

# Transitions in Omicron sublineages

Update 2022/06/08

Bette Korber, Will Fischer, Hyejin Yoon, James Theiler

## Contents:

- Slide 2: Transitions to BA.2.12.1, and BA.4 and BA.5 globally 2022/03/0 through 2022/04/01
- Slide 3: Transitions to BA.2.12.1, and BA.4 and BA.5 by continent 2021/10/01 through 2022/04/01  
-- BA.2.18 (BA.2+K417T) has a presence in Europe and the US.
- Slide 4: BA.2.12.1 is increasing relative to all other BA.2s wherever it has been sampled > 10 times.
- Slide 5: BA.4+BA.5 is increasing relative to BA.2s wherever it has been sampled > 10 times.
- Slide 6: Comparing frequencies of co-circulating BA.2.12.1 and BA.4+BA.5 suggests BA.4+BA.5 may have a slight edge.
- Slide 7: BA.2 + K417T while still rare is also increasingly sampled recently in Europe, the US, and Asia.
- Slide 8: BA.4+V3G is the most common form of BA.4 currently sampled, but this is likely a founder effect that was initiated when BA.4 began to be established internationally.

# Global Pango lineage transitions

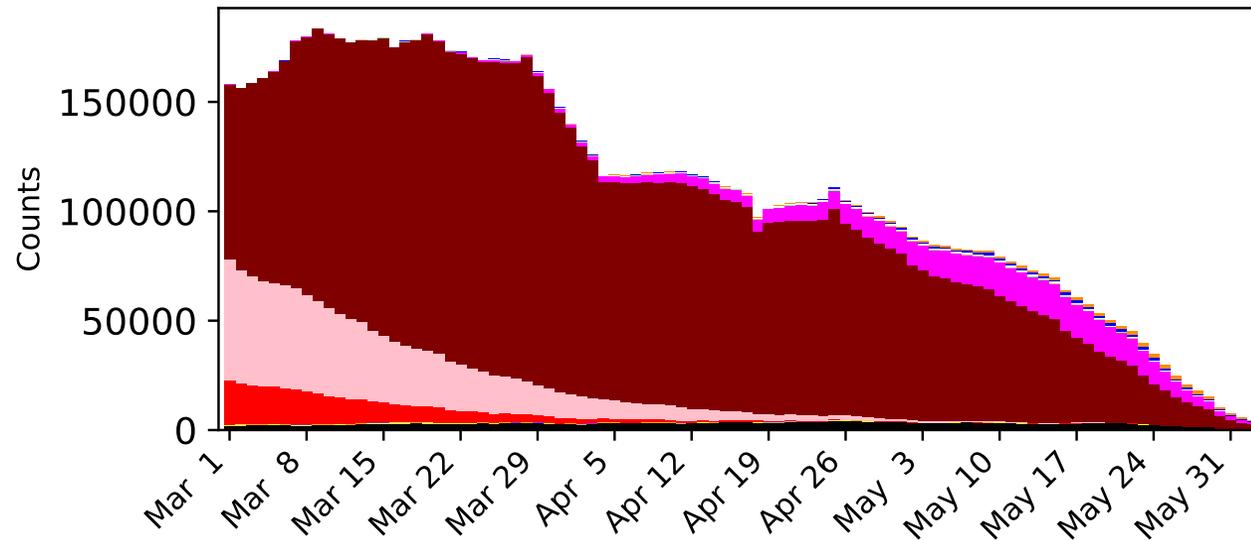
data: 2022-06-07

Of note:

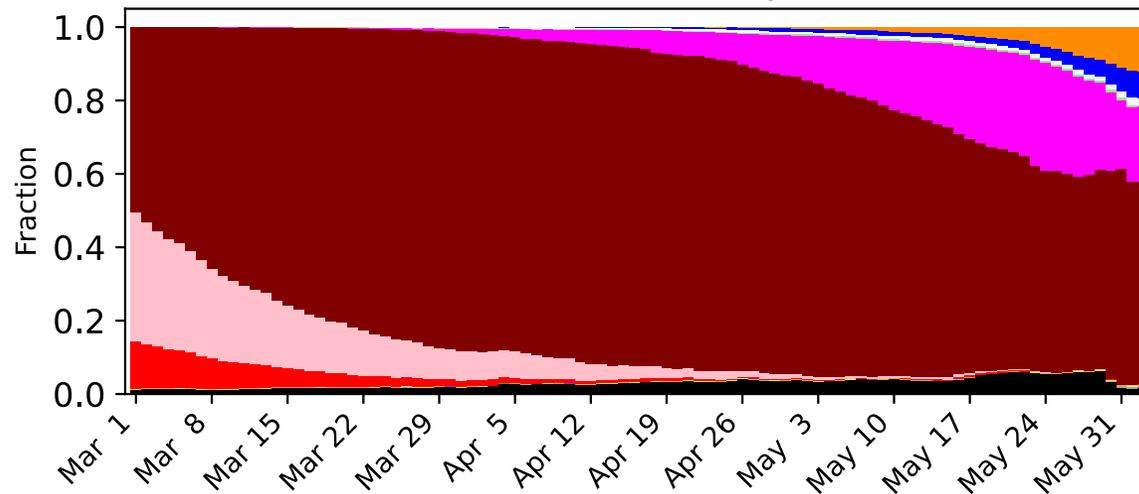
BA.2.12.1, BA.5, and BA.4 are continuing to increase

