Surveillance report

Surveillance generated by nf-ncov-voc for Delta variant

Date

This report is generated on 2022-05-06 using 272378 number of genomes collected between 2020-02-25 and 2022-04-06

Pango Lineages

Pango Lineages in this report ['AY.1', 'AY.10', 'AY.100', 'AY.101', 'AY.102', 'AY.103', 'AY.103.2', 'AY.104', 'AY.106', 'AY.107', 'AY.108', 'AY.109', 'AY.110', 'AY.111', 'AY.112', 'AY.112.2', 'AY.113', 'AY.114', 'AY.116', 'AY.116.1', 'AY.117', 'AY.118', 'AY.119', 'AY.119.1', 'AY.119.2', 'AY.120', 'AY.120.1', 'AY.121', 'AY.121.1', 'AY.122', 'AY.122.1', 'AY.122.4', 'AY.122.5', 'AY.122.6', 'AY.124', 'AY.124.1', 'AY.125', 'AY.126', 'AY.127', 'AY.127.1', 'AY.128', 'AY.129', 'AY.13', 'AY.131', 'AY.133', 'AY.14', 'AY.15', 'AY.16', 'AY.18', 'AY.2', 'AY.20', 'AY.23', 'AY.24', 'AY.25', 'AY.25.1', 'AY.25.1.2', 'AY.25.3', 'AY.26', 'AY.27', 'AY.28', 'AY.29', 'AY.29.2', 'AY.3', 'AY.3.1', 'AY.3.3', 'AY.32', 'AY.33', 'AY.34', 'AY.34.1', 'AY.34.1.1', 'AY.35', 'AY.36', 'AY.37', 'AY.38', 'AY.39', 'AY.39.1', 'AY.4', 'AY.4.12', 'AY.4.2', 'AY.4.2.1', 'AY.4.2.2', 'AY.4.2.3', 'AY.4.3', 'AY.4.4', 'AY.4.5', 'AY.4.6', 'AY.4.7', 'AY.4.8', 'AY.41', 'AY.42', 'AY.43', 'AY.43.3', 'AY.43.8', 'AY.44', 'AY.45', 'AY.46', 'AY.46.1', 'AY.46.2', 'AY.46.4', 'AY.46.5', 'AY.46.6', 'AY.47', 'AY.48', 'AY.49', 'AY.5', 'AY.5.3', 'AY.5.4', 'AY.5.6', 'AY.51', 'AY.53', 'AY.54', 'AY.55', 'AY.56', 'AY.57', 'AY.58', 'AY.59', 'AY.6', 'AY.60', 'AY.61', 'AY.62', 'AY.64', 'AY.65', 'AY.67', 'AY.68', 'AY.7.1', 'AY.70', 'AY.72', 'AY.73', 'AY.74', 'AY.75', 'AY.75.2', 'AY.76', 'AY.77', 'AY.78', 'AY.82', 'AY.83', 'AY.84', 'AY.85', 'AY.86', 'AY.88', 'AY.9', 'AY.9.2', 'AY.9.2.1', 'AY.92', 'AY.93', 'AY.94', 'AY.98', 'AY.98.1', 'AY.99', 'AY.99.1', 'AY.99.2', 'B.1.617.2']

Indicator

This table contains key indicators identified

Indicator	Sub-categories from POKAY	Mutations
Transmissibility between humans	transmissibility	p.D614G, p.E484Q, p.L452R, p.P681R
Infection Severity	ACE2 receptor binding affinity, viral load, outcome hazard ratio	p.D614G, p.E484Q, p.H69del, p.K417N, p.L452R, p.L5F, p.N501T, p.P26S, p.S494P, p.T95I, p.V70del, p.Y144del
Immunity after natural infection	convalescent plasma escape, reinfection, humoral response durability	p.D614G, p.E484A, p.E484Q, p.G446V, p.H69del, p.K417N, p.K458N, p.L452R, p.P1162S, p.S494P, p.V70del, p.Y144del
Vaccines	vaccine neutralization efficacy	p.D614G, p.E484Q, p.K417N, p.L452R
Monoclonal antibodies	monoclonal antibody serial passage escape, pharmaceutical effectiveness	p.E484A, p.E484Q, p.G142D, p.G446V, p.K417N, p.L452R, p.N501T, p.P251L, p.R158G, p.S255F, p.S443F, p.S494P
Diagnostics	clinical indicators, antigenic test failure, symptom prevalence	

Mutation Significance

This table contains key functional impacts of mutations identified

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.Y144del	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a slight decrease in binding (KD) relative to D614G.	AY.34.1.1	Gong et al. (2021)	2	TTTA	T	0.5

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.Y144del	antibody epitope effects	Wildtype elicits immune response, COVID-19 cohort epitope score > 99th percentile of the 497 pre-pandemic controls, mutant drops PIWAS epitope score from 1% to 0.17% (poorer immune recognition) Together with other B1.1.7 lineage mutational changes (Spike: N501Y, A570D, P681H, Nucleoprotein: D3L, S235F) resulted in only 2 of 579 individuals (0.3% of the population) having a dramatic reduction in PIWAS antigen scores, which reflects the peak epitope signal along the entire antigen.	AY.34.1.1	Haynes et al. (2021)	2	TTTA	T	0.5
p.Y144del	antibody epitope effects	Massive reduction in S2M28 monoclonal antibody EC50 (i.e. ablated recognition), within antigenic supersite "i" Massive reduction in S2X28 monoclonal antibody EC50 (i.e. ablated recognition), within antigenic supersite "i" Massive reduction in S2X333 monoclonal antibody EC50 (i.e. ablated recognition), within antigenic supersite "i" Massive reduction in 4A8 monoclonal antibody EC50 (i.e. ablated recognition)	AY.34.1.1	McCallum et al. (2021)	2	TTTA	T	0.5
p.Y144del	antibody epitope effects	Abolishes neutralization by N-terminal-domain-directed mAbs 5-24, 4-8, and 4A8.	AY.34.1.1	Wang et al. (2021)	2	TTTA	T	0.5
p.Y144del	convalescent plasma binding	1.14x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.34.1.1	Gong et al. (2021)	2	TTTA	T	0.5
p.Y144del	convalescent plasma escape	Virus evolution data in 9 immunocomprised patients with long active COVID-19 infections was gathered, showing sequence deletion hotspots. This variant was present in 4 patients.	AY.34.1.1	McCarthy et al. (2021)	2	TTTA	T	0.5
p.Y144del	immunosuppression variant emergence	Emergent as 100% variant from larger minor (1% allele frequency) deletion by day 70 post-infection of female immunocompromised individual with chronic lymphocytic leukemia and acquired hypogammaglobulinemia. Variant disappeared after convalescent plasma treatment (day 71) in subsequent sample sequencing.	AY.34.1.1	Avanzato et al. (2020)	2	TTTA	T	0.5
p.Y144del	trafficking	Lentiviral pseudotyped with this individual mutation from B.1.1.7 was tested on ACE2.293T cells. Luciferase activity was measured two days postinfection, showing slightly increased infection rate amongst the cells.	AY.34.1.1	Tada et al. (2021)	2	TTTA	T	0.5

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.Y144del	vaccinee plasma binding	1.08x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.11x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.34.1.1	Gong et al. (2021)	2	TTTA	T	0.5

