

23rd June 2021

Modelling forecasts of a fourth wave of COVID-19 in Kenya: when, where and how big?

Policy Brief

Key points

- We provide modelling forecasts of the COVID-19 pandemic in Kenya up to end of 2021.
- Genomic data indicate that the Delta variant is established in the country and gaining dominance over the Alpha variant.
- The best estimate of increased transmissibility of the Delta variant over the Alpha variant is 60%, which will result in a fourth wave across the country that will peak around mid-July 2021.
- We estimate an additional 4300 hospitalisations and 580 deaths for a Delta variant that is 60% more transmissible than the Alpha variant.
- The start of a fourth wave is imminent in the Coastal region and Nairobi county, and is already causing a surge in cases in Nyanza/Western Region counties.
- The most likely location where health service demand will exceed capacity is in the Nyanza/Western Region.

Background

We previously developed a mathematical model to provide an explanation underlying the first three waves of COVID-19 in Kenya (1). Based on this model we made predictions on the potential impact of different vaccine strategies (Policy Brief 13th May). We now use the model to forecast the impact of the Delta variant of concern (VOC) in relation to a fourth wave. The Delta variant is estimated to be 60% more transmissible than the Alpha variant, but there is uncertainty around this value (2). The Delta VOC was first identified in samples from Kenya in April 2021. Genomic data from across the country now indicates an increasing proportion of cases positive for the Delta variant, suggests the establishment of local transmission sometime in April or May, and we are beginning to see replacement of the Alpha variant that was predominant in the third wave (Figure 1). This indicates a strong likelihood of a fourth wave and prompts consideration of its timing and impact.

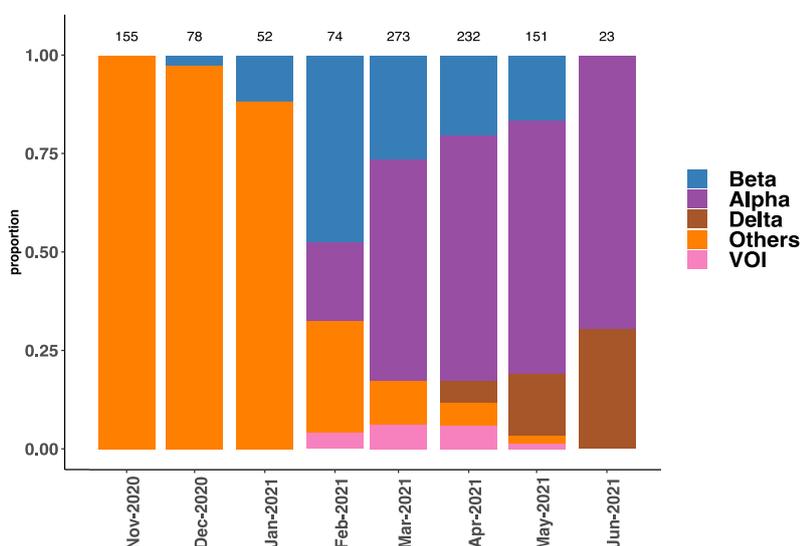


Figure 1. Timeline of SARS-CoV-2 genomic data from November 2020 to early June 2021 showing the transition from variants prevailing in the second wave (Orange) to variants of concern, Beta (first identified in South Africa, blue), Alpha (first identified in UK, purple), Delta (first identified in India, brown), and variants of interest, VOI (pink). Data arise from samples sequenced at KEMRI-Wellcome Trust, including 677 from Coast counties, 114 from Nairobi, 143 from Nyanza/Western Region, and 104 from other counties.

