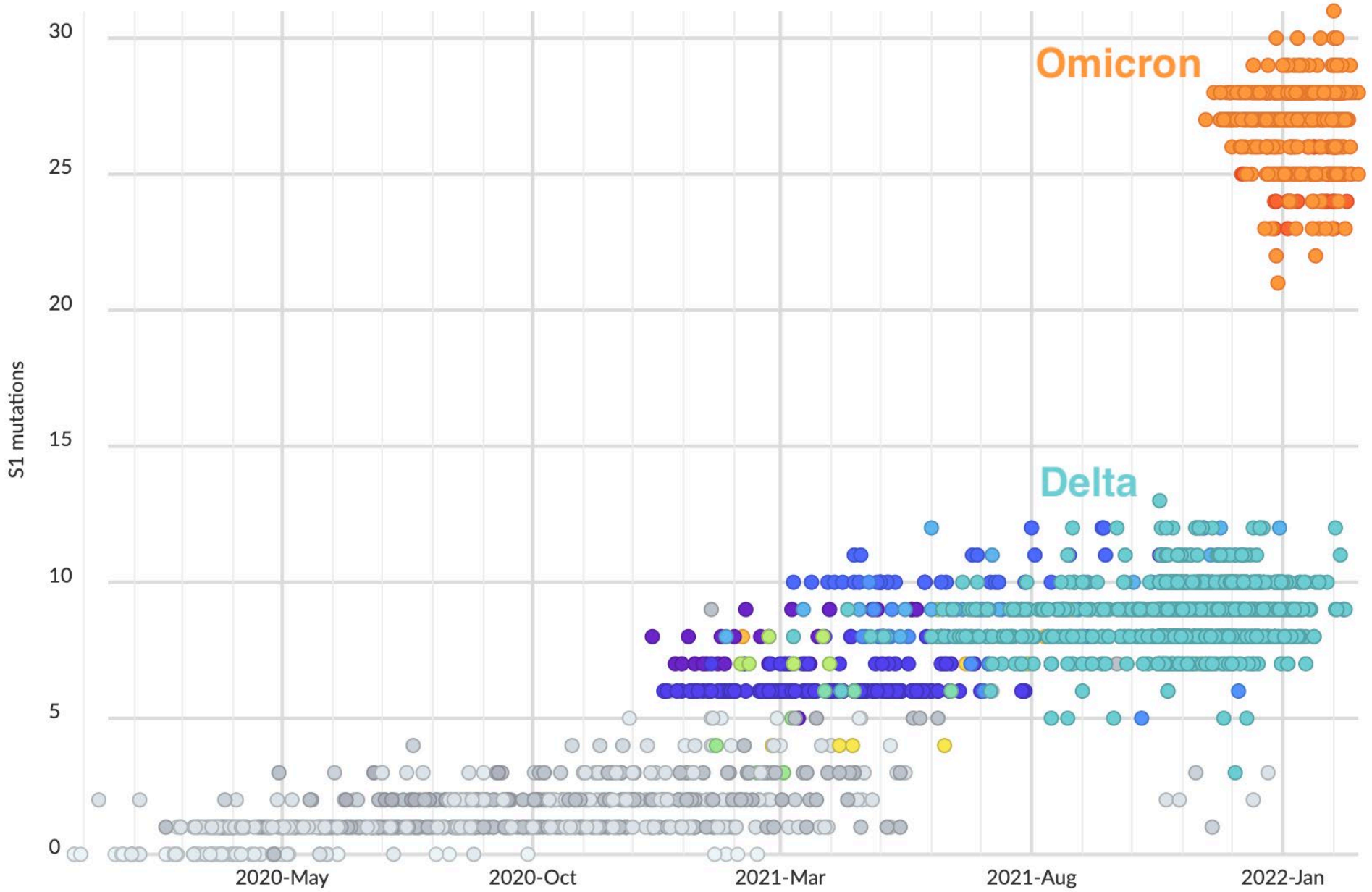
Omicron shows particular excess of mutations at S1