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 2.66x increase in binding (KD) relative to D614G.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Gong et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant combination (representing lineage B.1.617) showed a 1.85x increase in binding (KD) relative to D614G. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	ACE2 receptor binding affinity	extasciitilde1.7-fold increase in binding affinity vs wild type.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Motozono et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	T cell evasion	L452R derivative virus did not induce IFN-gamma expression even at the highest concentration tested (10 nM) in two different A*24:02 convalescent sera donor plasma (linear epitope NYNYLYRLF 448,456).	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Motozono et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	antibody epitope effects	Resistent to some neutralizing antibodies: mAbs X593 and P2B-2F6	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Li et al. (2020)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	antibody epitope effects	Mutant screen in neutralization assay with a broad range of monoclonal antibodies shows resistence to more than one antibody.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Liu et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	antibody epitope effects	10 of 14 RBD-specific mAbs that showed at least 10-fold reduced neutralization of B.1.427/B.1.429 variant pseudotype (S13I, W152C, and L452R) were also found to poorly bind to just a L452R RBD mutant, demonstrating a role for this mutation as an escape mechanism for certain RBD-targeting mAbs.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	McCallum et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	antibody epitope effects	extasciitilde20% (ELISA significance threshold) drop in antibody binding (ELISA) by this variant against monoclonal antibody VH ab6.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Sun et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma binding	2.15x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Gong et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma binding	This variant combination (representing lineage B.1.617) showed a 1.22x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma escape	Observed extasciitilde2x decrease on average in 16 health workers' convalescent sera.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Alenquer et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma escape	Ablation of neutralization capability of 3 of 4 convalescent sera tested, the other is significantly hindered.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Liu et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma escape	Pseudotyped viruses for B.1.617 was 2.3-fold resistant to neutralization by convalescent sera compared to wild type - a finding that was similar to that of the 3-fold resistance of the South Africa B.1.351 variant using the same assay. The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617. [details on the convalescent patient sera collection are not abundantly clear in the preprint]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	convalescent plasma escape	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by convalescent plasma [no cohort details provided]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Wilhelm et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	gene expression increase	Experimentally, Spike gene expression increased 0.32 fold	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Starr et al. (2020)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	monoclonal antibody serial passage escape	Ranked effective mutant against this position in the RBD for highly neutralizing COV2-2096	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Greaney et al. (2020)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	monoclonal antibody serial passage escape	Escape mutation against monoclonal antibody LY-CoV555 (antibody that forms the basis for Eli Lilly's bamlanivimab)	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Starr et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	monoclonal antibody serial passage escape	Class 2/3 antibody C628 and class 2 antibody C643 selected for the emergence of the L452R mutation in vitro.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Wang et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	pharmaceutical effectiveness	Bamlanivimab (LY-CoV555) lost extasci-itilde5x binding against this isolated mutation. Cligavimab lost extasci-itilde4x binding against this isolated mutation. Regdanvimab lost extasci-itilde4x binding against this isolated mutation.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Engelhart et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	pharmaceutical effectiveness	Bamlanivimab (LY-CoV555) entirely lost its neutralizing activity due to the central location of L452R in the epitopes recognized by this mAb. Regdanvimab (CT-P59), and to a smaller extent etesevimab, showed a reduction in neutralization potency.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	McCallum et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	symptom prevalence	Gross examination of 3+3 hamster lung specimens showed pronounced congestion and hemorrhages on days 5 and 7 post-infection in the case of the B.1.617.1 as compared with the B.1. The lung lesions with the B.1 variant were minimal to mild whereas with B.1.617.1 they were moderate. For B.1 pneumonic changes were minimal to mild (inflammatory cell infiltration, focal consolidation and mild congestion). The pronounced changes (moderate to severe) with mononuclear infiltration in the alveolar interstitial space, interstitial septal thickening, consolidation and pneumocyte hyperplasia were observed with B.1.617.1 variant consistently.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	trafficking	We observed increased entry by pseudoviruses carrying the L452R mutation compared to D614G alone, with a 6.7 to 22.5-fold increase in 293T cells and a 5.8 to 14.7-fold increase in human airway organoids.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Deng et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	trafficking	This variant alone shows a extasciitilde5x decrease in cell entry efficiency (RLU measurement in 293T cells) compared to D614G. [listed as L454R in Figure, but L452R in text, also text suggests not statistucally significant, but error bars say otherwise in Figure 4]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Ferriera et al (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	trafficking	Increased stability of RBD expression in yeast, suggesting increased Spike protein stability.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Motozono et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	transmissibility	Increased infectivity of the B.1.617 spike was attributed to L452R, which itself caused a 3.5-fold increase in infectivity relative to D614G wild type. [In combination with E484Q caused a lower 3-fold increase]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Tada et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	transmissibility	The combination caused a 3-fold increase in infectivity relative to D614G wild type. [compare to 3.5x for L452R alone]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	T	G	1.0
p.L452R	transmissibility	Normalized for particle number, on ACE2.293T cells showed that the B.1.617 spike protein was >2-fold increase in infectivity relative to D614G wild type.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccine neutralization efficacy	Nine stored sera from Pfizer BNT162b2 vaccinees were tested against a range of spike mutation bearing PV. L452R conferred about a two-fold reduction in neutralisation by vaccine sera, but was not statistically significant with this sample size.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Ferreira et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccine neutralization efficacy	Nine stored sera from Pfizer BNT162b2 vaccinees were tested against a range of spike mutation bearing PV. E484Q had a extasciitilde5x drop in neutralization (vs extasciitilde10x for E484K). When E484Q and L452R were combined, the fold change was significant, but similar to that of L452R alone (extasciitilde2x), suggesting no evidence for an additive effect [perhaps even E484Q effect dilution].	AY.35, AY.77, AY.112.2	Ferreira et al. (2021)	4	T	G	1.0
p.L452R	vaccine neutralization efficacy	1.4x reduction in neutralization (ID50) in sera 3 weeks after one dose of Pfizer/BioNTech BNT162b2 (up to 5 naive and post infection vaccinees)	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccine neutralization efficacy	The presence of this variant in 189 post-mRNA-vaccination COVID-19 cases was proportionally in line with lineage prevalence in Northen California during the study period, suggesting no effect of these variants on immune escape.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Jacobson et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccine neutralization efficacy	Pseudotyped viruses for B.1.617 was 4-fold resistant to neutralization by 6 BNT162b2 vaccine sera 28 days post-booster compared to wild type - a finding that was similar to that of the 3.4-fold resistance of the South Africa B.1.351 variant using the same assay. Neutralization by 3 Moderna vaccine sera 28 days post-booster was 5-fold resistant (vs. 2.2-fold for B.1.351). The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccine neutralization efficacy	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by 18 vaccinee sera (BNT162b2 and mRNA1273).	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Wilhelm et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccinee plasma binding	1.05x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.16x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Gong et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	vaccinee plasma binding	This variant combination (representing lineage B.1.617) showed a 1.30x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.18x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	T	G	1.0
p.L452R	viral load	In 9 infected hamsters each for B.1 and B.1.617.1, no significant change in viral load or subgenomic RNA levels were detected.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.L452R	virion structure	Estimated free energy change (ddG) for this variant is -0.67 kcal/mol (i.e. destabilizing relative to wild type)	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.16.1, AY.16, AY.14, AY.106,	Spratt et al. (2021)	101814	T	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P1162S	convalescent plasma escape	Escape mutant found after in passage in plasma pool of 26 convalescents mean 1.5 post symptom onset.	AY.94, AY.4.12	Schmidt et al. (2021)	601	C	T	1.0
p.K417N	ACE2 receptor binding affinity	The K417N mutation decreased the affinity extasciitilde4 fold, mainly by decreasing the k(on) but also by increasing the k(off) as measured by surface plasmon resonance.	AY.2, AY.1	Barton et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	This combination showed extasciitilde3x increase binding to ACE2 vs wild type, about half that of the B.1.1.7 lineage, suggesting that the K417N mutation is slightly detrimental to ACE2 binding, probably as a result of disrupting the salt bridge formed with ACE2 residue D30	AY.2, AY.1	Collier et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.5x decrease in binding (KD) relative to D614G.	AY.2, AY.1	Gong et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	RBD containing the N501Y mutation results in 9-fold stronger binding to the hACE2 receptor than wild type RBD. The E484K mutation does not significantly influence the affinity for the receptor, while K417N attenuates affinity. As a result, RBD from B.1.351 containing all three mutations binds 3-fold stronger to hACE2 than wild type RBD but 3-fold weaker than N501Y.	AY.2, AY.1	Laffeber et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	Studying the key covariants in lineage of concern 501Y.V2, observed about 2-fold increase in ACE2 binding vs wildtype, but greatly decreased mAb binding, suggesting evolutionary optimum tension between immune evasion and ACE2 binding affinity as the N501Y variant alone has 10x increase in affinity but no effect on tested mAb binding.	AY.2, AY.1	Liu et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	Using Mircoscale Thermopheresis, the B.1.351 variant harboring three mutations, binds ACE2 at nearly five-fold greater affinity than the original SARS-COV-2 RBD (Kd 87.6, vs 402.5 nM).	AY.2, AY.1	Ramanathan et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	Reported 3-fold decrease in affinity compared to wild-type RBD on the cell surface (Kd	AY.2, AY.1	Tian et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	Reported slight increase in affinity compared to wild-type RBD on the cell surface (Kd	AY.2, AY.1	Tian et al. (2021)	14	G	T	1.0
p.K417N	ACE2 receptor binding affinity	The affinity of ACE2 for this mutation combination was twice as high as for wild type. Having in mind that the affinity of SARS-CoV-2 for ACE2 is only 4-fold higher compared to SARS-CoV-1, this factor of 2 is expected to be biologically significant.	AY.2, AY.1	Vogel et al. (2021)	14	G	T	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.K417N	antibody epitope effects	>20% (ELISA significance threshold) drop in antibody binding (ELISA) by this variant against IgG1 monoclonal antibody ab1.	AY.2, AY.1	Sun et al. (2021)	14	G	T	1.0
p.K417N	antibody epitope effects	5 antibodies tested were less potent against K417N by ten-fold or more (class 1 mAbs)	AY.2, AY.1	Wang et al. (2021)	14	G	T	1.0
p.K417N	antibody epitope effects	Pseudotyped virus model ablates binding by RBD-directed mAbs CB6 and 910-30 (targeting the inner side of the RBD). Pseudotyped virus model impairs binding by RBD-directed mAbs 4-20 and REGN10933.	AY.2, AY.1	Wang et al. (2021)	14	G	T	1.0
p.K417N	convalescent plasma binding	2.16x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.2, AY.1	Gong et al. (2021)	14	G	T	1.0
p.K417N	convalescent plasma escape	The 501Y.V2 to first wave IC50 ratio ranged from 6 to 200-fold. Averaging across all 7 participant convalescent sera highlighted the dramatic decrease in sensitivity to neutralization of authentic 501Y.V2 variants. PG: I'm purposefully ignoring D614G and A701V as contributors	AY.2, AY.1	Cele et al. (2021)	14	G	T	1.0
p.K417N	convalescent plasma escape	In 19 convalescent human sera extasciitilde1mo post infection, Two-tailed Wilcoxon matched-pairs signed-rank test shows mild resistence P	AY.2, AY.1	Chen et al. (2021)	14	G	T	1.0
p.K417N	convalescent plasma escape	27% of 44 early pandemic exposure convalescent plasma/sera lose all activity against a RBD triple mutant pseudovirus (RBD mutatants of the 501Y.V2 "South African" lineage), while only 23% retained high titres	AY.2, AY.1	Wibmer et al. (2021)	14	G	T	1.0
p.K417N	convalescent plasma escape	Nearly half (21 of 44, 48%) of early pandemic exposure convalescent plasma/sera failed to neutralize the 501Y.V2 ("South African") lineage pseudovirus construct Only 3 of 44 convascent sera (those with the highest titer, which correlated direectly with initial infection severity) had high neutralization against this 501Y.V2 PG: note that lineage variant R246I was excluded from the text in reference to these sera assays, not sure if that was an oversight.	AY.2, AY.1	Wibmer et al. (2021)	14	G	T	1.0
p.K417N	gene expression increase	Experimentally, Spike gene expression increased 0.1 fold	AY.2, AY.1	Starr et al. (2020)	14	G	T	1.0
p.K417N	monoclonal antibody serial passage escape	Escape mutation against monoclonal antibody LY-CoV016	AY.2, AY.1	Starr et al. (2021)	14	G	T	1.0
p.K417N	monoclonal antibody serial passage escape	In vitro selection against class 1 (Spike 'up' conformation) monoclonal antibody C682, and to a lesser extent C614 and C660	AY.2, AY.1	Wang et al. (2021)	14	G	T	1.0
p.K417N	pharmaceutical effectiveness	COR-101 lost extasciitilde6x binding against this isolated mutation. Estesevimab lost extasciitilde100x binding against this isolated mutation.	AY.2, AY.1	Engelhart et al. (2021)	14	G	T	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.K417N	pharmaceutical effectiveness	Tixagevimab, Regdanvimab and COR-101 display reduced binding affinity to virus pseudotyped as RBD from B.1.351.	AY.2, AY.1	Engelhart et al. (2021)	14	G	T	1.0
p.K417N	pharmaceutical effectiveness	This mutated version of RBD completely abolishes the binding to a therapeutic antibody, Bamlanivimab, in vitro.	AY.2, AY.1	Liu et al. (2021)	14	G	T	1.0
p.K417N	trafficking	extasciitilde2x more infectivity than D614G alone in HEK293T-ACE2 cells 48h post-transduction.	AY.2, AY.1	Kuzmina et al. (2021)	14	G	T	1.0
p.K417N	trafficking	Lentiviral pseudotyped with this individual mutation from B.1.351 was tested on ACE2.293T cells. Luciferase activity was measured two days postinfection, showing mild decrease in infection rate amongst the cells, suggesting that this mutation does not contributing to cell entry fitness.	AY.2, AY.1	Tada et al. (2021)	14	G	T	1.0
p.K417N	vaccine neutralization efficacy	This variant showed only minor in Pfizer sera (one or two dose) neutralization efficiency vs D614G (using lentivirus pseudotype).	AY.2, AY.1	Kuzmina et al. (2021)	14	G	T	1.0
p.K417N	vaccinee plasma binding	1.76x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.75x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.2, AY.1	Gong et al. (2021)	14	G	T	1.0
p.K417N	virion structure	Estimated free energy change (ddG) for this variant is -0.86 kcal/mol (i.e. destabilizing relative to wild type)	AY.2, AY.1	Spratt et al. (2021)	14	G	T	1.0
p.G142D	anthropozoonotic events	These variants dominate in mink infections in North America, sometime supplemented with F486L. The Y453F variant found in other jurisdictions in mink infections is notably absent in North America.	AY.131	Cai and Cai (2021)	1	G	A	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.G142D	monoclonal antibody serial passage escape	Escape mutation against Spike N terminal domain antigenic supersite i mAbs S2M28, S2X28, S2X333	AY.34, AY.3.3, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.55, AY.127, AY.4.7, AY.39.1, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.5.3, AY.43.3, AY.57, AY.99.2, AY.120, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.16, AY.14, AY.106, AY.75, AY.4.12, AY.76,	McCallum et al. (2021)	92545	G	A,ATGT,ATGTTA,ATT,ATG	1,1,1,1,1

