

Genomic surveillance of SARS-CoV-2 in Kenya

Background

From early March 2021, Kenya has reported an increased number of confirmed SARS-CoV-2 cases with an average positivity rate of approximately 17%. In our previous policy briefs (#3, #9, #10 and #11), we have reported a total of 49 variants of concern (VOC) from two major clades; 501Y.V1 (n=11) and 501Y.V2 (n=38) isolated largely from travellers presenting at points of entry (PoE) and from individuals without a history of recent international travel. Here we report additional detection of the VOC 501Y.V1 (UK origin) and 501Y.V2 (South-African origin) from samples collected in Nairobi and across five counties at the Kenyan coast.

Key Points

- We sequenced 133 samples collected between 27th February 2021 and 27th March 2021 from Nairobi (n=27) and the coast regions (Kilifi (n=50), Mombasa (n=39), Taita Taveta (n=12), Kwale (n=3) and Lamu (n=2)).
- Whole genome sequences from a total of 107 (80.5%) out of the 133 samples were classified as variants of concern (VOC) (501Y.V1 (n=68) and 501Y.V2 (n=39)).
- A total of 36 (33.6%) samples classified as VOC were obtained from individuals without a history of recent international travel.

Findings from sequence data obtained on 1st April 2021

We sequenced a total of 133 samples collected from Nairobi (n=27) and across five coastal counties of Kilifi (n=50), Mombasa (n=39), Taita Taveta (n=12), Kwale (n=3) and Lamu (n=2) between 27th February 2021 and 27th March 2021 (**Figure 1**). Based on the two main classifications systems for SARS-CoV-2 genome sequences, namely, the Pango and the NextStrain clade classification, we classified the recovered genome sequences into 6 Pango lineages; B.1.1.7 (NextStrain clade 501Y.V1; n=68), B.1.351 (NextStrain clade 501Y.V2; n=34), B.1 (n=20), B.1.525 (n=6), A.23.1 (n=4) and B.1.1.29 (n=1) (**Figure 1**). The variants of concern comprised 80.5% (n=107) of the 133 sequenced samples and of the detected 107 VOCs, a total of 68 were classified as 501Y.V1 and 39 as 501Y.V2.

Our genomic surveillance provides evidence for increased local transmission of SARS-CoV-2 501Y.V1 (B.1.1.7) and 501Y.V2 (B.1.351) across Nairobi and the coastal regions given that a larger proportion of infected persons did not have a history of international travel. Of the 27 sequenced samples from Nairobi 19 were classified as B.1.1.7 (501Y.V1) while 2 were classified as B.1.351 (501Y.V2). These samples were collected between 27th February and 10th March 2021 by the KEMRI-CBRD centre from individuals who presented or were tested at the Kenyatta National Hospital.

Of the 39 samples collected in Mombasa between 12th March and 23rd March 2021, 12 were classified as B.1.1.7 (501Y.V1) and 16 were classified as B.1.351 (501Y.V2).

Samples from the rest of the coastal counties, Kilifi, Lamu, Taita Taveta and Kwale, and collected between 13th March and 27th March 2021 comprised of 40 sequences that were classified as B.1.1.7 (501Y.V1) and 21 that were classified as B.1.351 (501Y.V2).

A total of 5 of the 16 sequences that were classified as lineage B.1 contained between 3 and 4 amino acid changes in the spike protein e.g. D80A, D614G, A701V. (A detailed breakdown of mutations is shown in the **Appendix section**).

In addition, we report detection of a variant of interest (VOI), B.1.525 which has the E484K amino acid change. A total of 4 sequences, (2 from Nairobi, 1 from Kilifi and 1 from Mombasa) were assigned lineage A.23.1, a dominant lineage in Kampala Uganda based on a recent report [1]. Among the individuals infected with the VOC at the coast, 4 (501Y.V1 (n=1) and 501Y.V2 (n=3)) were inmates at Shimo la Tewa prison.

Table 1: Basic epidemiological characteristics of SARS-CoV-2 Rt-PCR positive samples collected from Nairobi and at the coast.

	UK Origin Variant of Concern (501Y.V1) (n=68)	South Africa Origin Variant of Concern (501Y.V2) (n=39)	Variants of Interest (i.e. uncertain significance) # (n=10)	Variants of no Concern* (n=16)
Location				
Nairobi	19	2	6	0
Coast	49	37	4	16
Clinical presentation				
Asymptomatic	37	25	4	4
Symptomatic	22	9	2	0
Data not available	9	5	4	12
Travel History				
With history of travel	7	2	0	3
Local	40	24	6	0
Data not available	21	13	4	13
Testing criteria				
Point of entry	0	2	0	0
Surveillance	23	23	0	3
Contact with a confirmed case	8	2	2	0
Presented at health facility	15	6	1	0
Travelling	1	0	0	0
Data not available	21	6	7	13

*Variants of no Concern; B.1 and B.1.1.29
#Variants of interest: A.23.1 and B.1.525