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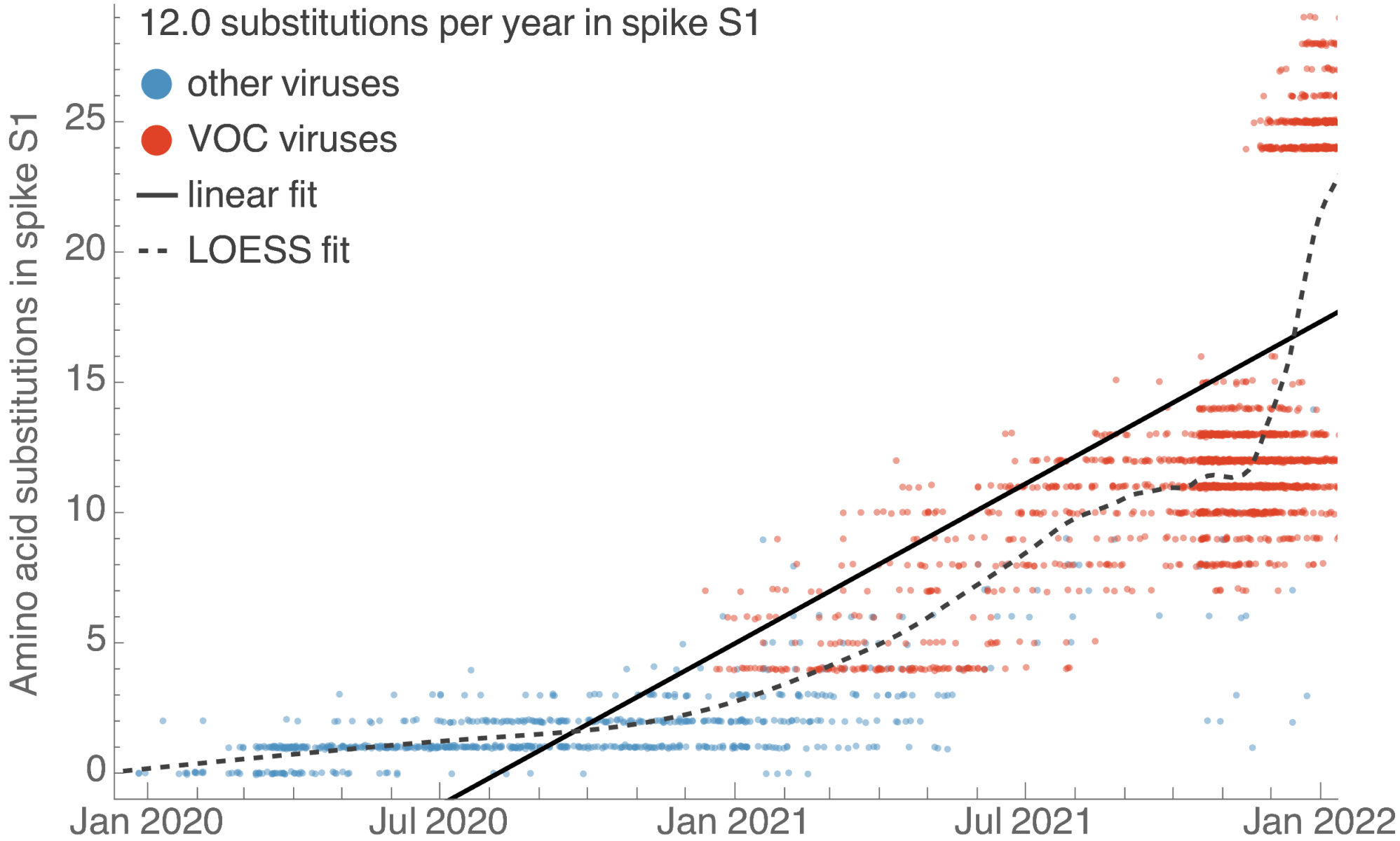
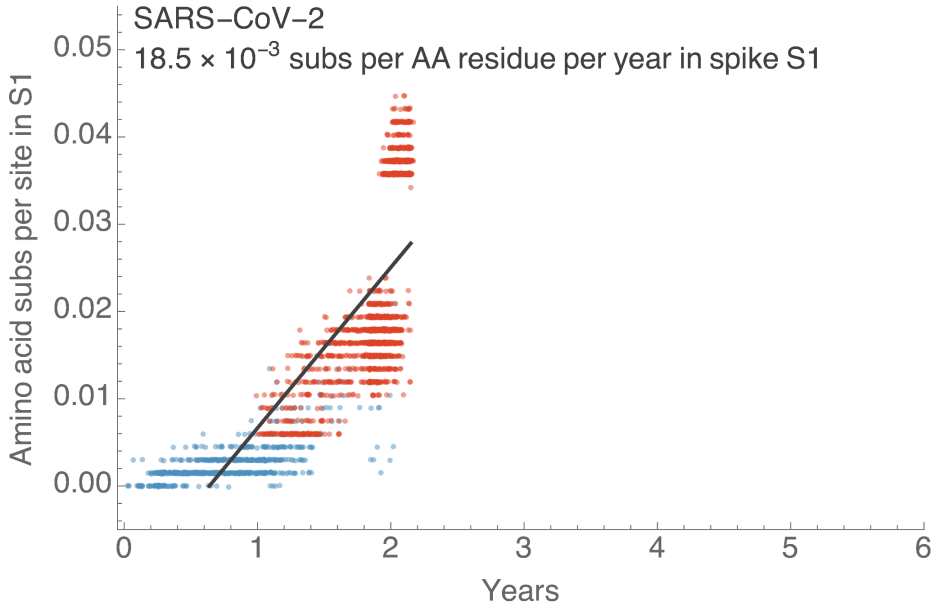
