

Table 1. Omicron variant mutations occurrence and prevalence across other variants (7, 12, 13).

Types of Mutation	The mutation in the Omicron lineage	SARS-CoV-2 variants possessing the same mutation as the omicron variant (VOC, VOI)	First occurrence location	Collection date	The accession number of the first discovered viral sequence with the mutation (GISAID)	Mutation revealed in our Research
Non-Structural Protein:1 (NSP1)						
S135R	BA.2 and BA.3	—	Asia / Armenia	2020-08-03	EPI_ISL_1854612	S135R
P62T	BA.2	Delta	North America / USA / Mississippi	2020-11-27	EPI_ISL_751683	P62T
Non-Structural Protein:2 (NSP2)						
S378F	BA.2	—	Europe / Germany / Hamburg	2020-03-20	EPI_ISL_775657	S378F
V364G	BA.2	—	Europe / Belgium / Antwerp	2021-02-05	EPI_ISL_1039246	V364G
Non-Structural Protein:3 (NSP3)						
T24I	BA.2	—	Asia / Saudi Arabia / Makkah	2020-04-06	EPI_ISL_437704	T24I
K38R	BA.1 and BA.1.1	—	North America / Canada / Ontario	2020-02	EPI_ISL_418325	K38R
G489S	BA.2 and BA.3	—	Asia / China / Guangdong / Dongguan	2020-01-26	EPI_ISL_428466	G489S
S1265del	BA.1 and BA.1.1	—	South America / Brazil / Sao Paulo / Sao Jose dos Campos	2020-03-09	EPI_ISL_875545	S1265
L1266I	BA.1 and BA.1.1	—	South America / Brazil / Sao Paulo / Sao Jose dos Campos	2020-03-09	EPI_ISL_875545	L1266I
A1892T	BA.1 and BA.1.1	—	North America / USA / New York / Erie County	2020-04-17	EPI_ISL_1009376	—
E642K	BA.2	—	Asia / India / Odisha	2020-05-14	EPI_ISL_463069	E642K
C1392F	BA.1	—	Europe / United Kingdom / England	2020	EPI_ISL_478921	C1392F
L689F	BA.2	—	Europe / United Kingdom / England	2020	EPI_ISL_705553	L689F
A150V	BA.2	—	Asia / South Korea / Gwangju	2020-03-03	EPI_ISL_540999	A150V
Non-Structural Protein:4 (NSP4)						
L264F	BA.2	—	Europe / Italy / Lombardy	2020-02-23	EPI_ISL_542227	L264F

T327I	BA.2 and BA.3	—	Asia / China / Hubei / Wuhan	2019-12-30	EPI_ISL_402130	T327I
L438F	BA.2	—	North America / USA / Washington	2020-03-13	EPI_ISL_430895	L438F
T492I	BA.1, BA.2, BA.1.1, and BA.3	Delta, Mu, Lambda	Asia / Georgia	2020-02-28	EPI_ISL_2896261	T492I
L447F	BA.2	—	Europe / Germany / Lower Saxony / Hannover	2020	EPI_ISL_885141	L447F
Non-Structural Protein:5 (NSP5)						
P132H	BA.1, BA.2, BA.1.1, and BA.3	—	North America / USA / Texas / Houston	2020-07-20	EPI_ISL_5073555	P132H
Non-Structural Protein:6 (NSP6)						
A88V	BA.3	—	Europe / Poland / Zachodniopomorskie	2020-01-14	EPI_ISL_2631277	—
S106del	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Beta, Gamma	North America / USA / New York	2020-01-28	EPI_ISL_3364539	S106del
G107del	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Beta, Gamma	North America / USA / New York	2020-01-28	EPI_ISL_3364539	G107del
F108del	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Beta, Gamma	North America / USA / New York	2020-01-28	EPI_ISL_3364539	F108del
I189V	BA.1 and BA.1.1	—	Europe / Ireland	2020-03-10	EPI_ISL_5248210	I189V
L105del	BA.1	—	Africa / Namibia / Khomas	2021-11	EPI_ISL_7649987	L105del
Non-Structural Protein:12 (NSP12) (RdRp)						
P323L	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Beta, Gamma, Delta, Mu, Lambda	Africa / Niger / Niamey	2020-01-01	EPI_ISL_3804266	P323L
Q822E	BA.2	Delta	Europe / Italy / Lombardy / Pavia	2020-04-28	EPI_ISL_1133148	Q822E
Non-Structural Protein:13 (NSP13)						
R392C	BA.2	—	Asia / China / Hubei / Wuhan	2020-01-26	EPI_ISL_493181	—
Non-Structural Protein:14 (NSP14)						
I42V	BA.1, BA.2, BA.1.1, and BA.3	—	Asia / United Arab Emirates	2020-03-15	EPI_ISL_435127	I42V
D301E	BA.1	Alpha, Delta	Europe / Finland / Uusimaa	2020-09-23	EPI_ISL_759808	D301E
Non-Structural Protein:15 (NSP15)						
T112I	BA.2	—	North America / USA / Florida	2020-03-19	EPI_ISL_1379452	T112I