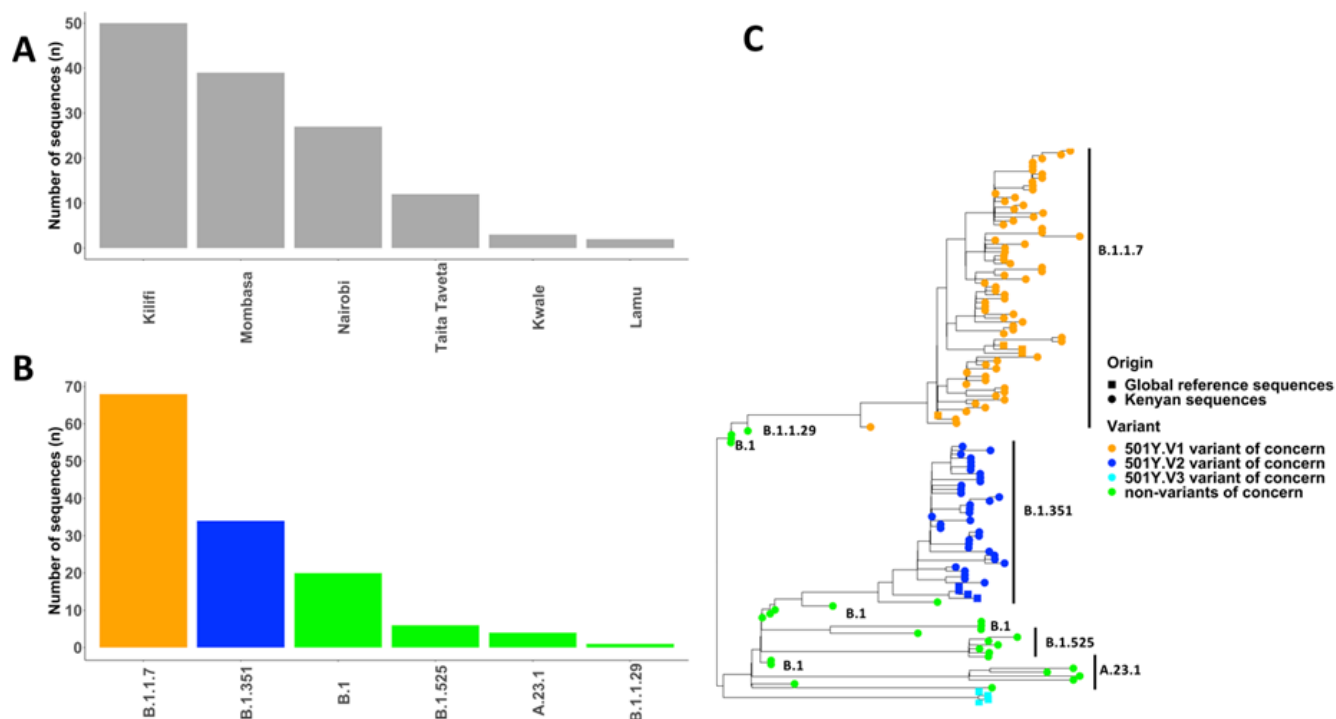


Figure 1: Analysis of 43 SARS-CoV-2 sequences from samples collected between 27th February 2021 and 27th April 2021 A bar plot showing the distribution of the 133 sequenced samples per county (x-axis). (B) A bar plot showing the frequency of lineages (x-axis) circulating in Nairobi and five counties in coastal Kenya based on the 133 sequences. (C) A phylogenetic analysis of 133 SARS-CoV-2 sequences from samples collected between 27th February and 27th March 2021 from Nairobi and five coastal counties. The figure shows the relationship between the sequenced genomes (circular tip-points) and the global variants of concern (square tip-points).

Implications

These data suggest that the SARS-CoV-2 variant 501Y.V1 is dominant among cases from Nairobi, and that both variants 501Y.V1 and 501Y.V2 have increased frequency among local cases at the coast region. These observations are preliminary but given the higher transmissibility of the 501Y.V1 [2] (also likely for 501Y.V2) offer a mechanism underlying the occurrence of a third wave of COVID-19 in Kenya.

Recommendations

- Enhanced genomic surveillance of SARS-CoV-2 surveillance across the country and among hospitalised persons.
- Emphasize to RRT to collect complete epidemiological information for example recent travel histories.
- There is need to revise the case investigation forms to capture details such as previous testing history and vaccination history.

Data availability

Whole-genome sequence data will be available from the GISAID database to allow access to the global scientific community.

References

1. Bugembe, D.L., et al., A SARS-CoV-2 lineage A variant (A.23.1) with altered spike has emerged and is dominating the current Uganda epidemic. *medRxiv*, 2021: p. 2021.02.08.21251393.
2. Davies, N.G., et al., Estimated transmissibility and impact of SARS-CoV-2 lineage B.1.1.7 in England. *medRxiv*, 2021: p. 2020.12.24.20248822.

Acknowledgements

This work was supported by the National Institute for Health Research (NIHR) (project references 17/63/82 and 16/136/33) using UK aid from the UK Government to support global health research, The UK Foreign, Commonwealth and Development Office and Wellcome Trust (grant# 102975; 220985). The views expressed in this publication are those of the author (s) and not necessarily those of NIHR, the Department of Health and Social Care, Foreign Commonwealth and Development Office, Wellcome Trust or the UK government. In addition, this work was supported by the KEMRI Internal Research Grant (Grant # KEMRI/COV/SPE/012).



Appendix: A summary of epidemiological characteristics of SARS-CoV-2 RT-PCR positive samples collected between 27th February and 27th March 2021 from Nairobi and coastal regions of Kenya. The entries are sorted chronologically from the earliest sample based on the date of sample collection.

Collection date	NextStrain clade	Pango lineage	County	Travel history	Reason for Testing	Nationality	Patient Status	Mutations of concern on the spike protein
27/02/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
27/02/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
02/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
02/03/2021	20A	B.1.525	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	E484K, D614G
02/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
02/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
02/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
05/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
05/03/2021	20A	B.1.525	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	E484K, D614G
05/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
05/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	N501Y, D614G, P681H
06/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
09/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
09/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
09/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
09/03/2021	20H/501Y.V2	B.1.351	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
09/03/2021	20A	B.1.525	Nairobi	No	Contact with a confirmed case	Kenyan	Symptomatic	E484K, D614G
09/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
10/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
10/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H



10/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
10/03/2021	20H/501Y.V2	B.1.351	Nairobi	No	Missing	Kenyan	Asymptomatic	D80A, K417N, N501Y, D614G,
10/03/2021	20A	B.1.525	Nairobi	No	Missing	Kenyan	Asymptomatic	E484K, D614G
10/03/2021	19B	A.23.1	Nairobi	No	Missing	Kenyan	Asymptomatic	None
10/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
10/03/2021	19B	A.23.1	Nairobi	No	Missing	Kenyan	Asymptomatic	None
10/03/2021	20I/501Y.V1	B.1.1.7	Nairobi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
12/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Asymptomatic	D614G
12/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
12/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
12/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
12/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
12/03/2021	20H/501Y.V2	B.1	Mombasa	Missing	Surveillance	Kenyan	Asymptomatic	K417N, D614G, A701V
12/03/2021	20I/501Y.V1	B.1.1.7	Mombasa	Missing	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
12/03/2021	19B	A.23.1	Mombasa	Missing	Missing	Kenyan	Missing	None
12/03/2021	20H/501Y.V2	B.1	Mombasa	Missing	Surveillance	Kenyan	Asymptomatic	D80A, K417N, D614G, A701V
12/03/2021	20H/501Y.V2	B.1	Mombasa	Missing	Surveillance	Kenyan	Asymptomatic	D80A, D614G, A701V
13/03/2021	20I/501Y.V1	B.1.1.7	Mombasa	No	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
13/03/2021	20I/501Y.V1	B.1.1.7	Mombasa	Yes	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
13/03/2021	20H/501Y.V2	B.1.351	Taita Taveta	Yes	Point of entry	Tanzanian	Asymptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
13/03/2021	20H/501Y.V2	B.1.351	Kwale	Yes	Point of entry	Kenyan	Asymptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
14/03/2021	20H/501Y.V2	B.1	Lamu	No	Presented at hospital	Kenyan	Asymptomatic	D80A, D614G, A701V
15/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Presented at hospital	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
15/03/2021	20A	B.1.525	Kilifi	Missing	Missing	Kenyan	Missing	E484K, D614G
15/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	Yes	Surveillance	Kenyan	Symptomatic	D614G, P681H
15/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
15/03/2021	20I/501Y.V1	B.1.1.7	Taita Taveta					N501Y, A570D, D614G, P681H