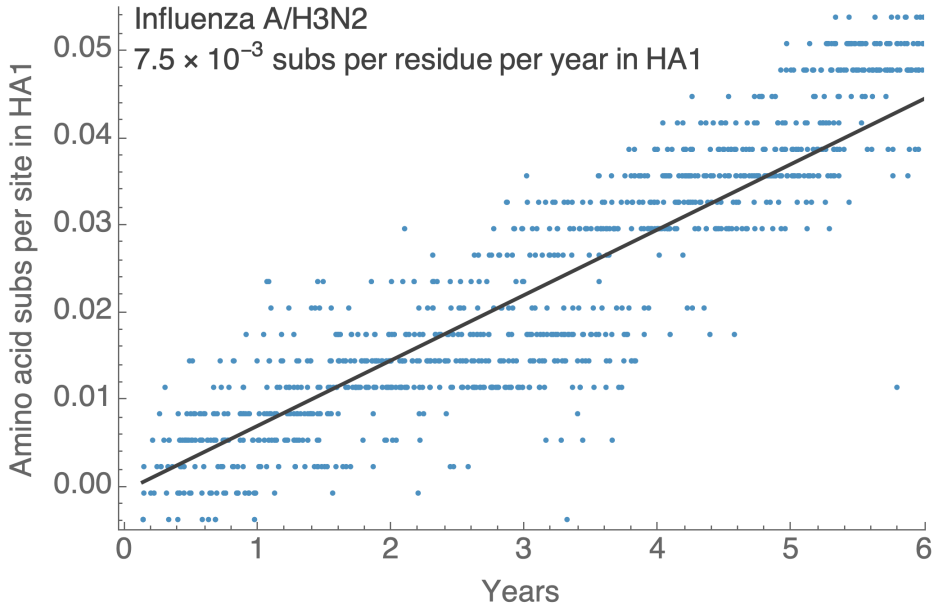
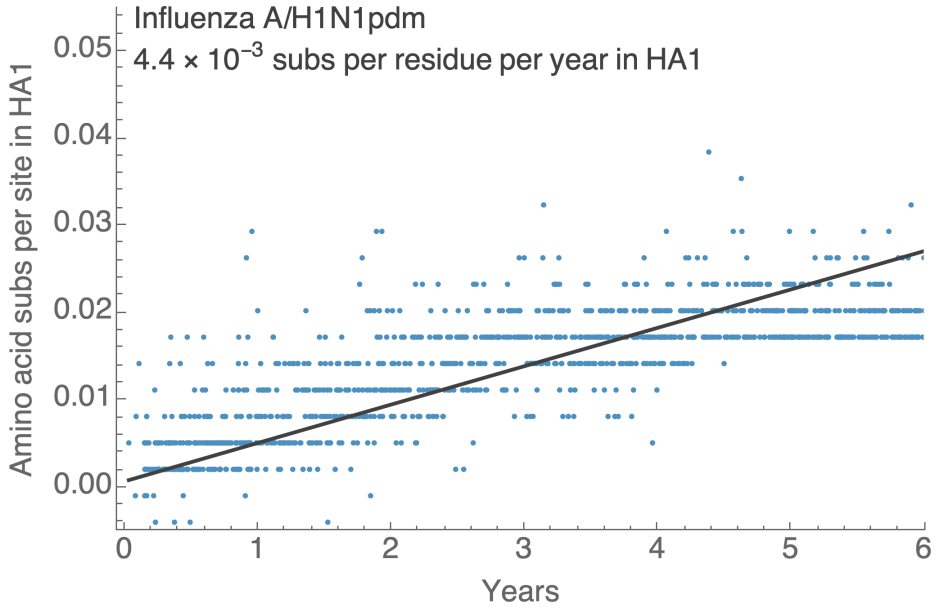
S1 evolved at a rate of 12 amino acid changes per year in 2021