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.G142D	monoclonal antibody serial passage escape	Selected twice in passage with mAb COV2-2489.	AY.34, AY.3.3, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.55, AY.127, AY.4.7, AY.39.1, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.5.3, AY.43.3, AY.57, AY.99.2, AY.120, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.16, AY.14, AY.106, AY.75, AY.4.12, AY.76,	Suryadevara et al. (2021)	92545	G	A,ATGT,ATGTTA,ATT,ATG	1,1,1,1,1

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.V70del	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.51x increase in binding (KD) relative to D614G, mostly due to decreased in "off-rate" a.k.a. dissociation rate (Kdis).	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5
p.V70del	antibody epitope effects	Reduces neutralization by structurally unmapped mAb COVA1-21 (cluster XI).	AY.34.1.1	Rees-Spear et al. (2021)	2	ATACATG	A	0.5
p.V70del	convalescent plasma binding	1.33x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5
p.V70del	convalescent plasma escape	Fatal COVID-19 complications in immunocomprimised patient after immune escape from convalescent plasma	AY.34.1.1	Kemp et al. (2020)	2	ATACATG	A	0.5
p.V70del	convalescent plasma escape	Neutralization activity of almost all Moderna Phase 1 sera tested actually *increased*.	AY.34.1.1	Shen et al. (2021)	2	ATACATG	A	0.5
p.V70del	convalescent plasma escape	Viruses containing the point mutations of B.1.1.7 showed that the single point mutations (Δ69-70 and N501Y) were neutralized as efficiently as D614G across 10 convalescent sera from April 2020 infectees.	AY.34.1.1	Tada et al. (2021)	2	ATACATG	A	0.5
p.V70del	immunosuppression variant emergence	The delH69/V70 enhances viral infectivity, indicating its effect on virus fitness is independent to the N501Y RBM change [with which it is found in lineage B.1.1.7] Possibly arisen as a result of the virus evolving from immune selection pressure in infected individuals and possibly only one chronic infection in the case of lineage B.1.1.7.	AY.34.1.1	Kemp et al. (2020)	2	ATACATG	A	0.5
p.V70del	vaccinee plasma binding	1.14x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.09x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.R158G	monoclonal antibody serial passage escape	Escape mutation against Spike N terminal domain antigenic supersite i mAb S2X28	AY.3.3, AY.122.1, AY.34, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1,	McCallum et al. (2021)	100298	GAGTTCA	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.T95I	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.33x decrease in binding (KD) relative to D614G.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	6772	C	T	0.78