15/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
16/03/2021	20H/501Y.V2	B.1.351	Kilifi	No	Presented at hospital	Kenyan	Asymptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
16/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	Missing	Missing	Kenyan	Missing	N501Y, A570D, D614G, P681H
16/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
16/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
16/03/2021	20A	B.1	Kilifi	Missing	Missing	Kenyan	Missing	D614G, P681H
16/03/2021	20H/501Y.V2	B.1.351	Mombasa	No	Contact with a confirmed case	Kenyan	Asymptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
16/03/2021	20I/501Y.V1	B.1.1.7	Mombasa	No	Contact with a confirmed case	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
16/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
16/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
16/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
16/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
16/03/2021	20H/501Y.V2	B.1.351	Taita Taveta					D80A, K417N, E484K, D614G, A701V
17/03/2021	20A	B.1	Kilifi	Missing	Missing	Kenyan	Missing	D614G, P681H
17/03/2021	20H/501Y.V2	B.1.351	Kilifi	No	Presented at hospital	Kenyan	Symptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
17/03/2021	20H/501Y.V2	B.1.351	Kilifi	No	Presented at hospital	Kenyan	Symptomatic	D80A, K417N, E484K, D614G, A701V
17/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Presented at hospital	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
17/03/2021	20H/501Y.V2	B.1.351	Kilifi	Missing	Missing	Kenyan	Missing	D80A, K417N, E484K, N501Y, D614G, A701V
17/03/2021	20B	B.1.1.29	Kilifi	Missing	Missing	Kenyan	Missing	D614G, P681H
17/03/2021	19B	A.23.1	Kilifi	Missing	Missing	Kenyan	Missing	None
17/03/2021	20H/501Y.V2	B.1.351	Kilifi	No	Presented at hospital	Kenyan	Symptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
17/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	Missing	Surveillance	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
17/03/2021	20I/501Y.V1	B.1.1.7	Taita Taveta	Missing	Travelling	Kenyan	Missing	N501Y, A570D, D614G, P681H



17/03/2021	20I/501Y.V1	B.1.1.7	Lamu					N501Y, A570D, D614G, P681H
18/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
18/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G, P681H
18/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G, P681H
18/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Surveillance	Kenyan	Symptomatic	N501Y, A570D, D614G, P681H
18/03/2021	20A	B.1	Mombasa	Missing	Missing	Kenyan	Missing	D614G
18/03/2021	20H/501Y.V2	B.1.351	Kilifi	No	Surveillance	Kenyan	Asymptomatic	D80A, K417N, E484K, N501Y, D614G, A701V
18/03/2021	20I/501Y.V1	B.1.1.7	Kwale					N501Y, A570D, D614G, P681H
18/03/2021	20I/501Y.V1	B.1.1.7	Kwale					N501Y, A570D, D614G, P681H
19/03/2021	20I/501Y.V1	B.1.1.7	Kilifi	No	Missing	Kenyan	Asymptomatic	N501Y, A570D, D614G, P681H
19/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
19/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
19/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, D614G, A701V
19/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
19/03/2021	20H/501Y.V2	B.1	Mombasa					D80A, K417N,, N501Y, D614G, A701V
21/03/2021	20I/501Y.V1	B.1.1.7	Mombasa					N501Y, A570D, D614G, P681H
21/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
22/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, E484K, N501Y, D614G, A701V
22/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, E484K, N501Y, D614G, A701V
22/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
22/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, N501Y, D614G, A701V
22/03/2021	20A	B.1.525	Kilifi					E484K, D614G
22/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
22/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
22/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
22/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H



22/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20I/501Y.V1	B.1.1.7	Mombasa					N501Y, A570D, D614G, P681H
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20I/501Y.V1	B.1.1.7	Mombasa					N501Y, A570D, D614G, P681H
23/03/2021	20I/501Y.V1	B.1.1.7	Mombasa					N501Y, A570D, D614G, P681H
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
23/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
23/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
23/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
23/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
23/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20A	B.1	Mombasa					D614G, P681H
23/03/2021	20A	B.1	Mombasa					D614G, P681H
23/03/2021	20A	B.1	Mombasa					D614G, P681H
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, E484K, N501Y, D614G, A701V
23/03/2021	20H/501Y.V2	B.1.351	Mombasa					D80A, K417N, N501Y, D614G, A701V
23/03/2021	20I/501Y.V1	B.1.1.7	Mombasa					N501Y, P681H
24/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, N501Y, D614G, A701V
24/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H



24/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Taita Taveta					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Taita Taveta					N501Y, A570D, D614G, P681H
24/03/2021	20I/501Y.V1	B.1.1.7	Taita Taveta					N501Y, A570D, D614G, P681H
25/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
25/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, P681H
25/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
25/03/2021	20H/501Y.V2	B.1.351	Kilifi					D80A, K417N, E484K, N501Y, D614G, A701V
27/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
27/03/2021	20I/501Y.V1	B.1.1.7	Kilifi					N501Y, A570D, D614G, P681H
Missing	20H/501Y.V2	B.1.351	Mombasa					D80A, E484K, N501Y, D614G, A701V



Ongoing Genomic Surveillance of SARS-CoV-2 in Kenya

Key Points

- We report sequences of 48 SARS-CoV-2 positive samples collected between 1st February and 18th March 2021 from across 13 counties in Kenya (Nairobi (n=10), Trans Nzoia (n=10), Busia (n=8), Kisumu (n=4), Lamu (n=3), Kwale (n=2), Mombasa (n=2), Makueni (n=1), Nakuru (n=1), Nandi (n=1), Garissa (n=1), Kiambu (n=1), and Uasin Gishu (n=1)).
- These genomes fell into 7 lineages: B.1.1.7 (NextStrain clade 501Y.V1, n=20), B.1.351 (NextStrain clade 501Y.V2, n=5), B.1.525 (n=10), A.23.1 (n=9), B.1 (n=2), B.1.469 (n=1) and B.1.551 (n=1).
- Greater than half (i.e. 25/48, 52.1%) of these whole genome sequences were classified as variants of concern (501Y.V1 (n=20) and 501Y.V2 (n=5) and came from 6 counties: Nairobi (501Y.V1 (n=8), Trans Nzoia (501Y.V1 (n=9), Kisumu (501Y.V1 (n=2), 501Y.V2 (n=1), Lamu (501Y.V2 (n=3), Uasin Gishu (501Y.V1 (n=1) and Kwale (501Y.V2 (n=1).
- These data point out to extensive geographical spread of the VOC in Kenya, the 501Y.V1, which was first identified in the United Kingdom

Background

In our previous policy briefs (#3, #9, #10, #11 and #15), covering the period 14th January to 1st April 2021, we have reported the detection of variants of concern (VOC) from two major clades; 501Y.V1 (initially detected in the UK) (n=77) and 501Y.V2 (initially detected in South Africa) (n=77) isolated largely from travellers presenting at points of entry (PoE) and from individuals without a history of recent international travel. Here we report additional detection of the VOC 501Y.V1 and 501Y.V2 from samples collected from the Western, Nyanza, Rift valley, Nairobi and coastal Kenya regions. The samples were selected from the current third wave (between 31st January and 19th April 2021) and had sufficient viral load (cycle threshold (Ct) value of < 33.