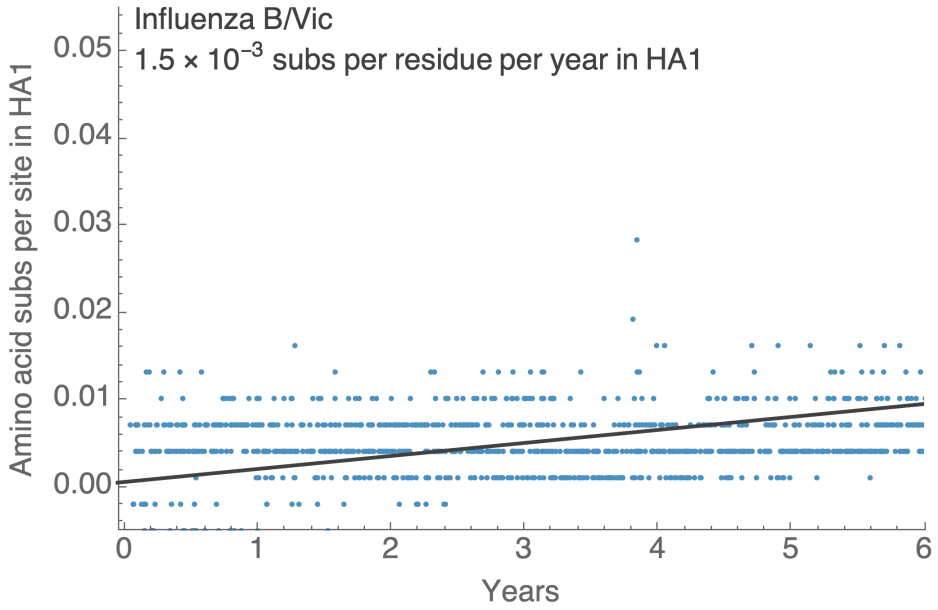


This is remarkably fast relative to seasonal influenza

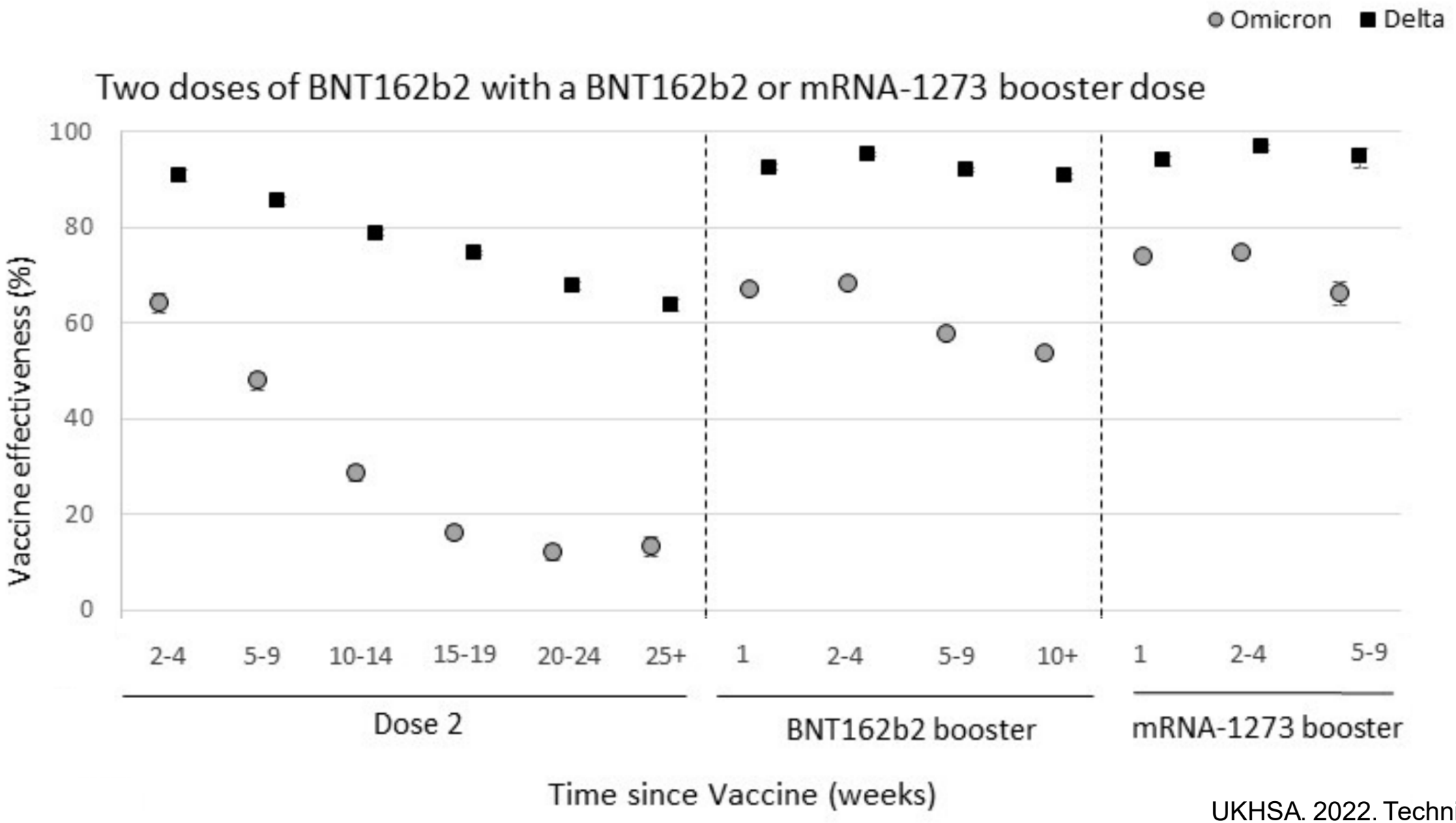