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.T95I	convalescent plasma binding	No change in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	6772	C	T	0.78

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.T95I	vaccinee plasma binding	1.16x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.02x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	6772	C	T	0.78
p.N501T	ACE2 receptor binding affinity	Experimentally, ACE2 binding affinity increased 0.1 fold	AY.131	Starr et al. (2020)	1	A	C	1.0
p.N501T	anthropozoonotic events	These variants dominate in mink infections in North America, sometime supplemented with F486L. The Y453F variant found in other jurisdictions in mink infections is notably absent in North America.	AY.131	Cai and Cai (2021)	1	A	C	1.0
p.N501T	anthropozoonotic events	Observed in second of two Netherlands mink cohorts, potential adaptation.	AY.131	Oreshkova et al. (2020)	1	A	C	1.0
p.N501T	anthropozoonotic events	Observed in 4 separate mink farms in Denmark, but not humans, potential adaptation (diff set of farms than F486L).	AY.131	Oude Munnink et al. (2020)	1	A	C	1.0
p.N501T	anthropozoonotic events	Emergent variants observed in tandem in ferrets post-serial infection.	AY.131	Richard et al. (2020)	1	A	C	1.0
p.N501T	monoclonal antibody serial passage escape	Mild in vitro selection against class 3 monoclonal antibody C670.	AY.131	Wang et al. (2021)	1	A	C	1.0
p.N501T	pharmaceutical effectiveness	Estesevimab lost extasciitilde12x binding against this isolated mutation.	AY.131	Engelhart et al. (2021)	1	A	C	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 2.66x increase in binding (KD) relative to D614G.	AY.27, AY.33, AY.16, AY.5	Gong et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	ACE2 receptor binding affinity	In four cell lines (including 293T-hACE2 cells), this mutation combination increases infectivity vs D614G alone	AY.27, AY.33, AY.16, AY.5	Li et al. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	convalescent plasma binding	2.15x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.27, AY.33, AY.16, AY.5	Gong et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	convalescent plasma escape	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by convalescent plasma [no cohort details provided]	AY.27, AY.33, AY.16, AY.5	Wilhelm et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	humoral response durability	27yo female nurse reinfected in December 2020 (B.1.177) after initial infection in March 2020 (B.3), i.e. with a 9 month interval. Both cases were mild. No significant differences in the neutralizing capacity of the two linages were observed in 4 sera taken (1 pre-reinfection, three post-reinfection). Neutralizing antibody titres (IC50) before and immediately after re-infection were <300 against both strains, and jumped >7x upon re-infection. Viral titres were also higher in the second case. Second case also includes N:p.A220V	AY.27	Brehm et al. (2021)	19278	GGA	TGG,GGG	1.0
p.D614G	immunosuppression variant emergence	Studying 94 COVID-19 extended infection cases with genomics April 1 to October 17, 2020, one case developed 23 mutations in a 19 day period, including this combination in Spike.	AY.27, AY.33, AY.16, AY.5	Landis et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	reinfection	27yo female nurse reinfected in December 2020 (B.1.177) after initial infection in March 2020 (B.3). Both cases were mild. Second case also includes N:p.A220V	AY.27	Brehm et al. (2021)	19278	GGA	TGG,GGG	1.0
p.D614G	syncytium formation	Slight increase in Vero cell-cell membrane fusion assay under infection with VSV pseudotyped virus.	AY.27, AY.33, AY.16, AY.5	Kim et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	tissue specific neutralization	The nasal mucosa of Pfizer vaccinees with time course collection was evaluated against VSV pseudotypes: results (only one nasal swab from different previously infected vacinee neutralizing at weeks 3 and 6 against B.1.1.7 and D614G) suggest that vaccinees probably do not elicit an early humoral response detectable at mucosal surfaces even though sera neutralization was observed. They strengthen the hypothesis that some vaccines may not protect against viral acquisition and infection of the oral–nasal region, but may prevent severe disease associated with viral dissemination in the lower respiratory tract.	AY.27, AY.33, AY.16, AY.5	Planas et al. (2021)	19554	GGA	TGG,GGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	Circulating variant shown in vitro to not have major defects or enhancement of cell surface protein trafficking (i.e. Spike cleavage or fusion required for cell entry)	AY.27, AY.33, AY.16, AY.5	Barrett et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	The increased transduction with Spike D614G ranged from 1.3- to 2.4-fold in Caco-2 and Calu-3 cells expressing endogenous ACE2 and from 1.5- to 7.7-fold in A549ACE2 and Huh7.5ACE2 overexpressing ACE2. Although there is minimal difference in ACE2 receptor binding between the D614 and G614 Spike variants, the G614 variant is more resistant to proteolytic cleavage, suggesting a possible mechanism for the increased transduction.	AY.27, AY.33, AY.16, AY.5	Daniloski et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	No change in infectivity (24h) relative to D614G alone in Caco-2 cells, Vero or Calu-3.	AY.27, AY.33, AY.16, AY.5	Kim et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	extasciitilde4x more efficient S2 domain cleavage compared to wild type in Caco-2 cells, mid-range of three cell line tested (Vero and Calu-3).	AY.27, AY.33, AY.16, AY.5	Kim et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	Among S variants tested, the D614G mutant shows the highest cell entry (extasciitilde3.5x wild type), as supported by structural and binding analyses.	AY.27, AY.33, AY.16, AY.5	Ozono et al. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	Quantification of the band intensities showed that the P681R mutation, which lies near the proteolytic processing site, caused a small increase in proteolytic processing as measured by a 2-fold decrease in the ratio of S/S2.	AY.27, AY.33, AY.16, AY.5	Tada et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	trafficking	We report here pseudoviruses carrying SG614 enter ACE2-expressing cells more efficiently than wild type (extasciitilde9-fold). This increased entry correlates with less S1-domain shedding and higher S-protein incorporation into the virion. D614G does not alter S-protein binding to ACE2 or neutralization sensitivity of pseudoviruses. Thus, D614G may increase infectivity by assembling more functional S protein into the virion.	AY.27, AY.33, AY.16, AY.5	Zhang et l. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	transmissibility	Increased infectivity of the B.1.617 spike was attributed to L452R, which itself caused a 3.5-fold increase in infectivity relative to D614G wild type. [In combination with E484Q caused a lower 3-fold increase]	AY.27, AY.33, AY.16, AY.5	Tada et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	vaccine neutralization efficacy	Pseudotyped D614G virus has reduced neutralization activity vs wild type: 1.2x (37 sera Pfizer median 9 days post 2nd dose, 37 sera Moderna median 18 days post 2nd dose). This was NOT significant by ANOVA.	AY.27, AY.33, AY.16, AY.5	Garcia-Beltran et al. (2021)	19554	GGA	TGG,GGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	Using a lentivirus virus pseudotyped with D614G Spike, sera from vaccinated individuals who received the second dose (9–11 days post-second dose of Pfizer) exhibited a robust neutralizing potential, with a mean NT50 value of 99,000. This was an average of a 2-fold increase, relative to sera drawn from the individuals who received one dose of vaccination—mean NT50 dilution of 51,300. Importantly, a 6-fold increase in mean NT50 dilution was obtained when sera from the first vaccination dose was compared to convalescent sera from cohort with severe disease (NT50 51,000 vs 8,700) 21 to 63 days post-onset.	AY.27, AY.33, AY.16, AY.5	Kuzmina et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	vaccine neutralization efficacy	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by 18 vaccinee sera (BNT162b2 and mRNA1273).	AY.27, AY.33, AY.16, AY.5	Wilhelm et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	vaccinee plasma binding	1.05x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.16x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.27, AY.33, AY.16, AY.5	Gong et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	viral load	Hamsters infected with SARS-CoV-2 expressing spike(D614G) (G614 virus) produced higher infectious titres in nasal washes and the trachea, but not in the lungs, supporting clinical evidence showing that the mutation enhances viral loads in the upper respiratory tract of COVID-19 patients and may increase transmission.	AY.27, AY.33, AY.16, AY.5	Plante et al. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	virion structure	Estimated free energy change (ddG) for this variant is 2.5 kcal/mol (i.e. stabilizing relative to wild type)	AY.27, AY.33, AY.16, AY.5	Spratt et al. (2021)	19554	GGA	TGG,GGG	1.0
p.D614G	virion structure	Negative stain EM shows increased proportion of "one-up" trimer conformation of Spike proteins on the surface of virions, where the up conformation is presumed to be more likely to bind ACE2.	AY.27, AY.33, AY.16, AY.5	Weissman et al. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	virion structure	CryoEM shows increased proportion of "one-up" trimer conformation of Spike proteins on the surface of virions, where the up conformation is presumed to be more likely to bind ACE2.	AY.27, AY.33, AY.16, AY.5	Yurkovetskiy et al. (2020)	19554	GGA	TGG,GGG	1.0
p.D614G	virion structure	Based on pseudotyped virus experiments, D614G may increase infectivity by assembling more functional S protein into the virion.	AY.27, AY.33, AY.16, AY.5	Zhang et al. (2020)	19554	GGA	TGG,GGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.51x increase in binding (KD) relative to D614G, mostly due to decreased in "off-rate" a.k.a. dissociation rate (Kdis).	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.5x decrease in binding (KD) relative to D614G.	AY.2, AY.1	Gong et al. (2021)	14	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 2.66x increase in binding (KD) relative to D614G.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Gong et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant combination (representing lineage B.1.617) showed a 1.85x increase in binding (KD) relative to D614G. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	A	G	1.0
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.1x decrease in binding (KD) relative to D614G.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	A	G	1.0
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.58x increase in binding (KD) relative to D614G.	AY.4.3	Gong et al. (2021)	35	A	G	1.0
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.33x decrease in binding (KD) relative to D614G.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	8300	A	G	1.0
p.D614G	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a slight decrease in binding (KD) relative to D614G.	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	ACE2 receptor binding affinity	In four cell lines (including 293T-hACE2 cells), this mutation combination increases infectivity vs D614G alone	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106, AY.75,	Li et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	convalescent plasma binding	1.33x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0
p.D614G	convalescent plasma binding	2.16x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.2, AY.1	Gong et al. (2021)	14	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	convalescent plasma binding	2.15x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Gong et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	convalescent plasma binding	This variant combination (representing lineage B.1.617) showed a 1.22x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	A	G	1.0
p.D614G	convalescent plasma binding	No change in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	A	G	1.0
p.D614G	convalescent plasma binding	1.08x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.4.3	Gong et al. (2021)	35	A	G	1.0
p.D614G	convalescent plasma binding	No change in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	8300	A	G	1.0
p.D614G	convalescent plasma binding	1.14x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	convalescent plasma escape	Pseudotyped viruses for B.1.617 was 2.3-fold resistant to neutralization by convalescent sera compared to wild type - a finding that was similar to that of the 3-fold resistance of the South Africa B.1.351 variant using the same assay. The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617. [details on the convalescent patient sera collection are not abundantly clear in the preprint]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	convalescent plasma escape	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by convalescent plasma [no cohort details provided]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Wilhelm et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	humoral response durability	27yo female nurse reinfected in December 2020 (B.1.177) after initial infection in March 2020 (B.3), i.e. with a 9 month interval. Both cases were mild. No significant differences in the neutralizing capacity of the two linages were observed in 4 sera taken (1 pre-reinfection, three post-reinfection). Neutralizing antibody titres (IC50) before and immediately after re-infection were <300 against both strains, and jumped >7x upon re-infection. Viral titres were also higher in the second case. Second case also includes N:p.A220V	AY.9, AY.58, AY.75, AY.74, AY.4.2.2, AY.73, AY.4.2, AY.68, AY.56, AY.62, AY.61, AY.9.2, AY.119.1, AY.64, AY.9.2.1, AY.28, AY.26, AY.4.2.3, AY.55, AY.133, AY.37, AY.67, B.1.617.2, AY.4.2.1, AY.59, AY.75.2, AY.57, AY.24, AY.2, AY.47, AY.70, AY.60, AY.38, AY.72, AY.65, AY.10	Brehm et al. (2021)	12326	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	immunosuppression variant emergence	Studying 94 COVID-19 extended infection cases with genomics April 1 to October 17, 2020, one case developed 23 mutations in a 19 day period, including this combination in Spike.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106, AY.75,	Landis et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	reinfection	27yo female nurse reinfected in December 2020 (B.1.177) after initial infection in March 2020 (B.3). Both cases were mild. Second case also includes N:p.A220V	AY.9, AY.58, AY.75, AY.74, AY.4.2.2, AY.73, AY.4.2, AY.68, AY.56, AY.62, AY.61, AY.9.2, AY.119.1, AY.64, AY.9.2.1, AY.28, AY.26, AY.4.2.3, AY.55, AY.133, AY.37, AY.67, B.1.617.2, AY.4.2.1, AY.59, AY.75.2, AY.57, AY.24, AY.2, AY.47, AY.70, AY.60, AY.38, AY.72, AY.65, AY.10	Brehm et al. (2021)	12326	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	syncytium formation	Slight increase in Vero cell-cell membrane fusion assay under infection with VSV pseudotyped virus.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Kim et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	tissue specific neutralization	The nasal mucosa of Pfizer vaccinees with time course collection was evaluated against VSV pseudotypes: results (only one nasal swab from different previously infected vaccinee neutralizing at weeks 3 and 6 against B.1.1.7 and D614G) suggest that vaccinees probably do not elicit an early humoral response detectable at mucosal surfaces even though sera neutralization was observed. They strengthen the hypothesis that some vaccines may not protect against viral acquisition and infection of the oral–nasal region, but may prevent severe disease associated with viral dissemination in the lower respiratory tract.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Planas et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	Circulating variant shown in vitro to not have major defects or enhancement of cell surface protein trafficking (i.e. Spike cleavage or fusion required for cell entry)	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106, AY.75,	Barrett et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	The increased transduction with Spike D614G ranged from 1.3- to 2.4-fold in Caco-2 and Calu-3 cells expressing endogenous ACE2 and from 1.5- to 7.7-fold in A549ACE2 and Huh7.5ACE2 overexpressing ACE2. Although there is minimal difference in ACE2 receptor binding between the D614 and G614 Spike variants, the G614 variant is more resistant to proteolytic cleavage, suggesting a possible mechanism for the increased transduction.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Daniloski et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	No change in infectivity (24h) relative to D614G alone in Caco-2 cells, Vero or Calu-3.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Kim et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	extasciitilde4x more efficient S2 domain cleavage compared to wild type in Caco-2 cells, mid-range of three cell line tested (Vero and Calu-3).	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Kim et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	extasciitilde2x more infectivity than D614G alone in HEK293T-ACE2 cells 48h post-transduction.	AY.2, AY.1	Kuzmina et al. (2021)	14	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	Among S variants tested, the D614G mutant shows the highest cell entry (extasciitilde3.5x wild type), as supported by structural and binding analyses.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106, AY.75,	Ozono et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	Quantification of the band intensities showed that the P681R mutation, which lies near the proteolytic processing site, caused a small increase in proteolytic processing as measured by a 2-fold decrease in the ratio of S/S2.	AY.3.3, AY.122.1, AY.34, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Tada et al. (2021)	81633	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	trafficking	We report here pseudoviruses carrying SG614 enter ACE2-expressing cells more efficiently than wild type (extasciitilde9-fold). This increased entry correlates with less S1-domain shedding and higher S-protein incorporation into the virion. D614G does not alter S-protein binding to ACE2 or neutralization sensitivity of pseudoviruses. Thus, D614G may increase infectivity by assembling more functional S protein into the virion.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Zhang et l. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	transmissibility	Increased infectivity of the B.1.617 spike was attributed to L452R, which itself caused a 3.5-fold increase in infectivity relative to D614G wild type. [In combination with E484Q caused a lower 3-fold increase]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Tada et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	transmissibility	The combination caused a 3-fold increase in infectivity relative to D614G wild type. [compare to 3.5x for L452R alone]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	A	G	1.0