Methods

We extend the previously reported modelling analysis, starting from April 2021 and running to the end of December 2021, using the model predicted levels of population exposure across the country: estimated to be 75% of the country infected (but with significant variation) by the tail end of the 3rd wave (May 1st 2021) (1) (see Appendix Figure A1). Based on genomic data (Fig.1) we assume the start of local transmission of the Delta VOC was April 1st. We explore the impact of levels of increased transmissibility of the Delta variant relative to the Alpha variant from 20% to 80%, but focus on the best estimate of 60%, and assume a sigmoidal time pattern for the transition from Alpha to the Delta variant (Appendix Figure A2). We forecast the likely trajectory of new cases, hospitalisations and deaths, of a fourth wave, asking (i) when is it likely to occur, (ii) how large will it be and (iii) what will be the pattern of a fourth wave across the country? We do not include the impact of recent NPI implemented in Western Kenya in 17th June 2021. We also assume a very slow rate of decline in immunity following natural infection and hence negligible reinfections. The impact of vaccination is not considered here.

Results

How big will a fourth wave be and when will it occur?

Figure 2, describes the model predicted trajectory of PCR positive COVID-19 cases (upper panel) and deaths associated with COVID-19 (lower panel) across the country (average across simulations for each of the 47 counties) for 5 scenarios for the relative increase in transmissibility of the Delta variant from a baseline of 0% (ie no increase over the Alpha variant) to 80%. An increase in transmissibility of 60% (shown in purple in Figure 2) will result in a countrywide fourth wave peaking in July.

