

## Abstract

## Update : April 2021 Status and Characteristics of Variant Virus Outbreak in the Republic of Korea

Park Ae Kyung, Kim Il-Hwan, Kim Jeong-Min, Nam-Joo Lee, Rhee JeeEun, Kim Eun-Jin

Laboratory Analysis Team, Laboratory Diagnosis Task Force, Central Disease Control Headquarters, Korea Disease Control and Prevention Agency (KDCA)

Kim Jia, Kim JungYeon, Gwack Jin

Case and Guideline Management Team, Infection Prevention Support Team, Central Disease Control Headquarters, KDCA

Kim Eun-Kyoung, Kim Young-Man, Lee Sang-Eun, Park YoungJoon

Epidemiological Investigation Team, Epidemiological Investigation and Analysis Task Force, KDCA

Regarding the Coronavirus Disease 2019 (COVID-19) in Korea, the government intends to evaluate the domestic situation and respond to variant viruses by checking the status, dynamics, and the clinical characteristics of COVID-19 monthly. The aim of this study was to analyze the status and characteristics of COVID-19 variant viruses in Korea. As such, COVID-19 virus variant surveillance was conducted through full-length genome analysis and spike protein gene analysis for positive samples of confirmed cases related to various domestic outbreaks and imported cases.

The epidemiological and clinical characteristics were analyzed using initial and in-depth epidemiological investigation results reported through the Korea Disease Control and Prevention Agency's (KDCA) COVID-19 information management system; the information system for managing confirmed patients, and wired monitoring. Also, clinical characteristics such as severity and the occurrence of group cases were analyzed.

Among the number of confirmed cases in April 2021 (18,927), a total of 2,774 isolates were laboratory tested during the month of April for identification of variants of SARS-CoV-2. A total of 302 accounting for 10.9% of the tested were confirmed as Variants of Concern (VOC). The rate of sequenced isolates was 14.7% and the rate of VOC in April was 15.8%, which marked an increase of 9.7% when compared to March 2021.

By May 3rd 2021, a total of 632 patients of VOCs were confirmed in Korea. The 632 VOC cases were divided into three groups: 501Y.V1 (VOC originating from the United Kingdom), 501Y.V2 (VOC originating from South Africa) and 501Y.V3 (VOC originating Brazil). There were 551 cases (87.2%) of 501Y.V1, 71 cases (11.2%) of 501Y.V2, and 10 cases (1.6%) of 501Y.V3.

Among the 632 cases, there were 324 imported cases (51.3%). The patients' average age was 38.1. By age group, there were 71 cases (21.5%) each in their 20s and, 30s. 223 cases (70.6%) were Korean nationals. 192 cases (58.2%) were symptomatic at diagnosis, and 69 cases (20.9%) presented mild respiratory symptoms with fever. Most symptoms of VOC patients in Korea were mild, but 9 of the 501Y.V1 cases, and 1 of the 501Y.V2 cases were severe/critical (including one death). The rate of severe/critical cases of 501Y.V1 was 1.86%, and the fatality rate of 501Y.V1 cases was 2.01%. The rate of severe/critical cases of 501Y.V2 was 8.51%, and the fatality rate of 501Y.V2 cases was 9.22%.

A total of 25 VOC-related group cases were confirmed in April 2021, with 569 confirmed cases (90 laboratory confirmed cases, and 479 epidemiological cases), which was lower than those confirmed in March, when there was a total of 13 VOC-related group cases, with 284 confirmed cases (81 laboratory confirmed cases, and 203 epidemiological cases). There was a total of 19 VOC-related group cases and 1,094 confirmed cases (256 laboratory confirmed cases and 838 epidemiological related cases). By gender, there were 578 male cases (52.8%) and 224 female cases (20.5%) aged 20-29 years, and 470 (43.0%) cases were reported in Gyeonggi Province, followed by 308 cases (28.0%) reported in Ulsan Metropolitan City.

**Keywords:** Coronavirus Disease-19 (COVID-19), VOC (Variants of Concern), VOI (Variants of Interest), Whole Genome Sequencing, Clinical characteristics, Group cases