Spike protein: N-Terminal Domain (NTD)						
T19I	BA.2	—	North America / USA / Colorado	2020-03-17	EPI_ISL_5439308	T19I
L24S	BA.2	—	North America / USA / Washington	2020-03-17	EPI_ISL_570806	L24del
P25del	BA.2	—	South America / Brazil / Rio de Janeiro	2020-04-17	EPI_ISL_1691459	P25del
P26del	BA.2	—	South America / Brazil / Rio de Janeiro	2020-04-17	EPI_ISL_1691459	P26del
A27del	BA.2	—	South America / Brazil / Rio de Janeiro	2020-04-17	EPI_ISL_1691459	A27S
A67V	BA.1, BA.3, and BA.1.1	Eta	Europe / Spain / Madrid / Madrid	2020-03-12	EPI_ISL_779718	—
H69del	BA.1, BA.3, and BA.1.1	Alpha, Eta	Asia / Thailand / Nonthaburi	2020-01-05	EPI_ISL_434692	—
V70del	BA.1, BA.3, and BA.1.1	Alpha, Eta	Asia / Thailand / Nonthaburi	2020-01-05	EPI_ISL_434692	—
T95I	BA.1, BA.3, and BA.1.1	Many Delta sublineages, Iota, Mu	Asia / Lebanon	2020-01-10	EPI_ISL_8311730	—
G142D	BA.1, BA.2, BA.3, and BA.1.1	Delta	Asia / Japan / Kanto	2020-02-25	EPI_ISL_479852	G142D
V143del	BA.1, BA.3, and BA.1.1	Alpha, Eta	Asia / Japan / Kanto	2020-02-25	EPI_ISL_479852	V143del
Y144del	BA.1, BA.3, and BA.1.1	Alpha, Eta, Mu (Y144S)	Europe / Switzerland / Aargau	2020-01-05	EPI_ISL_896091.3	Y144del
Y145del	BA.1, BA.3, and BA.1.1	Alpha, Eta, Mu (Y145N)	North America / USA / Virginia	2020-03-30	EPI_ISL_429978	Y145del
N211I	BA.1, BA.3, and BA.1.1	—	North America / USA / Texas / Houston	2020-07-14	EPI_ISL_5343378	N211del
L212del	BA.1, BA.3, and BA.1.1	—	Europe / Spain / Navarra	2020-05-12	EPI_ISL_1382928	L212I
V213G	BA.2	—	Asia / Iran	2020-03-29	EPI_ISL_672575	V213G
ins214EPE	BA.1 and BA.1.1	—	Africa / Zambia / Lusaka / Lusaka	2021-02-12	EPI_ISL_7988145	ins214EPE
Spike protein: Receptor Binding Domain (RBD)						
G339D	BA.1, BA.2, BA.3, and BA.1.1	—	Europe / Norway	2020-03-05	EPI_ISL_420138	—