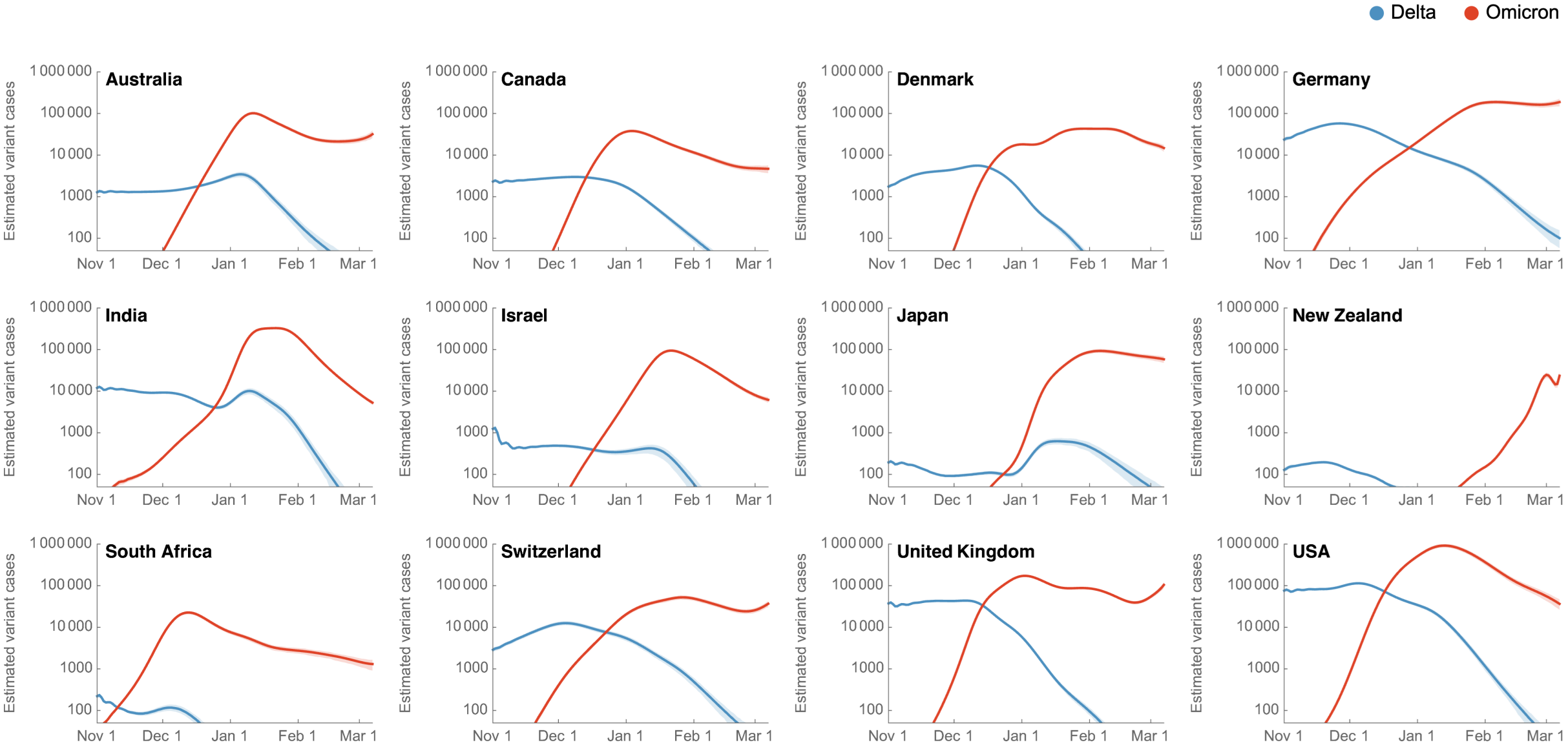


Omicron spike mutations substantially drop VE against infection



UKHSA. 2022. Technical Report.