BA.2.18 is also increasing:  
(BA.2 with K417T)

Global: 1562283 sequences



Global: 1562283 sequences

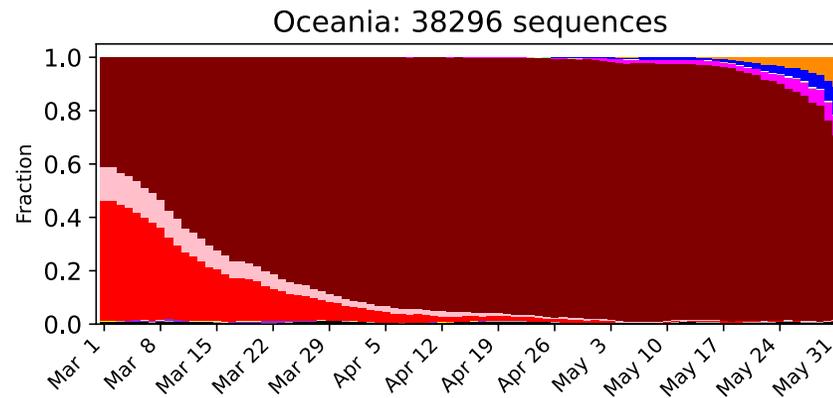
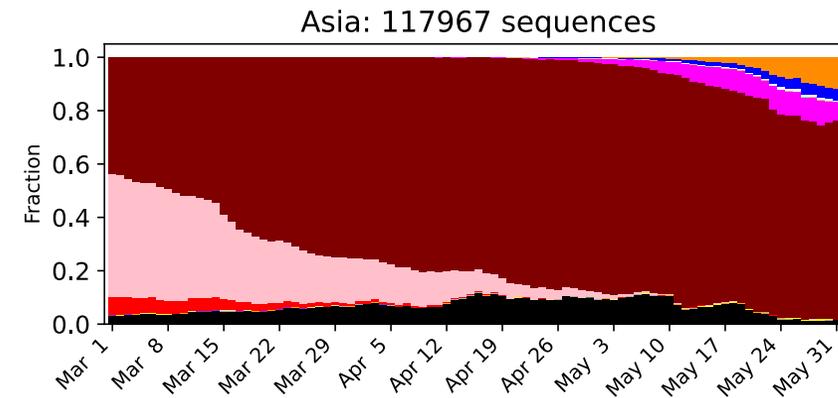
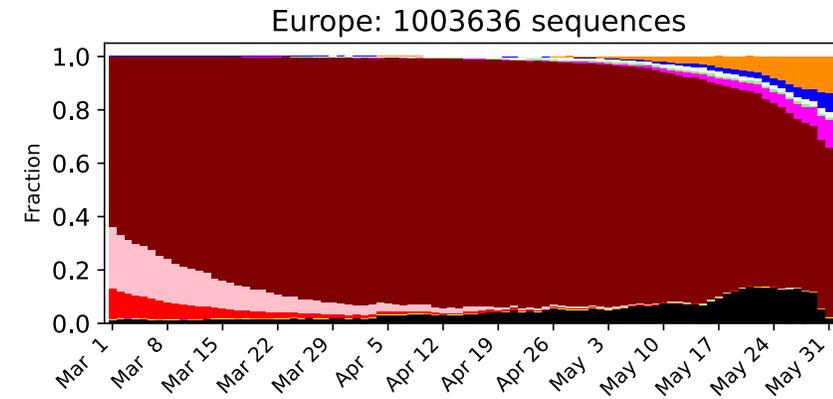
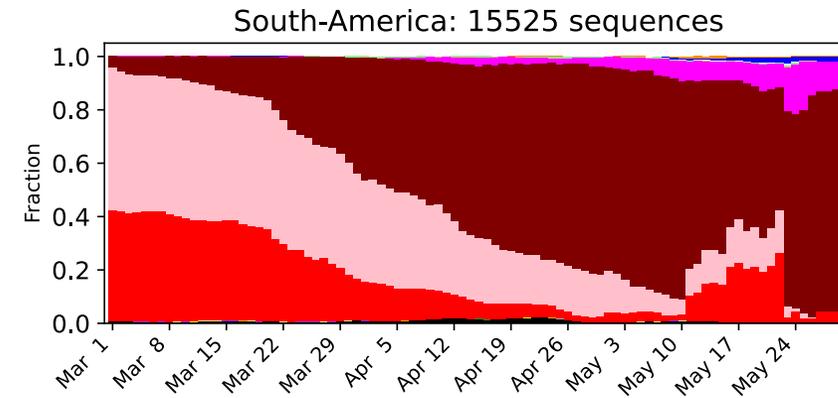
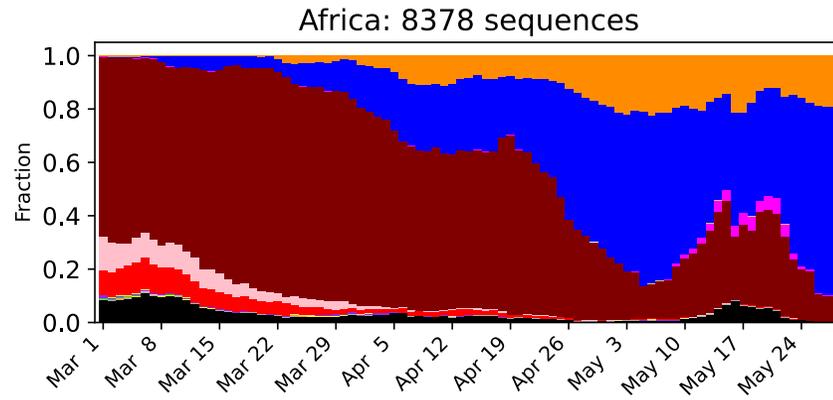
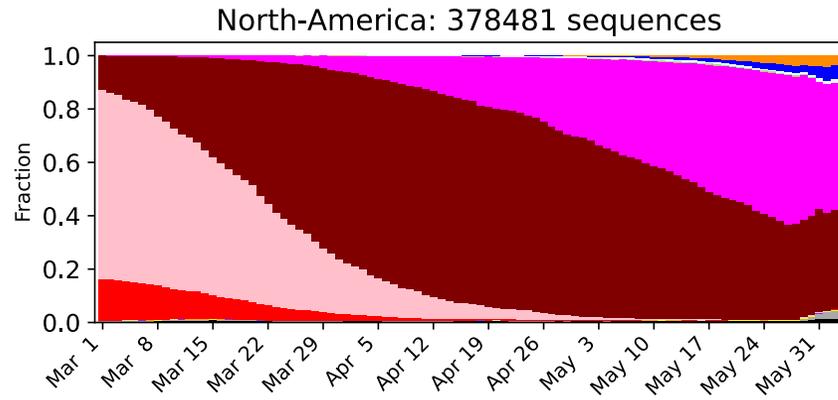