p.D614G	transmissibility	Normalized for particle number, on ACE2.293T cells showed that the B.1.617 spike protein was >2-fold increase in infectivity relative to D614G wild type.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	Pseudotyped D614G virus has reduced neutralization activity vs wild type: 1.2x (37 sera Pfizer median 9 days post 2nd dose, 37 sera Moderna median 18 days post 2nd dose). This was NOT significant by ANOVA.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Garcia-Beltran et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	1.4x reduction in neutralization (ID50) in sera 3 weeks after one dose of Pfizer/BioNTech BNT162b2 (up to 5 naive and post infection vaccinees)	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	Using a lentivirus virus pseudotyped with D614G Spike, sera from vaccinated individuals who received the second dose (9–11 days post-second dose of Pfizer) exhibited a robust neutralizing potential, with a mean NT50 value of 99,000. This was an average of a 2-fold increase, relative to sera drawn from the individuals who received one dose of vaccination—mean NT50 dilution of 51,300. Importantly, a 6-fold increase in mean NT50 dilution was obtained when sera from the first vaccination dose was compared to convalescent sera from cohort with severe disease (NT50 51,000 vs 8,700) 21 to 63 days post-onset.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Kuzmina et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	This variant showed only minor in Pfizer sera (one or two dose) neutralization efficiency vs D614G (using lentivirus pseudotype).	AY.2, AY.1	Kuzmina et al. (2021)	14	A	G	1.0
p.D614G	vaccine neutralization efficacy	Pseudotyped viruses for B.1.617 was 4-fold resistant to neutralization by 6 BNT162b2 vaccine sera 28 days post-booster compared to wild type - a finding that was similar to that of the 3.4-fold resistance of the South Africa B.1.351 variant using the same assay. Neutralization by 3 Moderna vaccine sera 28 days post-booster was 5-fold resistant (vs. 2.2-fold for B.1.351). The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccine neutralization efficacy	Relative to B.1, Epsilon (B.1.417/429) shows 1.74x-2.35x decrease in neutralization efficiency by 18 vaccinee sera (BNT162b2 and mRNA1273).	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Wilhelm et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccinee plasma binding	1.14x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.09x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0
p.D614G	vaccinee plasma binding	1.76x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.75x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.2, AY.1	Gong et al. (2021)	14	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccinee plasma binding	1.05x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.16x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Gong et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccinee plasma binding	This variant combination (representing lineage B.1.617) showed a 1.30x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.18x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	A	G	1.0
p.D614G	vaccinee plasma binding	1.23x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.1x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	A	G	1.0
p.D614G	vaccinee plasma binding	1.23x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.37x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.4.3	Gong et al. (2021)	35	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	vaccinee plasma binding	1.16x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.02x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.29.2, AY.34, AY.121, AY.34.1, AY.106, AY.111, AY.1, AY.4.6, AY.107, AY.4.12, AY.124, AY.129, AY.116.1, AY.126, AY.92, AY.4.2.2, AY.112, AY.100, AY.29, AY.4.2, AY.101, AY.112.2, AY.122.4, AY.119, AY.124.1, AY.85, AY.110, AY.119.1, AY.121.1, AY.127.1, AY.4.2.3, AY.127, AY.20, AY.39.1, AY.116, AY.102, AY.4.7, AY.4.8, AY.131, B.1.617.2, AY.113, AY.114, AY.4.2.1, AY.119.2, AY.120.1, AY.39, AY.109, AY.104, AY.108, AY.128, AY.34.1.1, AY.36, AY.120, AY.42, AY.4.5, AY.4.4, AY.117, AY.4, AY.4.3, AY.118, AY.125	Gong et al. (2021)	8300	A	G	1.0
p.D614G	vaccinee plasma binding	1.08x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.11x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.34.1.1	Gong et al. (2021)	2	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	viral load	Hamsters infected with SARS-CoV-2 expressing spike(D614G) (G614 virus) produced higher infectious titres in nasal washes and the trachea, but not in the lungs, supporting clinical evidence showing that the mutation enhances viral loads in the upper respiratory tract of COVID-19 patients and may increase transmission.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Plante et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	virion structure	Estimated free energy change (ddG) for this variant is 2.5 kcal/mol (i.e. stabilizing relative to wild type)	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106, AY.75,	Spratt et al. (2021)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	virion structure	Negative stain EM shows increased proportion of "one-up" trimer conformation of Spike proteins on the surface of virions, where the up conformation is presumed to be more likely to bind ACE2.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.14, AY.106,	Weissman et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	virion structure	CryoEM shows increased proportion of "one-up" trimer conformation of Spike proteins on the surface of virions, where the up conformation is presumed to be more likely to bind ACE2.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.44, AY.106, AY.75,	Yurkovetskiy et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.D614G	virion structure	Based on pseudotyped virus experiments, D614G may increase infectivity by assembling more functional S protein into the virion.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.127, AY.39.1, AY.4.7, AY.99.1, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.88, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.56, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.117, AY.86, AY.18, AY.54, AY.65, AY.46.1, AY.44, AY.106,	Zhang et al. (2020)	81634	A	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.S443F	monoclonal antibody serial passage escape	Ranked effective escape variant in the RBD for highly neutralizing COV2-2499 monoclonal antibody	AY.124, AY.124.1	Greaney et al. (2020)	3	C	T	1.0
p.P26S	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.58x increase in binding (KD) relative to D614G.	AY.4.3	Gong et al. (2021)	35	C	T	1.0
p.P26S	convalescent plasma binding	1.08x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.4.3	Gong et al. (2021)	35	C	T	1.0
p.P26S	vaccinee plasma binding	1.23x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.37x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.4.3	Gong et al. (2021)	35	C	T	1.0
p.E484A	antibody epitope effects	Mutant screen in neutralization assay with a broad range of monoclonal antibodies shows high resistence to 4 antibodies, and broad low level resistence against much of the rest of the panel.	AY.122.6	Liu et al. (2020)	2	A	C	1.0
p.E484A	convalescent plasma escape	Remarkably, several of the E484 escape mutants were resistant to neutralization at the highest concentration (1:80 initial dilution) of all 4 convalescent sera tested. Against a wider panel of 16 convalescent plasma (no replicates), all but one show major resistance.	AY.122.6	Liu et al. (2021)	2	A	C	1.0
p.E484A	monoclonal antibody serial passage escape	Ranked moderately effective mutant against this position in the RBD for highly neutralizing COV2-2050 monoclonal antibody	AY.122.6	Greaney et al. (2020)	2	A	C	1.0
p.E484A	monoclonal antibody serial passage escape	"E484A rose in frequency in linkage with F486I, but since E484A is not an escape mutation in our maps it is not shown in other panels"	AY.122.6	Starr et al. (2020)	2	A	C	1.0
p.E484A	monoclonal antibody serial passage escape	Escape mutation against monoclonal antibody LY-CoV555 (antibody that forms the basis for Eli Lilly's bamlanivimab)	AY.122.6	Starr et al. (2021)	2	A	C	1.0
p.E484A	pharmaceutical effectiveness	Bamlanivimab (LY-CoV555) lost extasciitilde8x binding against this isolated mutation.	AY.122.6	Engelhart et al. (2021)	2	A	C	1.0
p.S255F	monoclonal antibody serial passage escape	Escape mutation against Spike N terminal domain antigenic supersite i mAb S2L28	AY.106	McCallum et al. (2021)	234	C	T	1.0
p.K458N	convalescent plasma escape	Resistant to a pool of 10 convalescent sera (but less than 4x, a typical threshold for definition of escape)	AY.46.1	Li et al. (2020)	17	A	C	1.0
p.E484Q	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant combination (representing lineage B.1.617) showed a 1.85x increase in binding (KD) relative to D614G. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	G	C	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.E484Q	antibody epitope effects	>20% (ELISA significance threshold) drop in antibody binding by this variant against monoclonal antibody VH-Fc ab8.	AY.35, AY.77, AY.112.2	Sun et al. (2021)	4	G	C	1.0
p.E484Q	convalescent plasma binding	This variant combination (representing lineage B.1.617) showed a 1.22x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	G	C	1.0
p.E484Q	convalescent plasma escape	In 3 of 11 subjects' convalescent sera in an early+late mutational landscape analysis of the RBD, E484Q shows a notably resistant profile, comparable to or even more resistant than E484K at later time points (i.e. more resistant to immune cell somatic mutation evolution), see Figure 5a,b. Subject C 32 days post-infection showed »10 fold reduction in neutralization, reducing to extasciitilde10-fold by day 104. Subject B 26 days post-infection showed extasciitilde10 fold reduction in neutralization, reducing to extasciitilde4x at day 113. Notably, Subject B also showed smaller than typical (extasciitilde10 vs 30+ fold) reduction in one-month neutralization by E484K at day 32, and no E484K immune escape at day 104. Subject I 26 days post-infection showed extasciitilde10 fold reduction in neutralization, with no reduction in escape at day 102. Notably, Subject I also showed smaller than typical (extasciitilde10 vs 30+ fold) reduction in one-month neutralization by E484K at day 26, and no E484K immune escape at day 102.	AY.35, AY.77, AY.112.2	Greaney et al. (2021)	4	G	C	1.0
p.E484Q	convalescent plasma escape	Pseudotyped viruses for B.1.617 was 2.3-fold resistant to neutralization by convalescent sera compared to wild type - a finding that was similar to that of the 3-fold resistance of the South Africa B.1.351 variant using the same assay. The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617. [details on the convalescent patient sera collection are not abundantly clear in the preprint]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	G	C	1.0
p.E484Q	monoclonal antibody serial passage escape	Escape mutation against monoclonal antibody LY-CoV555 (antibody that forms the basis for Eli Lilly's bamlanivimab)	AY.35, AY.77, AY.112.2	Starr et al. (2021)	4	G	C	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.E484Q	pharmaceutical effectiveness	Bamlanivimab (LY-CoV555) lost extasciitilde20x binding against this isolated mutation. Casirivimab lost extasciitilde4x binding against this isolated mutation.	AY.35, AY.77, AY.112.2	Engelhart et al. (2021)	4	G	C	1.0
p.E484Q	symptom prevalence	Gross examination of 3+3 hamster lung specimens showed pronounced congestion and hemorrhages on days 5 and 7 post-infection in the case of the B.1.617.1 as compared with the B.1. The lung lesions with the B.1 variant were minimal to mild whereas with B.1.617.1 they were moderate. For B.1 pneumonic changes were minimal to mild (inflammatory cell infiltration, focal consolidation and mild congestion). The pronounced changes (moderate to severe) with mononuclear infiltration in the alveolar interstitial space, interstitial septal thickening, consolidation and pneumocyte hyperplasia were observed with B.1.617.1 variant consistently.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	G	C	1.0
p.E484Q	trafficking	This variant alone shows a 10x decrease in cell entry efficiency (RLU measurement in 293T cells) compared to D614G.	AY.35, AY.77, AY.112.2	Ferriera et al (2021)	4	G	C	1.0
p.E484Q	transmissibility	The combination caused a 3-fold increase in infectivity relative to D614G wild type. [compare to 3.5x for L452R alone]	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	G	C	1.0
p.E484Q	transmissibility	Normalized for particle number, on ACE2.293T cells showed that the B.1.617 spike protein was >2-fold increase in infectivity relative to D614G wild type.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	G	C	1.0
p.E484Q	vaccine neutralization efficacy	Nine stored sera from Pfizer BNT162b2 vaccinees were tested against a range of spike mutation bearing PV. E484Q had a extasciitilde5x drop in neutralization (vs extasciitilde10x for E484K). When E484Q and L452R were combined, the fold change was significant, but similar to that of L452R alone (extasciitilde2x), suggesting no evidence for an additive effect [perhaps even E484Q effect dilution].	AY.35, AY.77, AY.112.2	Ferreira et al. (2021)	4	G	C	1.0
p.E484Q	vaccine neutralization efficacy	1.4x reduction in neutralization (ID50) in sera 3 weeks after one dose of Pfizer/BioNTech BNT162b2 (up to 5 naive and post infection vaccinees)	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	G	C	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.E484Q	vaccine neutralization efficacy	Pseudotyped viruses for B.1.617 was 4-fold resistant to neutralization by 6 BNT162b2 vaccine sera 28 days post-booster compared to wild type - a finding that was similar to that of the 3.4-fold resistance of the South Africa B.1.351 variant using the same assay. Neutralization by 3 Moderna vaccine sera 28 days post-booster was 5-fold resistant (vs. 2.2-fold for B.1.351). The resistance of B.1.617 was caused by the L452R and E484Q mutation, based on results from viruses pseudotyped for individual variants within B.1.617.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	G	C	1.0
p.E484Q	vaccinee plasma binding	This variant combination (representing lineage B.1.617) showed a 1.30x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.18x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees. [exact variant list not provided in manuscript, is inferred fro common knowledge]	AY.35, AY.77, AY.112.2	Gong et al. (2021)	4	G	C	1.0
p.E484Q	viral load	In 9 infected hamsters each for B.1 and B.1.617.1, no significant change in viral load or subgenomic RNA levels were detected.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	G	C	1.0
p.G446V	antibody epitope effects	Mutant screen in neutralization assay with a broad range of monoclonal antibodies shows resistence to more than one antibody.	AY.127.1, AY.131	Liu et al. (2021)	33	G	T	0.88
p.G446V	antibody epitope effects	Massive reduction in binding efficiency vs wild type for mAb REGN10933.	AY.127.1, AY.131	Rappazzo et al. (2021)	33	G	T	0.88
p.G446V	convalescent plasma escape	In 2 of 11 subjects' convalescent sera in an early+late mutational landscape analysis of the RBD, the early serum timepoint shows significant resistance (extasciitilde10x or more), but both abate by the late timepoint (extasciitilde3m) presumably through immune cell somatic mutation evolution.	AY.127.1, AY.131	Greaney et al. (2021)	33	G	T	0.88
p.G446V	convalescent plasma escape	Resistant to a pool of 10 convalescent sera (but less than 4x, a typical threshold for definition of escape)	AY.127.1, AY.131	Li et al. (2020)	33	G	T	0.88
p.G446V	convalescent plasma escape	Ablation of neutralization capability of 3 convalescent sera tested, 1 improvement.	AY.127.1, AY.131	Liu et al. (2021)	33	G	T	0.88
p.G446V	monoclonal antibody serial passage escape	Most effective mutant against this position in the RBD for highly neutralizing COV2-2499 monoclonal antibody Most but only mildly effective mutant against this position in the RBD for highly neutralizing COV2-2096 monoclonal antibody	AY.127.1, AY.131	Greaney et al. (2020)	33	G	T	0.88