Findings from sequence data obtained on 16th April 2021

A total of 48 samples were collected from 13 counties between 1st February and 18th March 2021 and sequenced by KEMRI/USAMRD-A Basic Science Laboratory, Kisumu. The distribution of the samples was as follows: Nairobi (n=10), Trans Nzoia (n=10), Busia (n=8), Kisumu (n=4), Lamu

(n=3), Kwale (n=2), Mombasa (n=2), Makueni (n=1), Nakuru (n=1), Nandi (n=1), Garissa (n=1), Kiambu (n=1) and Uasin Gishu (n=1), summarised in the **Figure, panel A**. Based on the Pango lineage and NextStrain clade classification systems for SARS-CoV-2, we classified the recovered genome sequences into 7 Pango lineages and 5 NextStrain clades: B.1.1.7 (NextStrain clade 501Y.V1, n=20), B.1.351 (NextStrain clade 501Y.V2, n=5), B.1.525 (n=10), A.23.1 (n=9), B.1 (n=2), B.1.469 (n=1), B.1.551 (n=1) and B.1.602 (n=1) (**Figure 1, panel B and C**). The variants of concern comprised slightly more than half (n=25) of the 48 sequenced samples. A summary of the genetic classification and changes for each sequenced sample is tabulated in **Table 1**.

This report provides evidence of the first detection of SARS-CoV-2 501Y.V1 (B.1.1.7) and 501Y.V2 (B.1.351) in three additional counties in Kenya i.e. Trans Nzoia (n=9), Kisumu (n=3) and Uasin Gishu (n=1), **Table 1**. Detailed travel information was missing or not captured in the sequenced samples and we cannot therefore comment on the source of infections for these patients carrying these VOC. Six samples, 3 from Lamu, 2 from Kwale and 1 from Kisumu, were obtained from symptomatic individuals who presented at USAMRD-A febrile illness surveillance hospitals.

Notably, of the 10 samples collected between 11th February and 18th March 2021 from Nairobi, a majority (n=8) classified as B.1.1.7 (501Y.V1). Additional counties that reported circulating VOC include Trans Nzoia (501Y.V1 (n=9), Kisumu (501Y.V1 (n=2), 501Y.V2 (n=1), Lamu (501Y.V2 (n=3), Uasin Gishu (501Y.V1 (n=1) and Kwale (501Y.V2 (n=1).

Furthermore, we report on detection of a variant of interest (VOI), B.1.525 (n=10) which has the E484K amino acid change and similar set of deletions observed in B.1.1.7, which are suspected to also aid enhanced transmission capacity and immune escape [2]. Finally, 9 sequences, (6 from Busia, 1 from Kisumu, 1 from Nairobi and 1 from Mombasa) were assigned lineage A.23.1, recently assigned a VOI status, a dominant lineage in Kampala Uganda based on a recent report [1].

Table 1: A summary of epidemiological characteristics of SARS-CoV-2 Rt-PCR positive samples collected between 01st February and 18th March 2021 from 13 counties across Kenya. The entries are sorted chronologically from the earliest sample based on the date of sample collection.

Serial	Pango lineage	Next Strain Clade	Collection Date	County	Age (years)	Gender	Mutations of interest in the spike region
1	B.1	20C	01/02/2021	Kiambu	44	Male	D614G
2	B.1.469	20A	08/02/2021	Nakuru	41	Male	D614G, P681H
3	B.1.525	20A	10/02/2021	Makueni	38	Male	E484K
4	B.1.551	20C	11/02/2021	Busia	45	Male	D614G, P681H
5	B.1.525	20A	11/02/2021	Nairobi	37	Male	E484K, D614G
6	B.1.351	20H/501Y.V2	16/02/2021	Lamu	19	Male	D80A, K417N, E484K, N501Y, D614G, A701V
7	B.1.525	20A	16/02/2021	Mombasa	28	Male	E484K, D614G
8	B.1.1.7	20I/501Y.V1	17/02/2021	Uasin Gishu	52	Male	A570D, D614G, P681H
9	B.1.351	20H/501Y.V2	22/02/2021	Lamu	2	Male	D80A, K417N, E484K, N501Y, D614G, A701V
10	B.1.351	20H/501Y.V2	22/02/2021	Lamu	23	Male	D80A, K417N, E484K, N501Y, D614G, A701V
11	B.1	20A	22/02/2021	Busia	27	Male	D614G
12	B.1.525	20A	23/02/2021	Garissa	40	Male	D614G
13	A.23.1	19B	23/02/2021	Mombasa	40	Male	None
14	A.23.1	19B ₂	24/02/2021	Busia	25	Male	None
15	A.23.1	19B	24/02/2021	Busia	23	Male	None
16	A.23.1	19B	24/02/2021	Busia	34	Male	None
17	A.23.1	19B	24/02/2021	Busia	31	Male	None
18	A.23.1	19B	24/02/2021	Busia	40	Male	None
19	A.23.1	19B	24/02/2021	Busia	27	Male	None
20	B.1.525	20A	03/03/2021	Kwale	9	Female	E484K, D614G
21	B.1.1.7	20I/501Y.V1	04/03/2021	Kisumu	36	Male	N501Y, A570D, D614G, P681H
22	B.1.1.7	20I/501Y.V1	04/03/2021	Kisumu	48	Male	N501Y, A570D, D614G, P681H
23	B.1.351	20H/501Y.V2	08/03/2021	Kisumu	38	Male	D80A, K417N, E484K, N501Y, D614G, A701V
24	B.1.525	20A	09/03/2021	Nandi	36	Male	E484K, D614G