- Omicron\_BA.5
- Omicron\_BA.4
- Omicron\_BA.2.18\_K417T
- Omicron\_BA.2.13/9.1\_L452M
- Omicron\_BA.2.11
- Omicron\_BA.2.12.1
- Omicron\_BA.2
- Omicron\_BA.1.1
- Omicron\_other
- C.1.2
- Delta
- R.1
- Kappa
- Eta
- Iota
- Epsilon
- Gamma
- Mu
- Beta
- Lambda
- Alpha
- Other
- Ancestral
- Unassigned



# Pango Lineages By Continent

BA.2.12.1 has rapidly expanded in North America, BA.4 and BA.5 in Africa, and all three are now co-circulating globally. BA.2.18 is most often sampled in Europe.



- Omicron\_BA.5
- Omicron\_BA.4
- Omicron\_BA.2.18\_K417T
- Omicron\_BA.2.13/9.1\_L452M
- Omicron\_BA.2.11
- Omicron\_BA.2.12.1
- Omicron\_BA.2
- Omicron\_BA.1.1
- Omicron\_other
- C.1.2
- Delta
- R.1
- Kappa
- Eta
- Iota
- Epsilon
- Gamma
- Mu
- Beta
- Lambda
- Alpha
- Other
- Ancestral
- Unassigned