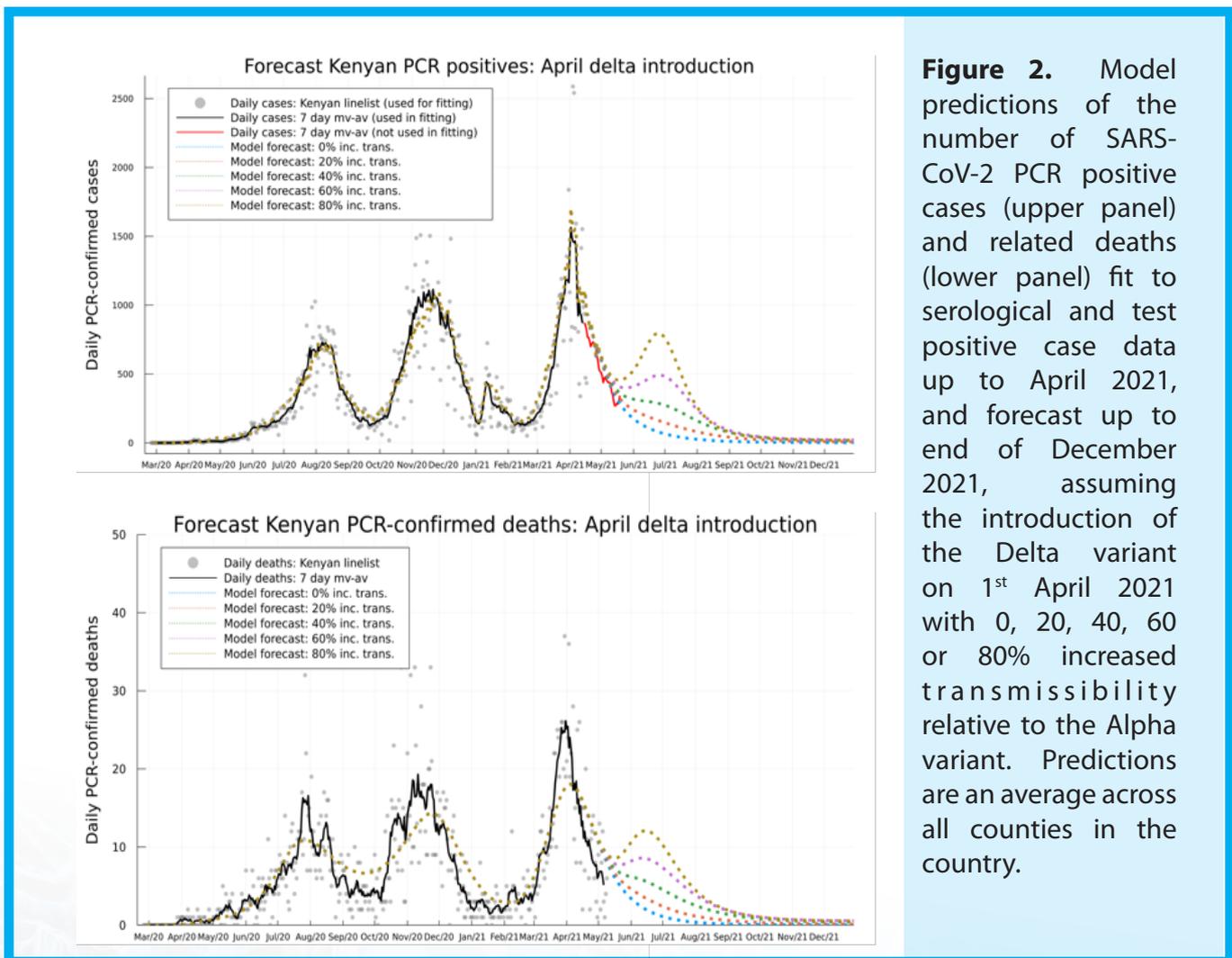


Figure 2. Model predictions of the number of SARS-CoV-2 PCR positive cases (upper panel) and related deaths (lower panel) fit to serological and test positive case data up to April 2021, and forecast up to end of December 2021, assuming the introduction of the Delta variant on 1st April 2021 with 0, 20, 40, 60 or 80% increased transmissibility relative to the Alpha variant. Predictions are an average across all counties in the country.

The predicted excess in test positive cases, hospitalisations and deaths accumulated from May 1st to 31st December 2021 are given in Table 1 for a Delta variant with 20 to 80% increased transmissibility, relative to 0% increase over the Alpha variant. For a variant of 60% increased transmissibility we predict an additional 4300 hospitalisations and 580 deaths by the end of 2021.

Table 1. The number of excess test positive cases, hospitalisations and deaths (ie increase over no Delta variant introduction) based on the predictions shown in Figure 1.

Scenario	Cases	Hospitalisations	Deaths
20% more transmissible	8,500	1,300	140
40% more transmissible	19,500	2,900	360
60% more transmissible	32,000	4,300	580
80% more transmissible	44,500	5,300	760

How will the pattern of a fourth wave vary across the country?

We provide projections of test positive cases for different parts of the country in Figure 3. Nairobi and Coast counties look set for an imminent start to a fourth wave. The LREB counties appear to have experienced a surge of cases later than elsewhere in the country that appears to be extending due to the rise in cases from the Delta variant. This is seen also in the rate of rise in cases shown in the heat map of Figure A1 in the Appendix.