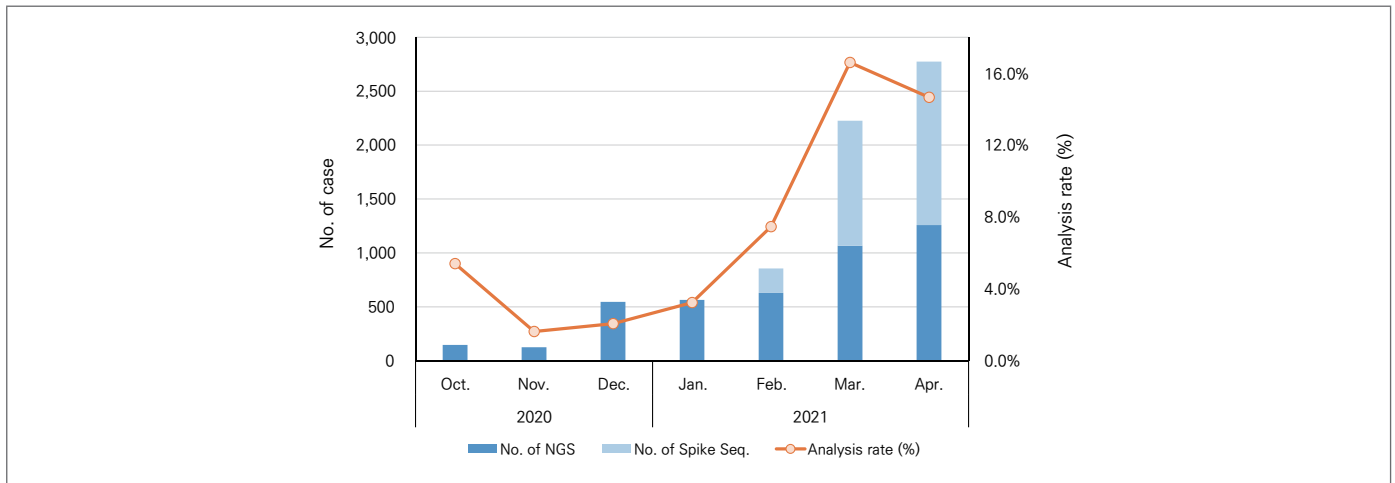


Figure 1. The number of sequenced Coronavirus Disease–19 (COVID–19) cases and the rate of sequenced isolates among the confirmed cases

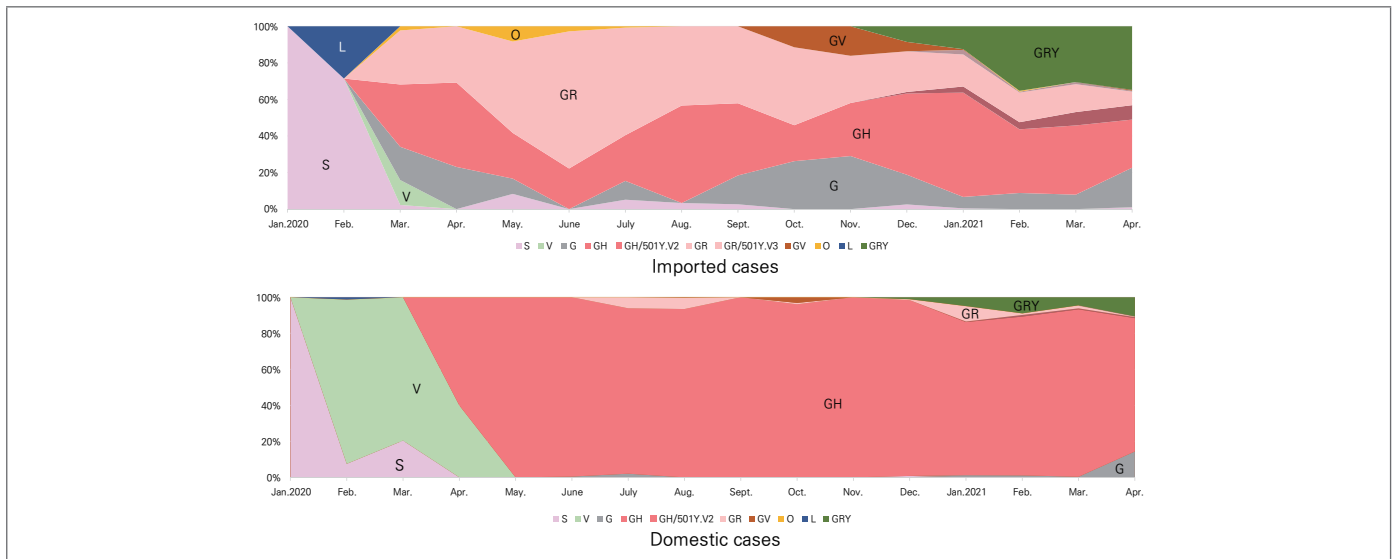


Figure 2. The distribution of the clades of Coronavirus Disease–19 (COVID–19) virus in domestic and imported cases

Table 1. The regional occurrence of Coronavirus Disease-19 (COVID-19) variants in the Republic of Korea (Up to May 3, 2021)