# BA.2.12.1 analyses relative to BA.2: isotonic regression, country level



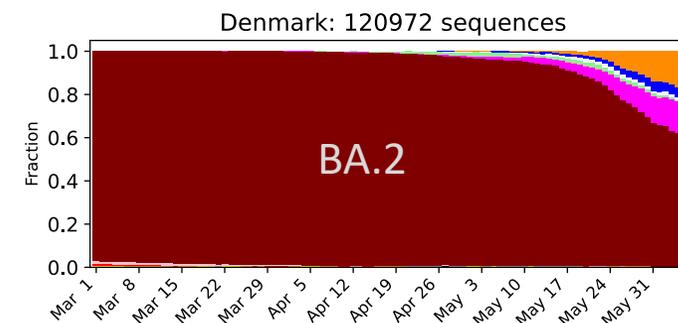
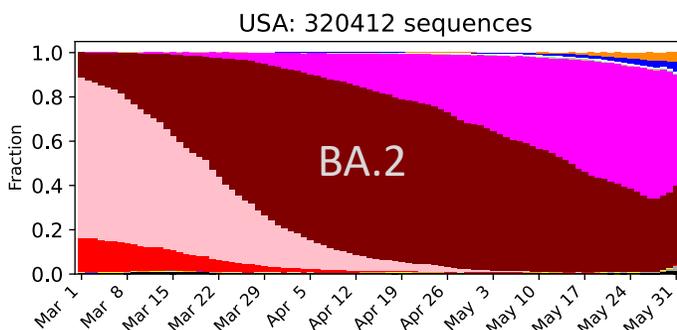
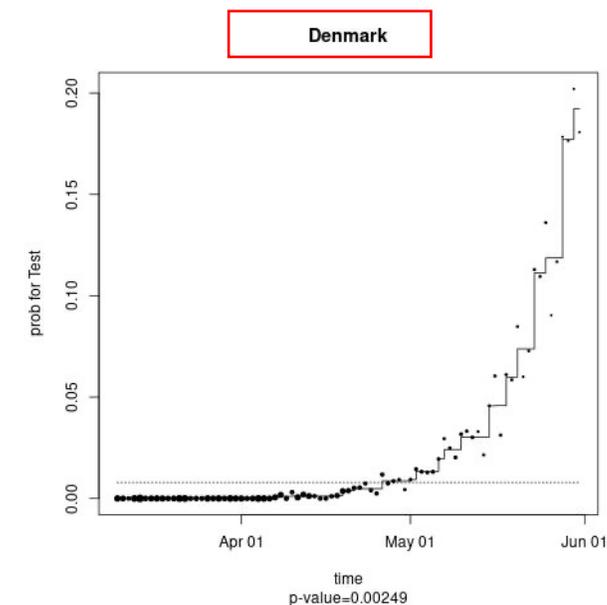
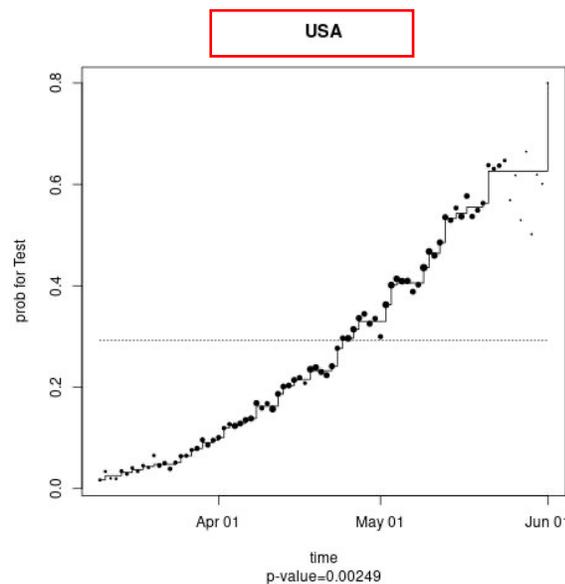
- Omicron\_BA.5
- Omicron\_BA.4
- Omicron\_BA.2.18\_K417T
- Omicron\_BA.2.13/9.1\_L452M
- Omicron\_BA.2.11
- Omicron\_BA.2.12.1

In almost all countries where BA.2.12.1 as been sampled  $\geq 10$  times (Test) it is significantly increasing in frequency relative to all other BA.2's.

Two examples

There were 76,863 sequences that matched your search term, the following summarizes the form in locations where it was found more than 10 times.

	# Test	# Others	Total	Test/Total (%)	# days	Time window	p-val
Australia	142	25932	26074	0.54	83	82	0.00249
Austria	77	3636	3713	2.07	70	77	0.00249
Belgium	49	14047	14096	0.35	81	80	0.00249
Brazil	15	1944	1959	0.77	74	74	0.0199
Canada	3456	30622	34078	10.14	82	81	0.00249
Chile	132	1528	1660	7.95	66	70	0.00249
Colombia	14	247	261	5.36	57	64	0.00249
Costa-Rica	19	809	828	2.29	70	73	0.00249
Denmark	710	89309	90019	0.79	83	82	0.00249
Ecuador	19	80	99	19.19	32	77	0.15174
France	55	43371	43426	0.13	76	75	0.00249
Germany	308	121105	121413	0.25	76	75	0.00249
Guatemala	14	92	106	13.21	39	67	0.02488
Hong-Kong	55	1330	1385	3.97	67	71	0.00249
India	45	3614	3659	1.23	81	81	0.00249
Ireland	61	7631	7692	0.79	69	68	0.00249
Israel	627	22742	23369	2.68	81	80	0.00249
Italy	23	10253	10276	0.22	83	82	0.00249
Japan	250	22233	22483	1.11	79	79	0.00249
Kenya	19	42	61	31.15	26	71	0.00249
Luxembourg	20	6254	6274	0.32	70	71	0.00249
Mexico	134	1211	1345	9.96	77	78	0.00249
Netherlands	80	11298	11378	0.70	81	81	0.00249
New-Zealand	33	3112	3145	1.05	68	67	0.00249
Norway	13	6631	6644	0.20	70	77	0.00249
Peru	75	365	440	17.05	60	67	0.00249
Philippines	13	131	144	9.03	52	66	0.00249
Portugal	21	4667	4688	0.45	72	76	0.00249
Puerto-Rico	63	341	404	15.59	52	75	0.00249
Singapore	58	3068	3126	1.86	81	80	0.00249
South-Korea	14	6462	6476	0.22	62	62	0.00249
Spain	44	13251	13295	0.33	81	80	0.00249
Sweden	12	8988	9000	0.13	79	79	0.00249
Switzerland	35	6751	6786	0.52	80	79	0.00249
USA	69147	167039	236186	29.28	84	83	0.00249
United-Kingdom	919	276704	277623	0.33	84	83	0.00249



The low p-values indicates that BA.2.12.1 is significantly increasing relative to all other BA.2s.