Significant immune escape drove large-scale epidemics



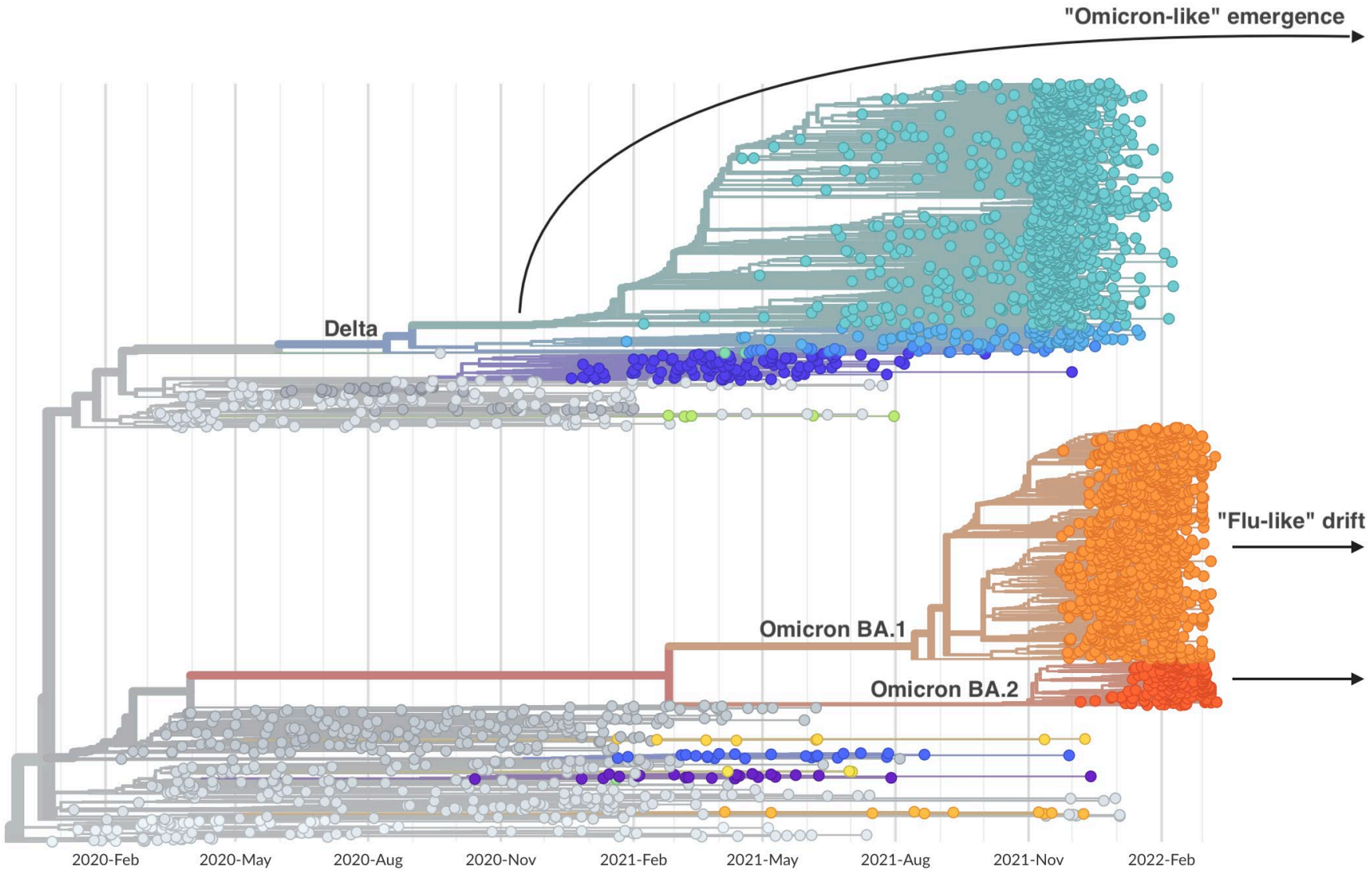
Figgins and Bedford. 2021. medRxiv.