Serial	Pango lineage	Next Strain Clade	Collection Date	County	Age (years)	Gender	Mutations of interest in the spike region
25	B.1.525	20A	09/03/2021	Nandi	50	Male	E484K, D614G
26	B.1.525	20A	09/03/2021	Nandi	27	Male	E484K, D614G
27	B.1.525	20A	09/03/2021	Nandi	60	Male	E484K, D614G
28	B.1.1.7	20I/501Y.V1	11/03/2021	Trans Nzoia	26	Male	N501Y, A570D, D614G, P681H
29	B.1.1.7	20I/501Y.V1	11/03/2021	Trans Nzoia	43	Female	N501Y, A570D, D614G, P681H
30	B.1.525	20A	11/03/2021	Trans Nzoia	30	Male	E484K, D614G
31	B.1.1.7	20I/501Y.V1	11/03/2021	Trans Nzoia	56	Male	N501Y, A570D, D614G, P681H
32	B.1.1.7	20I/501Y.V1	11/03/2021	Trans Nzoia	26	Male	N501Y, A570D, D614G, P681H
33	B.1.1.7	20I/501Y.V1	11/03/2021	Trans Nzoia	80	Male	N501Y, A570D, D614G, P681H
34	B.1.1.7	20I/501Y.V1	12/03/2021	Trans Nzoia	42	Female	N501Y, A570D, D614G, P681H
35	B.1.1.7	20I/501Y.V1	12/03/2021	Trans Nzoia	44	Male	N501Y, A570D, D614G, P681H
36	B.1.1.7	20I/501Y.V1	12/03/2021	Trans Nzoia	44	Male	N501Y, A570D, D614G, P681H
37	B.1.1.7	20I/501Y.V1	15/03/2021	Trans Nzoia	61	Female	N501Y, A570D, D614G, P681H
38	A.23.1	19B	16/03/2021	Kisumu	23	Female	None
39	B.1.351	20H/501Y.V2	17/03/2021	Kwale	26	Male	D80A, K417N, E484K, N501Y, D614G, A701V
40	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	54	Female	N501Y, A570D, D614G, P681H
41	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	43	Male	N501Y, A570D, D614G, P681H
42	A.23.1	19B	18/03/2021	Nairobi	46	Female	E484K
43	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	50	Male	N501Y, A570D, D614G, P681H
44	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	43	Male	N501Y, A570D, D614G, P681H
45	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	37	Male	N501Y, A570D, D614G, P681H
46	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	34	Male	N501Y, A570D, D614G, P681H
47	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	3	Female	N501Y, A570D, D614G, P681H
48	B.1.1.7	20I/501Y.V1	18/03/2021	Nairobi	32	Male	N501Y, A570D, D614G, P681H

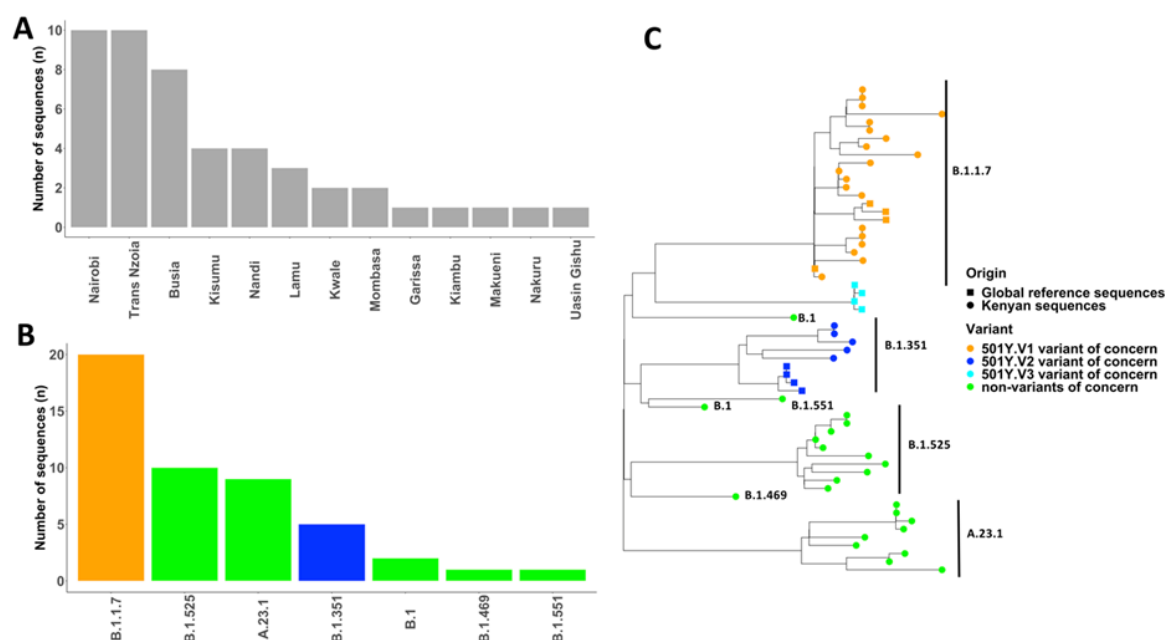


Figure 1: Analysis of 48 SARS-CoV-2 sequences from samples collected between 01st February 2021 and 18th March 2021. Panel (A) shows a bar plot showing the distribution of the 48 sequenced samples per county (x-axis). (B) A bar plot showing the frequency of lineages (x-axis) circulating in 13 counties across Kenya. (C) A phylogenetic tree of 48 SARS-CoV-2 sequences from samples collected between 01st February 2021 and 18th March 2021 from 13 counties across Kenya. The figure shows the relationship between the sequenced genomes (circular tip-points) and the global variants of concern (square tip-points).

Implications

These data suggest that the SARS-CoV-2 variant 501Y.V1 is rapidly spreading among cases from across the country, and that both variants 501Y.V1 and 501Y.V2 are increasing in frequency among local cases. Given the higher transmissibility of both 501Y.V1 [2] and 501Y.V2 SARS-CoV-2 variants, it is likely that these VOCs are driving the current “third wave” of infections witnessed across the country. These observations are preliminary since they are based on a small sample size across the counties. Thus these findings will need to be confirmed with a larger genomic data analysis that will become available from across the country in due course.

Recommendations

- Enhanced genomic surveillance of SARS-CoV-2 surveillance across the country especially in counties that have no genomic data available yet, at border entry points and among hospitalized persons.
- Emphasize to the rapid response team (RRT) to fully complete case investigation forms, to include recent travel histories.
- There is need to revise the case investigation forms to capture details such as previous testing history and vaccination history to help put the infections with VOC in proper context.

Data availability

Whole-genome sequence data will be available from the GISAID database to allow access to the global scientific community.

References

1. Bugembe, D.L., et al., A SARS-CoV-2 lineage A variant (A.23.1) with altered spike has emerged and is dominating the current Uganda epidemic. medRxiv, 2021: p. 2021.02.08.21251393.
2. Davies, N.G., et al., Estimated transmissibility and impact of SARS-CoV-2 lineage B.1.1.7 in England. medRxiv, 2021: p. 2020.12.24.20248822.

Acknowledgements:

This work was supported by funding from the US Army Armed Forces Health Surveillance.