# BA.4+BA.5 analyses relative to BA.2: isotonic regression, country level

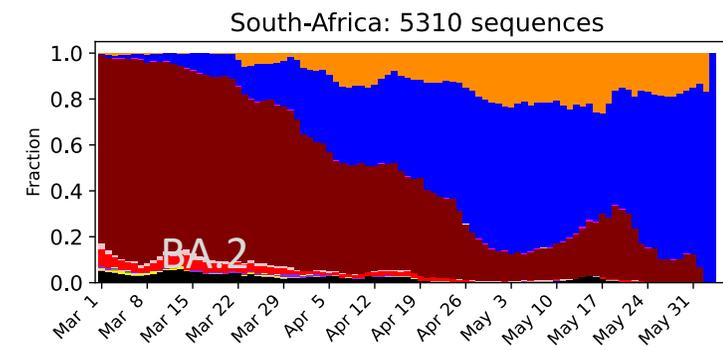
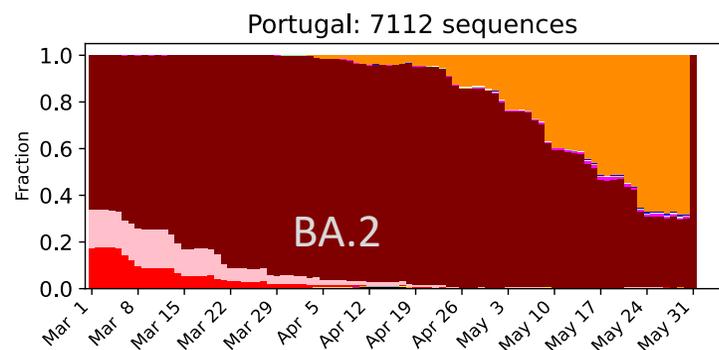
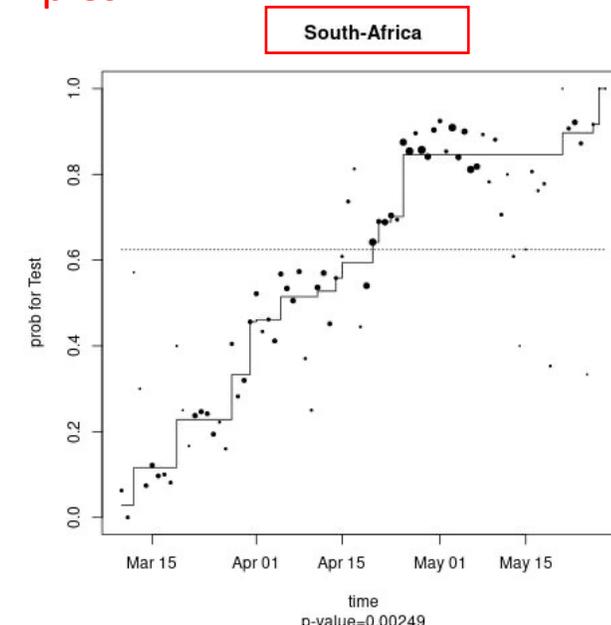
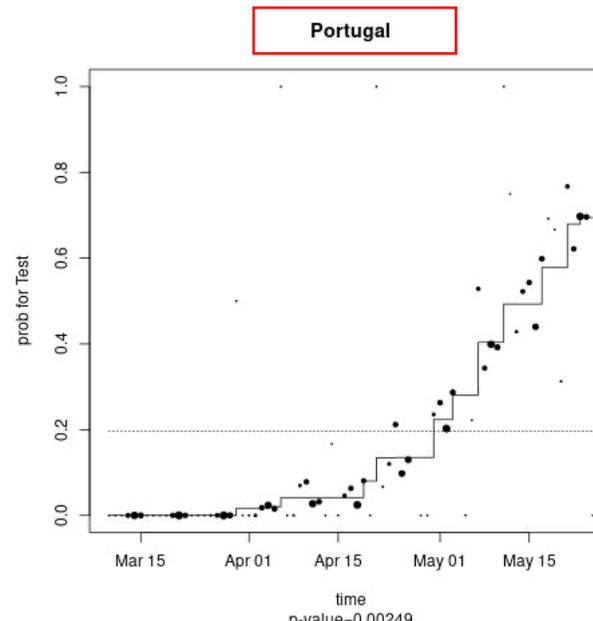
In almost all countries where BA.4 or BA.5 have been sampled  $\geq 10$  times (Test), BA.4 and BA.5 are significantly increasing in sample frequency relative to BA.2s.