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.G446V	pharmaceutical effectiveness	Cligavimab lost extasci-itilde16x binding against this isolated mutation. Imdevimab lost extasci-itilde16x binding against this isolated mutation (the only RBD variant to do so).	AY.127.1, AY.131	Engelhart et al. (2021)	33	G	T	0.88
p.H69del	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.51x increase in binding (KD) relative to D614G, mostly due to decreased in "off-rate" a.k.a. dissociation rate (Kdis).	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5
p.H69del	antibody epitope effects	Reduces neutralization by structurally unmapped mAb COVA1-21 (cluster XI).	AY.34.1.1	Rees-Spear et al. (2021)	2	ATACATG	A	0.5
p.H69del	convalescent plasma binding	1.33x increase in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5
p.H69del	convalescent plasma escape	Fatal COVID-19 complications in immunocomprimised patient after immune escape from convalescent plasma	AY.34.1.1	Kemp et al. (2020)	2	ATACATG	A	0.5
p.H69del	convalescent plasma escape	Neutralization activity of almost all Moderna Phase 1 sera tested actually *increased*.	AY.34.1.1	Shen et al. (2021)	2	ATACATG	A	0.5
p.H69del	convalescent plasma escape	Viruses containing the point mutations of B.1.1.7 showed that the single point mutations (Δ69-70 and N501Y) were neutralized as efficiently as D614G across 10 convalescent sera from April 2020 infectees.	AY.34.1.1	Tada et al. (2021)	2	ATACATG	A	0.5
p.H69del	immunosuppression variant emergence	The delH69/V70 enhances viral infectivity, indicating its effect on virus fitness is independent to the N501Y RBM change [with which it is found in lineage B.1.1.7] Possibly arisen as a result of the virus evolving from immune selection pressure in infected individuals and possibly only one chronic infection in the case of lineage B.1.1.7.	AY.34.1.1	Kemp et al. (2020)	2	ATACATG	A	0.5
p.H69del	vaccinee plasma binding	1.14x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.09x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.34.1.1	Gong et al. (2021)	2	ATACATG	A	0.5