Predominance of SARS-CoV-2 Variants of Concern, 501Y.V1 and 501Y.V2 at the Kenyan Coast

Key Points

- We sequenced 102 SARS-CoV-2 PCR positive samples collected between 23rd March-9th April 2021 from 5 counties in the coast region (Kilifi (n=71), Mombasa (n=14), Taita Taveta (n=13), Kwale (n=2) and Lamu (n=2)).
- A total of 94 (92.2%) out of the 102 samples were classified as variants of concern (VOC); 501Y.V1 (n=66) and 501Y.V2 (n=28).
- A total of 96 PCR positive samples were obtained from individuals who had no confirmed history of recent international travel and of these 89 (92.7%) were classified as VOC.

Background

Between 12th March and 27th March 2021, we reported genome sequences of two variants of concern (VOC); 501Y.V1 (n=49) and 501Y.V2 (n=37) from SARS-CoV-2 PCR positive samples collected from the Kenya coast. The majority of these were isolated from individuals presenting at points of entry (PoE), but some were isolated from individuals without a history of recent travel (policy brief #14). Here we report sequences from more recent samples, to investigate the possible spread of the two VOCs in the region.

Findings from sequence data obtained on 16th April 2021

We sequenced a total of 102 SARS-CoV-2 positive samples from across five coastal counties (Kilifi (n=71), Mombasa (n=14), Taita Taveta (n=13), Kwale (n=2) and Lamu (n=2)) collected between 23rd March and 9th April 2021 (**Figure**). We used the two main classification systems for SARS-CoV-2 genomes (i.e. the Pango and the NextStrain clade classification). We classified the genome sequences into 6 Pango lineages and 5 NextStrain clades; B.1.1.7 (NextStrain clade 501Y.V1; n=66), B.1.351 (NextStrain clade 501Y.V2; n=26), A.23.1 (n=4), B.1 (n=2), B.1.525 (n=2) and B.1.1 (n=2) (**Figure**).

The samples were dominated by VOCs comprising 92.2% (n=94) of the 102 sequenced samples. 501Y.V1 occurred in 64.7% (n=66) samples while 501Y.V2 occurred in 27.5% (n=28) of the samples. There were 96 PCR positive samples from individuals without history of recent travel and of these 62 (64.6%) were VOC 501Y.V1 and 27 (28.1%) were VOC 501Y.V2. Hence, our genomic surveillance provides evidence that local spread of SARS-CoV-2 is dominated by VOCs 501Y.V1 (B.1.1.7) and 501Y.V2 (B.1.351) across the coastal region (**Table**).

Two sequences that were classified as lineage B.1 contained 5 amino acid changes in the spike protein i.e D80A, K417N, N501Y, D614G, A701V. In addition, we report detection of a variant of interest (VOI), B.1.525 (n=2) which has the E484K amino acid change, also present in the B.1.351 VOC and known to aid immune evasion. Four sequences (2 from Taita Taveta, 1 from Lamu and 1 from Mombasa) were assigned lineage A.23.1, a dominant lineage in Kampala Uganda based on a recent report which has also been assigned VOI status [1]. A detailed breakdown of mutations is shown in the **Appendix**.

Table: Basic epidemiological characteristics of SARS-CoV-2 Rt-PCR positive samples collected from at the coast.

	501Y.V1 (n=66)	501Y.V2 (n=28)	Variants of Interest (i.e. uncertain significance) #(n=6)	Variants of no Concern* (n=2)
County				
Kilifi	50	19	2	0
Mombasa	6	6	1	1
Taita Taveta	9	2	2	0
Kwale	1	0	0	1
Lamu	0	1	1	0
Travel History				
With history of travel	4	1	0	1
Local	62	27	6	1
*Variants of no Concern: B.1.1 #Variants of interest: A.23.1 and B.1.525				

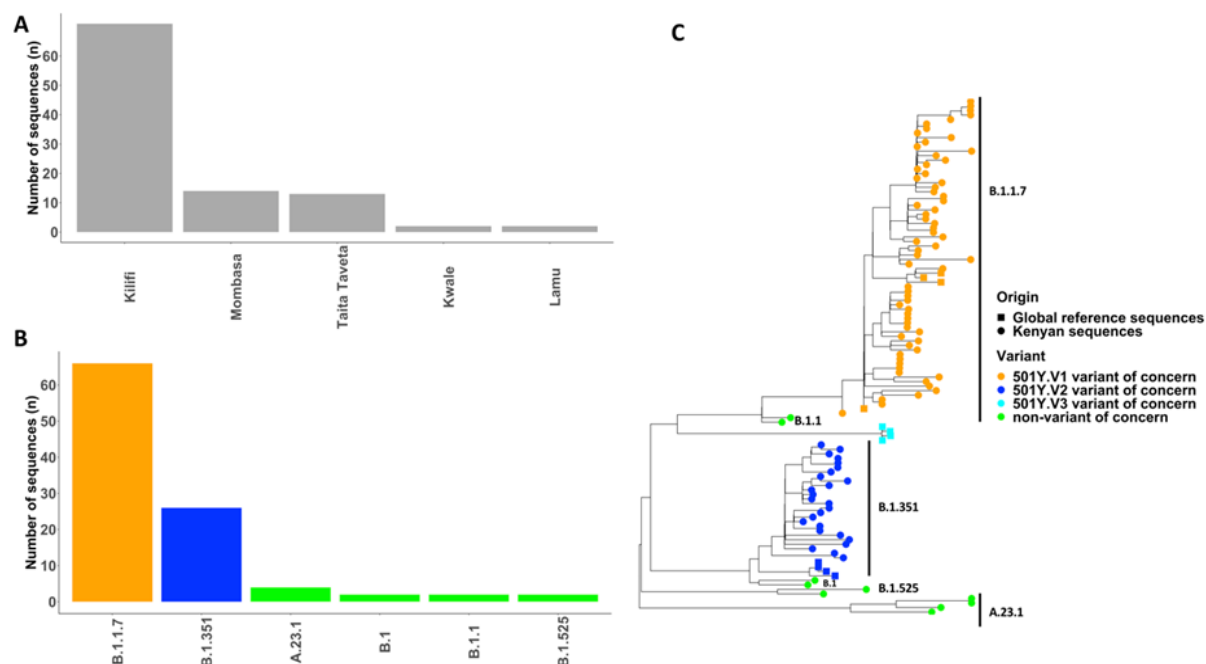


Figure: Analysis of 102 SARS-CoV-2 sequences from samples collected between 23rd March and 9th April 2021. (A) A bar plot showing the geographical distribution of the 102 sequenced samples by county (x-axis). (B) A bar plot showing the frequency of lineages (x-axis) circulating in five counties in coastal Kenya based on the 102 sequences. (C) A phylogenetic tree of 102 SARS-CoV-2 sequences from samples collected between 23rd March-9th April 2021 from six coastal counties together with 12 reference sequences. The tree diagram shows the relationship between the sequenced genomes (circular tip-points) and the global variants of concern (square tip-points).