R346K	BA.1.1	Mu	North America / Panama / Cocle	2020-03-18	EPI_ISL_496747	—
S371L	BA.1 and BA.1.1	—	North America / USA / Louisiana / Lincoln Parish	2020-12-27	EPI_ISL_8508546	S371L
S371F	BA.2 and BA.3	—	Europe / Italy / Campania	2020-05-17	EPI_ISL_6832115	S371F
S373P	BA.1, BA.2, BA.3, and BA.1.1	—	North America / USA / Texas / Houston	2020-06-04	EPI_ISL_545554	S373P
S375F	BA.1, BA.2, BA.3, and BA.1.1	—	Africa / Egypt / Cairo	2020-06-08	EPI_ISL_1097025	S375F
T376A	BA.2	—	Asia / Japan / Saitama	2021-06-09	EPI_ISL_3198900	T376A
D405N	BA.2 and BA.3	—	Europe / Portugal	2021-02-09	EPI_ISL_1116795	D405N
R408S	BA.2	—	Europe / Netherlands / Zuid-Holland	2020-03-27	EPI_ISL_422951	R408S
K417N	BA.1, BA.2, BA.3, and BA.1.1	Beta, Gamma (K417T), Delta variant	Asia / Qatar / Doha	2020-03-27	EPI_ISL_2274264	K417N
Spike Protein: Receptor Binding Motif(RBM)						
N440K	BA.1, BA.2, BA.3, and BA.1.1	—	North America / Canada / Quebec	2020-03-10	EPI_ISL_3458197	N440K
G446S	BA.1, BA.3, and BA.1.1	—	Europe / United Kingdom / England	2020-04-04	EPI_ISL_440772	G446S
S477N	BA.1, BA.2, BA.3, and BA.1.1	—	Asia / Lebanon	2020-01-10	EPI_ISL_8317205	—
T478K	BA.1, BA.2, BA.3, and BA.1.1	Delta	North America / USA / New York / Westchester County	2020-03-12	EPI_ISL_6661895	—
E484A	BA.1, BA.2, BA.3, and BA.1.1	Beta (E484K), Gamma (E484K), Eta (E484K), Iota (E484K), Mu (E484K), Kappa, Delta (E484Q)	Europe / Spain / La Rioja	2020-03-03	EPI_ISL_578200	—
Q493R	BA.1, BA.2, BA.3, and BA.1.1	—	Europe / United Kingdom / England	2020-04-22	EPI_ISL_470150	—
G496S	BA.1 and BA.1.1	—	Africa / Egypt	2020-06-06	EPI_ISL_8194875	—
Q498R	BA.1, BA.2, BA.3, and BA.1.1	—	North America / USA / Louisiana / Lincoln Parish	2020-12-27	EPI_ISL_8508546	—
N501Y	BA.1, BA.2, BA.3, and BA.1.1	Alpha, Beta, Gamma, Mu	Europe / Spain / Castilla y Leon	2020-02-07	EPI_ISL_1603195	—