Omicron attack rate

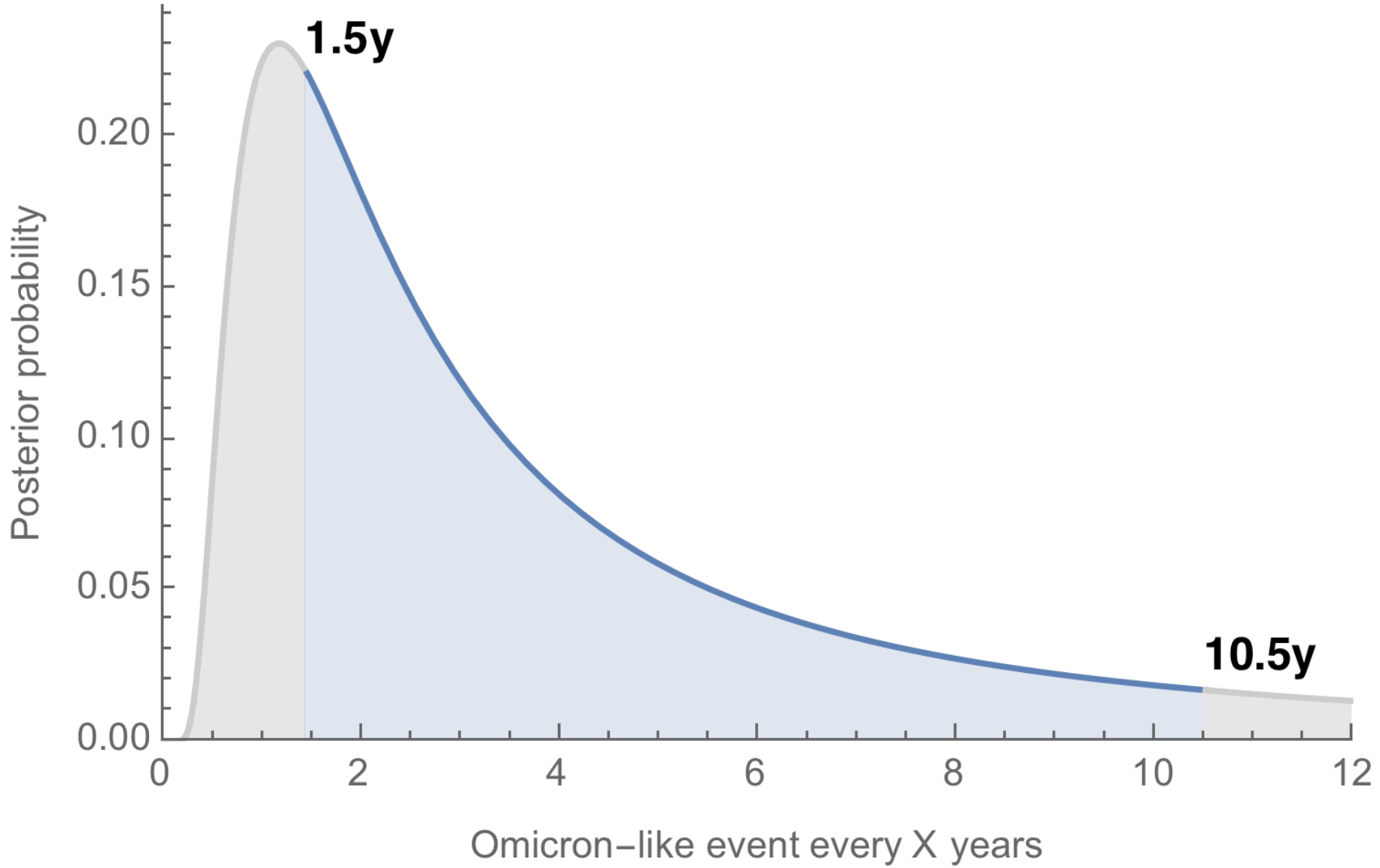
1. We estimate US has seen 9.8% of the population as confirmed cases of Omicron through Mar 1, with the large majority accumulating after Dec 15

2. Assuming a case detection rate of 1 in 5 infections, we estimate almost 50% of the US infected with Omicron, most in the span of ~10 weeks