Implications

These data suggest that two of the three major SARS-CoV-2 variants of concern (i.e. 501Y.V1 and 501Y.V2) have become the predominant strains in circulation in the coast region of Kenya, with 501Y.V1 most common of the two. Both these two VOC reported are documented to have considerably higher transmissibility compared to the original SARS-CoV-2 Wuhan strain and have been reported to have potential to either more efficiently evade pre-existing natural or vaccine immunity [2] or cause more severe disease [3].

Recommendations

- Continued genomic surveillance of SARS-CoV-2 surveillance across the coastal region.
- Emphasize to the rapid response team (RRT) to collect complete epidemiological information during sample collection, for example recent travel histories.
- There is need to revise the case investigation forms to capture details such as previous testing history and vaccination history to put the VOC infections in proper context.

Data availability

Whole-genome sequence data will be available from the GISAID database to allow access to the global scientific community.

References

1. D. Lule Bugembe, M. VTPhan, I. Ssewanyana, et al., A SARS-CoV-2 lineage A variant (A.23.1) with altered spike has emerged and is dominating the current Uganda epidemic, MedRxiv. (2021) 2021.02.08.21251393. <https://doi.org/10.1101/2021.02.08.21251393>.
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Acknowledgements:

This work was supported by the National Institute for Health Research (NIHR) (project references 17/63/82 and 16/136/33) using UK aid from the UK Government to support global health research, The UK Foreign, Commonwealth and Development Office and Wellcome Trust (grant# 102975; 220985). The views expressed in this publication are those of the author (s) and not necessarily those of NIHR, the Department of Health and Social Care, Foreign Commonwealth and Development Office, Wellcome Trust or the UK government. In addition, this work was supported by the KEMRI Internal Research Grant (Grant # KEMRI/COV/SPE/012).

This work is supported by the Rapid Response Teams (RRTs) from Kwale, Taita Taveta, Mombasa, Kilifi, Tana River, and Lamu and the dedicated effort from the various health care and testing facilities across the coast region and the country at large.



Appendix: A summary of epidemiological characteristics of SARS-CoV-2 RT-PCR positive samples collected between 23rd March and 09th April 2021 from five counties in the coastal regions of Kenya. The entries are sorted chronologically from the earliest sample based on the date of sample collection.

Serial	NextStrain Clade	Pango Lineage	date_collected	County	Gender	Age (Years)	Mutations of interest in the spike region
1	20I/501Y.V1	B.1.1.7	23/03/2021	Taita Taveta	Male	53	N501Y, A570D, D614G, P681H
2	20I/501Y.V1	B.1.1.7	23/03/2021	Taita Taveta	Male	50	N501Y, A570D, D614G, P681H
3	20I/501Y.V1	B.1.1.7	23/03/2021	Kwale	Female	30	N501Y, A570D, D614G, P681H
4	19B	A.23.1	24/03/2021	Taita Taveta	Male	2	None
5	20I/501Y.V1	B.1.1.7	24/03/2021	Taita Taveta	Female	22	N501Y, A570D, D614G, P681H
6	20I/501Y.V1	B.1.1.7	25/03/2021	Kilifi	Male	22	N501Y, A570D, D614G, P681H
7	19B	A.23.1	25/03/2021	Lamu	Male	29	None
8	20H/501Y.V2	B.1.351	26/03/2021	Mombasa	Male	18	D80A, K417N, N501Y, D614G, A701V
9	20H/501Y.V2	B.1.351	26/03/2021	Mombasa	Male	22	D80A, K417N, N501Y, D614G, A701V
10	20I/501Y.V1	B.1.1.7	28/03/2021	Mombasa	Male	51	N501Y, A570D, D614G, P681H
11	20I/501Y.V1	B.1.1.7	28/03/2021	Mombasa	Female	51	N501Y, A570D, D614G, P681H
12	20H/501Y.V2	B.1	28/03/2021	Mombasa	Male	15	D80A, K417N, N501Y, D614G, A701V
13	20H/501Y.V2	B.1.351	28/03/2021	Mombasa	Female	40	D80A, K417N, N501Y, D614G, A701V
14	20I/501Y.V1	B.1.1.7	28/03/2021	Mombasa	Male	25	N501Y, A570D, D614G, P681H
15	19B	A.23.1	28/03/2021	Taita Taveta	Male	57	E484K
16	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Female	32	D80A, K417N, E484K, N501Y, D614G, A701V
17	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	7	D80A, K417N, E484K, N501Y, D614G, A701V
18	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Male	66	N501Y, A570D, D614G, P681H
19	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	37	D80A, K417N, E484K, N501Y, D614G, A701V
20	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	36	D80A, K417N, E484K, N501Y, D614G, A701V
21	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	37	D80A, K417N, E484K, N501Y, D614G, A701V
22	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Male	40	N501Y, A570D, D614G, P681H
23	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Female	27	N501Y, D614G, P681H
24	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Male	36	N501Y, A570D, D614G, P681H

25	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Female	28	N501Y, A570D, D614G, P681H
26	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Male	40	N501Y, A570D, D614G, P681H
27	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Female	43	N501Y, A570D, D614G, P681H
28	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	47	D80A, K417N, E484K, N501Y, D614G, A701V
29	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	38	D80A, K417N, E484K, N501Y, D614G, A701V
30	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Female	47	N501Y, A570D, D614G, P681H
31	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Male	32	N501Y, A570D, D614G, P681H
32	20I/501Y.V1	B.1.1.7	29/03/2021	Kilifi	Female	33	N501Y, A570D, D614G, P681H
33	20H/501Y.V2	B.1.351	29/03/2021	Kilifi	Male	56	D80A, K417N, E484K, N501Y, D614G, A701V
34	20I/501Y.V1	B.1.1.7	29/03/2021	Taita Taveta	Male	1	N501Y, A570D, D614G, P681H
35	20I/501Y.V1	B.1.1.7	29/03/2021	Taita Taveta	Male	63	N501Y, A570D, D614G, P681H
36	20I/501Y.V1	B.1.1.7	29/03/2021	Taita Taveta	Female	32	N501Y, A570D, D614G, P681H
37	20H/501Y.V2	B.1.351	30/03/2021	Kilifi	Female	54	D80A, K417N, E484K, N501Y, D614G, A701V
38	20H/501Y.V2	B.1.351	30/03/2021	Kilifi	Female	49	D80A, K417N, E484K, N501Y, D614G, A701V
39	19B	A.23.1	30/03/2021	Mombasa	Male	40	None
40	20I/501Y.V1	B.1.1.7	30/03/2021	Mombasa	Male	25	N501Y, A570D, D614G, P681H
41	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	54	N501Y, A570D, D614G, P681H
42	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	43	N501Y, A570D, D614G, P681H
43	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	51	N501Y, A570D, D614G, P681H
44	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	32	N501Y, A570D, D614G, P681H
45	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	50	N501Y, A570D, D614G, P681H
46	20I/501Y.V1	B.1.1.7	30/03/2021	Kilifi	Male	56	N501Y, A570D, D614G, P681H
47	20I/501Y.V1	B.1.1.7	30/03/2021	Taita Taveta	Female	48	N501Y, A570D, D614G, P681H
48	20I/501Y.V1	B.1.1.7	30/03/2021	Taita Taveta	Male	52	N501Y, A570D, D614G, P681H
49	20H/501Y.V2	B.1.351	30/03/2021	Taita Taveta	Male	40	D80A, K417N, E484K, N501Y, D614G, A701V
50	20H/501Y.V2	B.1.351	30/03/2021	Taita Taveta	Male	24	D80A, K417N, E484K, N501Y, D614G, A701V
51	20H/501Y.V2	B.1	30/03/2021	Lamu	Female	NA	D80A, K417N, N501Y, D614G, A701V
52	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Male	42	N501Y, A570D, D614G, P681H