Y505H	BA.1, BA.2, BA.3, and BA.1.1	—	Europe / United Kingdom / England	2020-04-17	EPI_ISL_465212	—
Spike protein: Subdomain1/Subdomain (SD1/SD2)						
T547K	BA.1 and BA.1.1	—	North America / USA / Florida	2020-03-20	EPI_ISL_1379457	T547K
D614G	BA.1, BA.2, BA.3, and BA.1.1	Alpha, Beta, Gamma, Delta, Kappa, Eta, Iota, Lambda, Mu	Africa / Niger / Niamey	2020-01-01	EPI_ISL_3804266	D614G
H655Y	BA.1, BA.2, BA.3, and BA.1.1	Gamma	Europe / France / Île-de-France / Paris	2020-01-23	EPI_ISL_1301441	H655Y
Spike protein: Poly-Basic Cleavage Site (PBCS)						
N679K	BA.1, BA.2, BA.3, and BA.1.1	—	North America / USA / New York / Brooklyn	2020-03-18	EPI_ISL_421580	N679K
P681H	BA.1, BA.2, BA.3	Alpha, Mu, Delta (P681R), Kappa (P681R), A.23.1 (P681R)	Africa / Niger / Niamey	2020-01-01	EPI_ISL_3804266	P681H
Spike protein: C-Terminal Domain (CTD)						
N764K	BA.1, BA.2, BA.3, and BA.1.1	—	Africa / Egypt / Cairo	2020-06-08	EPI_ISL_1097025	N764K
D796Y	BA.1, BA.2, BA.3, and BA.1.1	—	Europe / United Kingdom / Scotland	2020-03-29	EPI_ISL_433364	D796Y
N856K	BA.1 and BA.1.1	—	Asia / China / Hubei / Wuhan	2020-01-25	EPI_ISL_493156	N856K
Q954H	BA.1, BA.2, BA.3, and BA.1.1	—	Africa / South Africa / North West	2020-06-29	EPI_ISL_8182884	Q954H
N969K	BA.1, BA.2, BA.3, and BA.1.1	—	North America / USA / Maryland	2020-05-31	EPI_ISL_3098538	N969K
L981F	BA.1 and BA.1.1	—	North America / USA / Wisconsin / Dane County	2020-04-17	EPI_ISL_450716	L981F
ORF3a (NS3a)						
T223I	BA.2 and BA.3	—	Asia / India / Himachal Pradesh	2020-02-24	EPI_ISL_2099688	T223I
L65F	BA.2	—	Asia / India / Chhattisgarh / Raipur	28-01-2022	EPI_ISL_10716789	L65F
E-protein						
T9I	BA.1, BA.2, BA.1.1, and BA.3	—	North America / USA / Washington	2020-03-12	EPI_ISL_476911	T9I
L18I	BA.2	Gamma	North America / USA / Washington	2020-03-28	EPI_ISL_486047	L18I

M-protein						
D3G	BA.1 and BA.1.1	—	Asia / China / Guangxi / Nanning	2020-02-19	EPI_ISL_6951243	—
Q19E	BA.1, BA.2, BA.1.1, and BA.3	—	North America / USA / New York / Brooklyn	2020-03-27	EPI_ISL_456032	Q19E
A63T	BA.1, BA.2, BA.1.1, and BA.3	—	Europe / United Kingdom / Scotland	2020-03-23	EPI_ISL_425915	A63T
ORF6						
D61L	BA.2	—	N/A	N/A	N/A	—
ORF7a						
L17F	BA.2, BA.1	—	Europe / United Kingdom / England	2021-12-15	EPI_ISL_8042383	L17F
N-protein						
P13L	BA.1, BA.2, BA.1.1, and BA.3	Lambda	Oceania / Papua New Guinea	2020-01-13	EPI_ISL_1307662	P13L
E31del	BA.1, BA.2, BA.1.1, and BA.3	—	Africa / Egypt / Cairo	2020-06-06	EPI_ISL_1167190	E31del
R32del	BA.1, BA.2, BA.1.1, and BA.3	—	Africa / Egypt / Cairo	2020-06-06	EPI_ISL_1167190	R32del
S33del	BA.1, BA.2, BA.1.1, and BA.3	—	Africa / Egypt / Cairo	2020-06-06	EPI_ISL_1167190	S33del
R203K	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Gamma, Lambda	Oceania / Australia / New South Wales / Sydney	2020-01-08	EPI_ISL_3568416	R203K
R203M	BA.2, BA.1	Delta	Europe / Switzerland / Geneva	2020-03	EPI_ISL_548226	R203M
G204R	BA.1, BA.2, BA.1.1, and BA.3	Alpha, Gamma, Lambda	Oceania / Australia / New South Wales / Sydney	2020-01-08	EPI_ISL_3568416	G204R
S413R	BA.2 and BA.3	—	Africa / Egypt	2020-06-24	EPI_ISL_2380075	S413R
G215C	BA.2	Delta	North America / USA / New York / Westchester County	2020-03-12	EPI_ISL_6661895	G215C

References

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