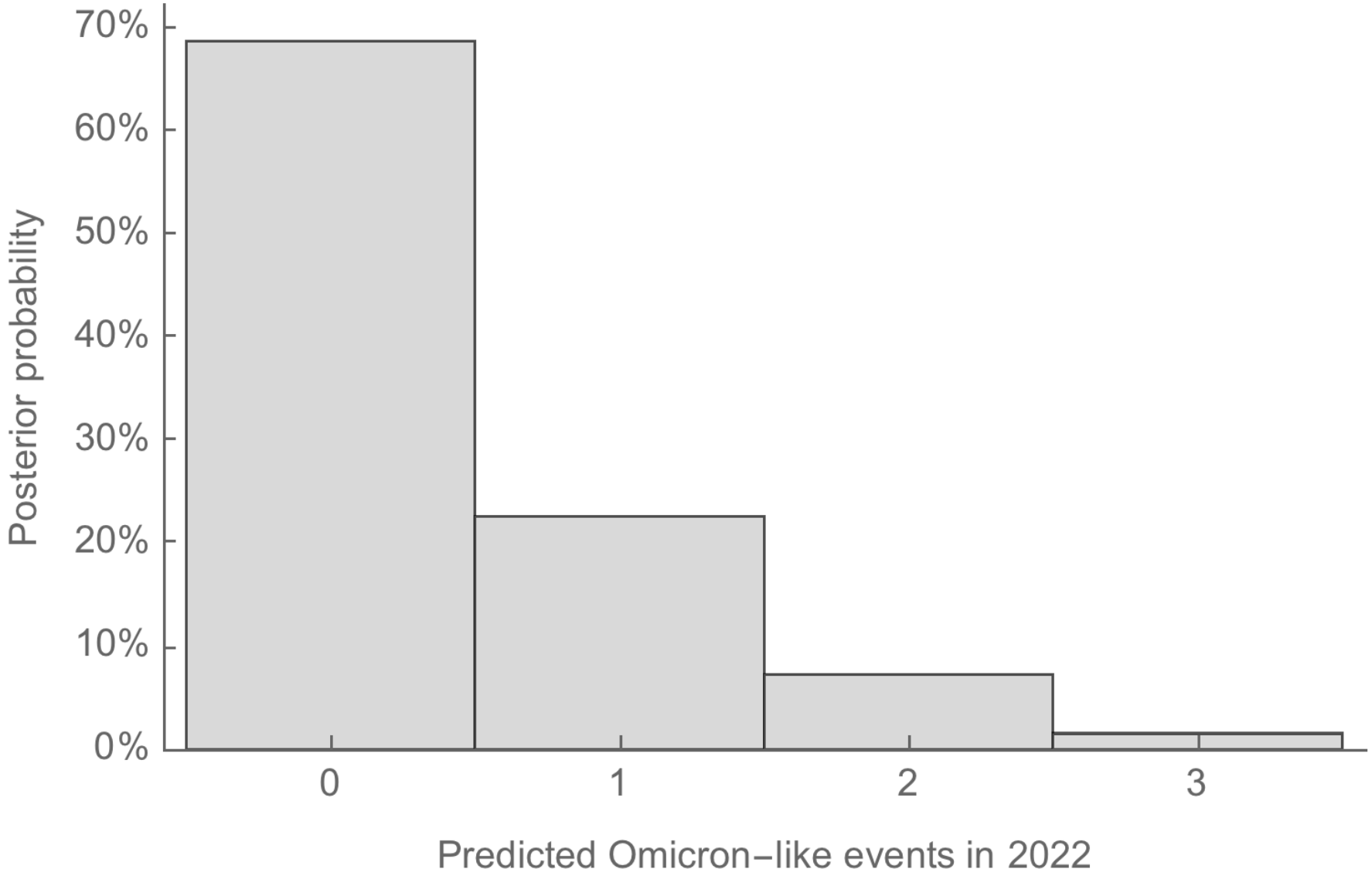
SARS-CoV-2 will continue to evolve to escape population immunity, though with multiple potential avenues



With 1 observation in 2.35 years of virus evolution, it's currently unclear how common Omicron-like events will be



This rate distribution gives a naive prediction of Omicron-like emergence events occurring in the next 12 months



Likely scenarios over the next 12 months

1. (More likely) Evolution within Omicron BA.2 to further increase intrinsic transmission and to escape from Omicron-derived immunity. This scenario sees lower attack rates with 2022-2023 epidemic driven by drift + waning + seasonality.

2. (Less likely) Another Omicron-like emergence event in which a chronic infection initiated in ~2021 incubates a new wildly divergent virus. This scenario sees high attack rates with epidemic driven by variant emergence.

Acknowledgements

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