53	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Male	67	N501Y, A570D, D614G, P681H
54	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Female	87	N501Y, A570D, D614G, P681H
55	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Female	33	N501Y, A570D, D614G, P681H
56	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Male	38	N501Y, A570D, D614G, P681H
57	20H/501Y.V2	B.1.351	31/03/2021	Kilifi	Female	51	D80A, K417N, E484K, N501Y, D614G, A701V
58	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Male	25	N501Y, A570D, D614G, P681H
59	20H/501Y.V2	B.1.351	31/03/2021	Kilifi	Male	57	D80A, K417N, E484K, N501Y, D614G, A701V
60	20H/501Y.V2	B.1.351	31/03/2021	Kilifi	Male	29	D80A, K417N, E484K, N501Y, D614G, A701V
61	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Female	19	N501Y, A570D, D614G, P681H
62	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Female	43	N501Y, A570D, D614G, P681H
63	20I/501Y.V1	B.1.1.7	31/03/2021	Kilifi	Male	40	N501Y, A570D, D614G, P681H
64	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	56	N501Y, A570D, D614G, P681H
65	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Female	35	N501Y, A570D, D614G, P681H
66	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Female	66	N501Y, A570D, D614G, P681H
67	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	71	N501Y, A570D, D614G, P681H
68	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	4	N501Y, A570D, D614G, P681H
69	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Female	38	N501Y, A570D, D614G, P681H
70	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	34	N501Y, A570D, D614G, P681H
71	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	36	N501Y, A570D, D614G, P681H
72	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	38	N501Y, A570D, D614G, P681H
73	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	43	N501Y, A570D, D614G, P681H
74	20I/501Y.V1	B.1.1.7	01/04/2021	Kilifi	Male	28	N501Y, A570D, D614G, P681H
75	20I/501Y.V1	B.1.1.7	01/04/2021	Mombasa	Male	33	N501Y, A570D, D614G, P681H
76	20B	B.1.1	01/04/2021	Mombasa	Na	43	N501Y, D614G
77	20I/501Y.V1	B.1.1.7	02/04/2021	Kilifi	Na	49	N501Y, A570D, D614G, P681H
78	20H/501Y.V2	B.1.351	02/04/2021	Kilifi	Male	29	D80A, K417N, N501Y, D614G, A701V
79	20H/501Y.V2	B.1.351	02/04/2021	Kilifi	Male	36	D80A, K417N, E484K, N501Y, D614G, A701V
80	20B	B.1.1	02/04/2021	Kwale	Male	41	N501Y, A570D, D614G
81	20I/501Y.V1	B.1.1.7	05/04/2021	Kilifi	Female	27	N501Y, A570D, D614G, P681H

82	20I/501Y.V1	B.1.1.7	05/04/2021	Kilifi	Female	52	N501Y, A570D, D614G, P681H
83	20A	B.1.525	06/04/2021	Kilifi	Male	10	E484K, D614G
84	20H/501Y.V2	B.1.351	06/04/2021	Kilifi	Female	27	N501Y, A570D, D614G, P681H
85	20I/501Y.V1	B.1.1.7	06/04/2021	Kilifi	Male	NA	N501Y, A570D, D614G, P681H
86	20I/501Y.V1	B.1.1.7	06/04/2021	Kilifi	Female	46	N501Y, A570D, D614G, P681H
87	20I/501Y.V1	B.1.1.7	06/04/2021	Kilifi	Male	16	N501Y, A570D, D614G, P681H
88	20H/501Y.V2	B.1.351	07/04/2021	Kilifi	Female	29	D80A, K417N, E484K, N501Y, D614G, A701V
89	20H/501Y.V2	B.1.351	07/04/2021	Kilifi	Male	39	D80A, K417N, E484K, N501Y, D614G, A701V
90	20I/501Y.V1	B.1.1.7	07/04/2021	Kilifi	Male	48	N501Y, A570D, D614G, P681H
91	20A	B.1.525	07/04/2021	Kilifi	Female	45	E484K, D614G
92	20I/501Y.V1	B.1.1.7	08/04/2021	Kilifi	Male	56	N501Y, A570D, D614G, P681H
93	20I/501Y.V1	B.1.1.7	08/04/2021	Kilifi	Male	58	N501Y, A570D, D614G, P681H
94	20H/501Y.V2	B.1.351	08/04/2021	Kilifi	Female	38	D80A, K417N, E484K, N501Y, D614G, A701V
95	20I/501Y.V1	B.1.1.7	08/04/2021	Kilifi	Male	29	N501Y, A570D, D614G, P681H
96	20I/501Y.V1	B.1.1.7	08/04/2021	Kilifi	Male	39	N501Y, A570D, D614G, P681H
97	20I/501Y.V1	B.1.1.7	08/04/2021	Taita Taveta	Female	45	N501Y, D614G, P681H
98	20I/501Y.V1	B.1.1.7	09/04/2021	Kilifi	Female	32	N501Y, A570D, D614G, P681H
99	20I/501Y.V1	B.1.1.7	09/04/2021	Kilifi	Female	48	N501Y, A570D, D614G, P681H
100	20I/501Y.V1	B.1.1.7	NA	Mombasa	Na	NA	N501Y, A570D, D614G, P681H
101	20H/501Y.V2	B.1.351	NA	Mombasa	Na	NA	D80A, K417N, E484K, N501Y, D614G, A701V
102	20H/501Y.V2	B.1.351	NA	Mombasa	Na	NA	D80A, K417N, E484K, N501Y, D614G, A701V