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	trafficking	This mutation in the first base of the furin clevage site maintains the RXXR recognition motif, and is presumed to enhance cleavage based on the removal of a proline-directed phosphotase recognition site at S680. In a homologuous site in Infectious Bronchitis Virus (IBV, Gammacoronaviruses), abolition of S680 phosphorylation improves furin cleavage (and presumably cell entry). [Inference from similar positively charged substitution P681H actually described in the work]	AY.127, AY.65, AY.88	Maaroufi (2021)	299	CTCC	TTCG,CTCG	1.0
p.P681R	trafficking	Quantification of the band intensities showed that the P681R mutation, which lies near the proteolytic processing site, caused a small increase in proteolytic processing as measured by a 2-fold decrease in the ratio of S/S2.	AY.127, AY.65, AY.88	Tada et al. (2021)	299	CTCC	TTCG,CTCG	1.0
p.P681R	virion structure	The Ratio of S2 (processed Spike) to full length Spike is higher for this mutation, due to a drop in the full length Spike measured, suggesting that this mutation compensates for decreased Spike production by improved proteolytic processing. [PG: Inferred by conservative AA substitution of described P681H]	AY.127, AY.65, AY.88	Tada et al. (2021)	299	CTCC	TTCG,CTCG	1.0
p.P681R	symptom prevalence	Gross examination of 3+3 hamster lung specimens showed pronounced congestion and hemorrhages on days 5 and 7 post-infection in the case of the B.1.617.1 as compared with the B.1. The lung lesions with the B.1 variant were minimal to mild whereas with B.1.617.1 they were moderate. For B.1 pneumonic changes were minimal to mild (inflammatory cell infiltration, focal consolidation and mild congestion). The pronounced changes (moderate to severe) with mononuclear infiltration in the alveolar interstitial space, interstitial septal thickening, consolidation and pneumocyte hyperplasia were observed with B.1.617.1 variant consistently.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	C	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	trafficking	This mutation in the first base of the furin clevage site maintains the RXXR recognition motif, and is presumed to enhance cleavage based on the removal of a proline-directed phosphotase recognition site at S680. In a homologuous site in Infectious Bronchitis Virus (IBV, Gammacoronaviruses), abolition of S680 phosphorylation improves furin cleavage (and presumably cell entry). [Inference from similar positively charged substitution P681H actually described in the work]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.46.1, AY.16, AY.14, AY.105, AY.75,	Maaroufi (2021)	100876	C	G,GTCGT,GTCGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	trafficking	Quantification of the band intensities showed that the P681R mutation, which lies near the proteolytic processing site, caused a small increase in proteolytic processing as measured by a 2-fold decrease in the ratio of S/S2.	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.46.1, AY.16, AY.14, AY.105, AY.75,	Tada et al. (2021)	100876	C	G,GTCGT,GTCGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	transmissibility	Normalized for particle number, on ACE2.293T cells showed that the B.1.617 spike protein was >2-fold increase in infectivity relative to D614G wild type.	AY.35, AY.77, AY.112.2	Tada et al. (2021)	4	C	G	1.0
p.P681R	viral load	In 9 infected hamsters each for B.1 and B.1.617.1, no significant change in viral load or subgenomic RNA levels were detected.	AY.35, AY.77, AY.112.2	Yadav et al. (2021)	4	C	G	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	virion structure	The Ratio of S2 (processed Spike) to full length Spike is higher for this mutation, due to a drop in the full length Spike measured, suggesting that this mutation compensates for decreased Spike production by improved proteolytic processing. [PG: Inferred by conservative AA substitution of described P681H]	AY.3.3, AY.34, AY.122.1, AY.103, AY.121, AY.58, AY.34.1, AY.122.6, AY.124, AY.126, AY.4.2.2, AY.100, AY.101, AY.112.2, AY.49, AY.55, AY.39.1, AY.4.7, AY.99.1, AY.5, B.1.617.2, AY.13, AY.25.3, AY.114, AY.53, AY.120.1, AY.27, AY.25.1, AY.104, AY.108, AY.36, AY.44, AY.24, AY.48, AY.51, AY.46.5, AY.4, AY.15, AY.125, AY.29.2, AY.9, AY.3.1, AY.94, AY.3, AY.45, AY.107, AY.129, AY.92, AY.73, AY.7.1, AY.112, AY.4.2, AY.68, AY.122.4, AY.124.1, AY.9.2, AY.110, AY.83, AY.5.6, AY.133, AY.102, AY.35, AY.67, AY.5.3, AY.59, AY.43.3, AY.57, AY.99.2, AY.120, AY.2, AY.42, AY.25.1.2, AY.47, AY.38, AY.72, AY.4.3, AY.6, AY.111, AY.122.5, AY.1, AY.4.6, AY.74, AY.29, AY.62, AY.85, AY.119, AY.61, AY.98, AY.119.1, AY.9.2.1, AY.28, AY.121.1, AY.26, AY.43, AY.43.8, AY.41, AY.116, AY.78, AY.25, AY.119.2, AY.122, AY.39, AY.109, AY.128, AY.34.1.1, AY.103.2, AY.32, AY.84, AY.4.5, AY.70, AY.33, AY.117, AY.86, AY.18, AY.54, AY.46.1, AY.16, AY.14, AY.105, AY.75, AY.4.12,	Tada et al. (2021)	100876	C	G,GTCGT,GTCGG	1.0