- Omicron\_BA.5
- Omicron\_BA.4
- Omicron\_BA.2.18\_K417T
- Omicron\_BA.2.13/9.1\_L452M
- Omicron\_BA.2.11
- Omicron\_BA.2.12.1

	# Test	# Others	Total	Test/Total (%)	# days	Time window	p-val
Australia	218	26074	26292	0.83	83	82	0.00249
Austria	352	3713	4065	8.66	77	77	0.00249
Belgium	249	14096	14345	1.74	82	81	0.00249
Brazil	18	1959	1977	0.91	74	74	0.00249
Canada	98	34078	34176	0.29	82	81	0.00249
Chile	22	1660	1682	1.31	66	70	0.00249
Czech-Republic	10	6826	6836	0.15	73	72	0.00249
Denmark	685	90019	90704	0.76	83	82	0.00249
Eswatini	29	17	46	63.04	20	39	0.1194
France	207	43426	43633	0.47	77	78	0.00249
Germany	879	121413	122292	0.72	76	75	0.00249
Hong-Kong	19	1385	1404	1.35	67	71	0.00249
India	25	3659	3684	0.68	81	81	0.00249
Ireland	13	7692	7705	0.17	69	68	0.00249
Israel	542	23369	23911	2.27	81	80	0.00249
Italy	127	10276	10403	1.22	83	82	0.00249
Japan	34	22483	22517	0.15	79	79	0.00249
Luxembourg	142	6274	6416	2.21	70	71	0.00249
Mexico	18	1345	1363	1.32	77	78	0.00249
Netherlands	174	11378	11552	1.51	81	81	0.00249
New-Zealand	16	3145	3161	0.51	68	67	0.00249
Norway	14	6644	6658	0.21	70	77	0.00249
Portugal	1148	4688	5836	19.67	75	76	0.00249
Singapore	74	3126	3200	2.31	81	80	0.00249
South-Africa	2834	1704	4538	62.45	79	79	0.00249
Spain	273	13295	13568	2.01	82	81	0.00249
Sweden	44	9000	9044	0.49	79	79	0.00249
Switzerland	54	6786	6840	0.79	80	79	0.00249
USA	2385	236186	238571	1.00	84	83	0.00249
United-Kingdom	1358	277623	278981	0.49	84	83	0.00249

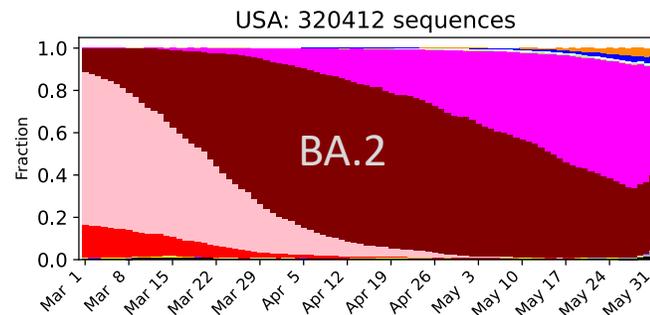
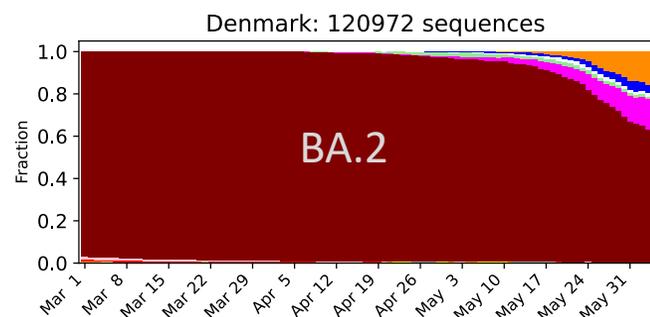
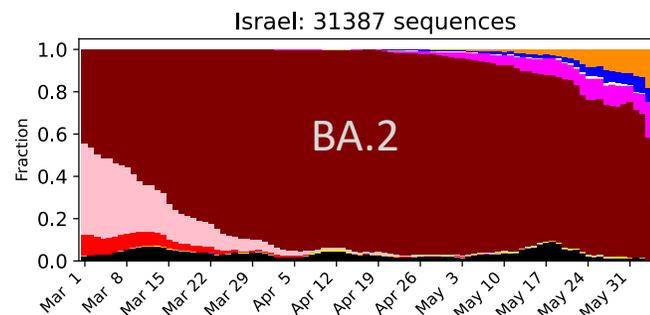
Two examples



The low p-values indicates that BA.4 + BA.5 is significantly increasing relative to all BA.2s.

In places where BA.4/BA.5 and BA.2.12.1 are co-circulating (>10x each), BA.4/BA.5s are more often significantly increasing in relative frequency compared to BA.2.12.1 (16/27), but this pattern is not consistent, and they were 3/27 countries where BA.2.12.1 was increasing more swiftly, and 8 other countries where there was no significant change in relative frequency. This supports that BA.4/5 many have a selective advantage relative to BA.2.12.1, but more data is needed to resolve this question.