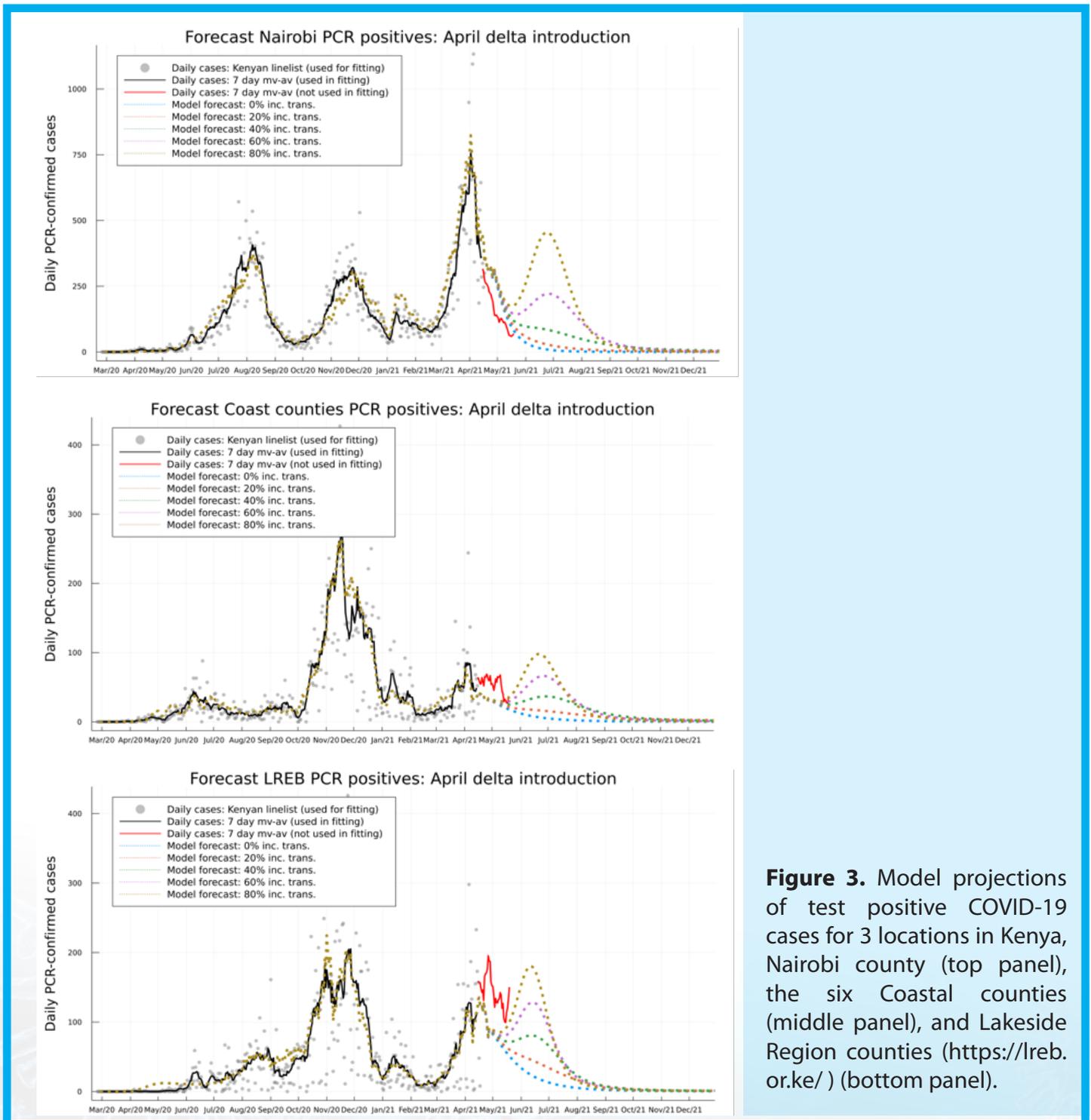


Figure 3. Model projections of test positive COVID-19 cases for 3 locations in Kenya, Nairobi county (top panel), the six Coastal counties (middle panel), and Lakeside Region counties (<https://lreb.or.ke/>) (bottom panel).

Discussion and implications

This modelling exercise suggests that a Delta variant of increased transmissibility of 40% or less relative to the Alpha variant would have little impact on cases and deaths across the country, and unlikely to exceed health service capacity except perhaps the Western/Lakeside counties. A 60% or more increased transmissibility of the Delta variant relative to the Alpha variant would give rise to a fourth wave of magnitude that would impact health services. However, even 80% would not result in a resurgence of the same magnitude as the third wave. The timing of the next wave is imminent for the country as a whole or, in the case of the Lakeside Region is currently occurring. The health services in the Lakeside Region counties are in jeopardy of being stretched beyond capacity.

References

1. Brand, Ojal et al. COVID-19 transmission dynamics underlying epidemic waves in Kenya. medRxiv 2021 <https://doi.org/10.1101/2021.06.17.21259100>
2. Campbell Finlay et al. Increased transmissibility and global spread of SARS-CoV-2 variants of concern as at June 2021. Euro Surveill. 2021;26(24):pii=2100509. <https://doi.org/10.2807/1560-7917.ES.2021.26.24.2100509>

Acknowledgments

This work was supported by the National Institute for Health Research (NIHR) (project references 17/63/82, 16/136/33 and 16/136/46) using UK aid from the UK Government to support global health research, and the UK Foreign, Commonwealth and Development Office (FCDO) and Wellcome Trust (grant# 220985/Z/20/Z). The views expressed in this publication are not necessarily those of the various funding agencies.