Mutations	Sub-category	Function	Lineages	Citation	Sequence Depth	Reference Allele	Alternate Allele	Alternate Frequency
p.P681R	trafficking	This mutation in the first base of the furin clevage site maintains the RXXR recognition motif, and is presumed to enhance cleavage based on the removal of a proline-directed phosphotase recognition site at S680. In a homologuous site in Infectious Bronchitis Virus (IBV, Gammacoronaviruses), abolition of S680 phosphorylation improves furin cleavage (and presumably cell entry). [Inference from similar positively charged substitution P681H actually described in the work]	AY.127.1	Maaroufi (2021)	16	CTCGG	GTCGT	1.0
p.P681R	trafficking	Quantification of the band intensities showed that the P681R mutation, which lies near the proteolytic processing site, caused a small increase in proteolytic processing as measured by a 2-fold decrease in the ratio of S/S2.	AY.127.1	Tada et al. (2021)	16	CTCGG	GTCGT	1.0
p.P681R	virion structure	The Ratio of S2 (processed Spike) to full length Spike is higher for this mutation, due to a drop in the full length Spike measured, suggesting that this mutation compensates for decreased Spike production by improved proteolytic processing. [PG: Inferred by conservative AA substitution of described P681H]	AY.127.1	Tada et al. (2021)	16	CTCGG	GTCGT	1.0
p.L5F	ACE2 receptor binding affinity	Using flow cytometry and ACE2 ectodomains-Fc portion IgG complex, this variant showed a 1.1x decrease in binding (KD) relative to D614G.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	C	T	0.34
p.L5F	convalescent plasma binding	No change in Spike binding (relative to D614G alone) by 5 plasma collected 8 months post-symptom-onset.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	C	T	0.34
p.L5F	vaccinee plasma binding	1.23x increase in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in previously non-seroconverted subjects. 1.1x decrease in Spike binding (relative to D614G alone) by 5 plasma collected 3 weeks after one dose of Pfizer/BioNtech BNT162b2 vaccine in post-infection vaccinees.	AY.35, AY.9, AY.77, AY.25.1.2, AY.4.4, AY.53	Gong et al. (2021)	41	C	T	0.34

The results here are in whole or part based upon data hosted at the Canadian VirusSeq Data Portal: https://virusseq-dataportal.ca/.We wish to acknowledge the following organisations/laboratories for contributing data to the Portal: Canadian Public Health Laboratory Network (CPHLN), CanCOGGeN VirusSeq and the list of labs available at https://virusseq-dataportal.ca/acknowledgements)