	# Test	# Others	Total	Test/Total (%)	# days	Time window	p-val
Australia	218	142	360	60.56	48	59	0.00249
Austria	352	77	429	82.05	38	51	0.00249
Belgium	249	49	298	83.56	44	62	0.15423
Brazil	18	15	33	54.55	14	42	0.00249
Canada	98	3456	3554	2.76	82	81	0.00249
Chile	22	132	154	14.29	33	60	0.00249
Denmark	685	710	1395	49.10	59	78	0.00249
France	207	55	262	79.01	32	60	0.26119
Germany	879	308	1187	74.05	57	69	0.5597
Hong-Kong	19	55	74	25.68	22	41	0.8408
India	25	45	70	35.71	29	53	0.00249
Ireland	13	61	74	17.57	22	37	0.27363
Israel	542	627	1169	46.36	46	58	0.00249
Italy	127	23	150	84.67	32	40	0.16915
Japan	34	250	284	11.97	40	56	0.00498
Luxembourg	142	20	162	87.65	21	39	0.00249
Mexico	18	134	152	11.84	38	51	0.00249
Netherlands	174	80	254	68.50	40	53	0.05721
New-Zealand	16	33	49	32.65	17	33	0.3408
Norway	14	13	27	51.85	14	52	0.24876
Portugal	1148	21	1169	98.20	43	55	0.6194
Singapore	74	58	132	56.06	33	48	0.00249
Spain	273	44	317	86.12	45	61	0.00249
Sweden	44	12	56	78.57	20	29	0.04229
Switzerland	54	35	89	60.67	32	54	0.65174
USA	2385	69147	71532	3.33	84	83	0.00249
United-Kingdom	1358	919	2277	59.64	60	70	0.00249



Three examples of places where BA.4/BA.5 is increasingly sampled relative to BA.2.12.1

- Omicron\_BA.5
- Omicron\_BA.4
- Omicron\_BA.2.18\_K417T
- Omicron\_BA.2.13/9.1\_L452M
- Omicron\_BA.2.11
- Omicron\_BA.2.12.1

When  $p < 0.05$  BA.4+BA.5 is significantly increasing *relative to* BA.2.12.1:  

$$\text{Fraction} = \frac{\text{BA.4} + \text{BA.5}}{\text{BA.4} + \text{BA.5} + \text{BA.2.12.1}}$$



# BA.2.18, BA.2 and “other BA.2.\*” Pango lineages frequently carry K417T



In GISAID: 9900 in in Omicron: BA.2.18: 5191 (52%) BA.2: 2285 (23%) others (25%)

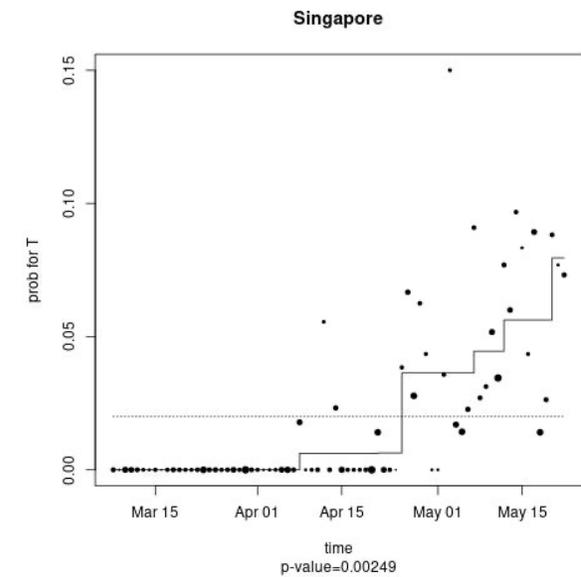
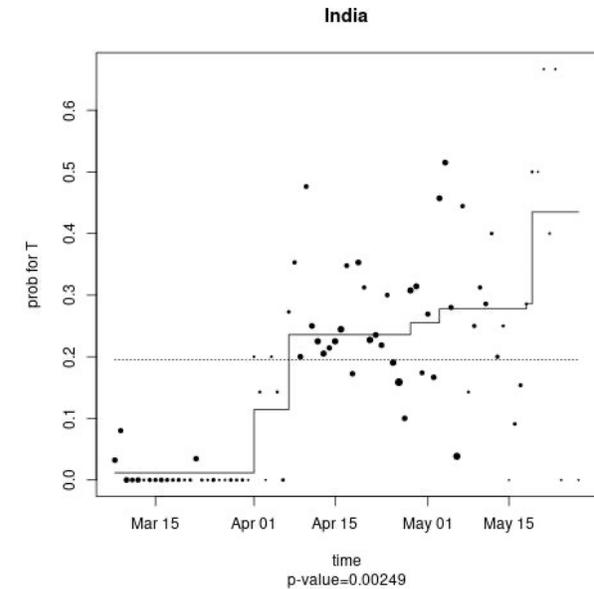
Two examples

Just tracking K417T among all BA.2 (will capture BA.2.18 and others)

This variant is still rare, but increasingly sampled in Asia, the US, and Europe

## Country level

	# T	# Others	Total	T/Total (%)	# days	Time window	p-val
Australia	46	18820	18866	0.24	78	77	0.00249
Belgium	16	8135	8151	0.20	83	82	0.00249
Canada	35	29529	29564	0.12	79	78	0.00249
Denmark	176	86138	86314	0.20	83	82	0.00249
France	121	25032	25153	0.48	74	73	0.00249
Germany	82	80055	80137	0.10	77	76	0.00249
Hong-Kong	10	1398	1408	0.71	69	73	0.00249
India	295	1217	1512	19.51	79	80	0.00249
Ireland	218	4689	4907	4.44	70	70	0.00249
Israel	57	9060	9117	0.63	83	82	0.00249
Japan	25	16704	16729	0.15	73	72	0.00249
Luxembourg	10	3603	3613	0.28	60	61	0.25622
Malaysia	153	4380	4533	3.38	73	78	0.00249
Netherlands	22	9018	9040	0.24	75	74	0.00249
Singapore	56	2745	2801	2.00	76	75	0.00249
Spain	26	7559	7585	0.34	79	82	0.00249
USA	1136	163136	164272	0.69	85	84	0.00249
United-Kingdom	2852	258403	261255	1.09	82	81	0.00249



# BA.4\_V3G: most common form of BA.4

BA.4 out started in S. Africa without this mutation.

BA.4\_V3G with this mutation is currently more common globally.

It is *not* consistently increasing relative to other BA.4's

This is consistent with it being a founder effect

Position: SPIKE 3 G

Assumption: Test amino acid form is increasing over time

Correlated variant: Do not consider. Include all sequences

Range of dates: 2022-03-08 - 2022-06-06

Pango lineage designation in GISAID : BA.4

Hosts: Human

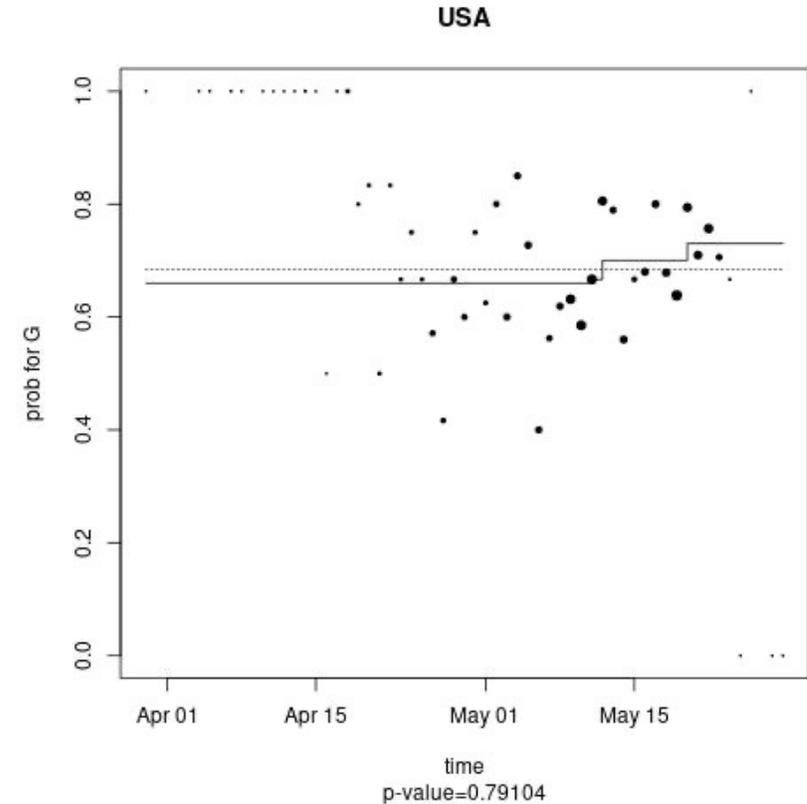
[Download plots and data](#)

No consistent pattern of increases



Country level

	# G	# Others	Total	G/Total (%)	# days	Time window	p-val
Australia	21	12	33	63.64	20	52	0.89801
Austria	49	18	67	73.13	18	35	0.31592
Belgium	53	13	66	80.30	36	60	0.91791
Denmark	87	74	161	54.04	43	76	0.73383
France	22	14	36	61.11	17	48	0.64428
Germany	47	24	71	66.20	25	41	0.00498
Israel	64	36	100	64.00	30	40	0.18408
Netherlands	32	21	53	60.38	18	40	0.13682
South-Africa	697	685	1382	50.43	76	81	0.00249
USA	505	233	738	68.43	54	60	0.79104
United-Kingdom	162	282	444	36.49	50	67	0.00995



Note: the pattern with in South Africa depended on the local region and was not Consistent across South Africa.

Thanks to all who share data through GISAID and enable this work tracking SARS-CoV-2 viral variants and supporting vaccine and reagent design.