Region		Number of VOC* (Detection rate †, %)					
		Total	Dec. 2020	Jan. 2021	Feb. 2021	Mar. 2021	Apr. 2021
Variants of Concern (VOC)	Total number of VOCs	632 (10.2%)	15 (2.9%)	67 (11.3%)	135 (11.9%)	168 (7.1%)	247 (15.8%)
	Subtotal	551 (8.9%)	14 (2.7%)	51 (8.6%)	122 (10.7%)	143 (6.0%)	221 (14.1%)
	Subtotal	290 (5.6%)	4 (1.0%)	21 (5.8%)	43 (4.8%)	79 (3.7%)	143 (10.4%)
	Capital	118 (4.6%)	4 (1.7%)	8 (5.8%)	14 (3.6%)	29 (2.7%)	63 (8.4%)
	Kyungbuk	23 (5.4%)	0 (0.0%)	0 (0.0%)	2 (1.9%)	18 (12.8%)	3 (2.9%)
	Kyungnam	92 (14.1%)	0 (0.0%)	7 (8.9%)	22 (22.7%)	28 (10.1%)	35 (23.6%)
	Honam	21 (3.6%)	0 (0.0%)	6 (6.5%)	5 (4.5%)	0 (0.0%)	10 (6.7%)
	Chungcheong	36 (4.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.9%)	32 (14.5%)
	Imported	261 (24.9%)	10 (8.3%)	30 (13.0%)	79 (32.9%)	64 (24.8%)	78 (39.4%)
	Total	71 (1.1)	1 (0.2%)	10 (1.7%)	12 (1.1%)	23 (1.0%)	25 (1.6%)
	Domestic	18 (0.4)	0 (0.0%)	1 (0.3%)	4 (0.4%)	5 (0.2%)	8 (0.6%)
	Imported	53 (3.3)	1 (0.8%)	9 (3.9%)	8 (3.3%)	18 (7.0%)	17 (8.6%)
	Total	10 (0.2%)	0 (0.0%)	6 (1.0%)	1 (0.1%)	2 (0.1%)	1 (0.1%)
	Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Imported	10 (1.0%)	0 (0.0%)	6 (2.6%)	1 (0.4%)	2 (0.8%)	1 (0.5%)
Variants of Interest (VOI)	Total number of VOIs	473 (7.1%)	13 (2.5%)	22 (3.7%)	69 (6.1%)	162 (6.8%)	207 (13.2%)
	Total	416 (6.7%)	13 (2.5%)	22 (3.7%)	59 (5.2%)	153 (6.4%)	169 (10.8%)
	Subtotal	384 (7.5%)	11 (2.7%)	5 (1.4%)	55 (6.1%)	147 (6.9%)	166 (12.1)
	Capital	195 (7.6%)	11 (4.6%)	4 (2.9%)	12 (3.1%)	75 (7.1%)	93 (12.4%)
	Kyungbuk	159 (37.2%)	0 (0.0%)	1 (2.8%)	35 (32.4%)	64 (45.4%)	59 (57.3%)
	Kyungnam	6 (0.9%)	0 (0.0%)	0 (0.0%)	2 (2.1%)	3 (1.1%)	1 (0.7%)
	Honam	14 (2.4%)	0 (0.0%)	0 (0.0%)	4 (3.6%)	1 (0.5%)	9 (6.0%)
	Chungcheong	10 (1.1%)	0 (0.0%)	0 (0.0%)	2 (1.0%)	4 (0.9%)	4 (1.8%)
	Imported	32 (3.1%)	2 (1.7%)	17 (7.4%)	4 (1.7%)	6 (2.3%)	3 (1.5%)
	Total	10 (0.2%)	0 (0.0%)	0 (0.0%)	3 (0.3%)	3 (0.1%)	4 (0.3%)
	Domestic	4 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.1%)	2 (0.1%)
	Imported	6 (0.6%)	0 (0.0%)	0 (0.0%)	3 (1.3%)	1 (0.4%)	2 (1.0%)
	Total	8 (0.1%)	0 (0.0%)	0 (0.0%)	5 (0.4%)	2 (0.1%)	1 (0.1%)
	Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Imported	8 (0.8%)	0 (0.0%)	0 (0.0%)	5 (2.1%)	2 (0.8%)	1 (0.5%)
	Total	6 (0.1%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	3 (0.1%)	1 (0.1%)
	Domestic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Imported	6 (0.6%)	0 (0.0%)	0 (0.0%)	2 (0.8%)	3 (1.2%)	1 (0.5%)
	Total	33 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	32 (2.0%)
	Domestic	4 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.3%)
	Imported	29 (2.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.4%)	28 (14.1%)

\*based on the date the case was confirmed

† Detection rate of VOC (%) = (number of VOCs/ number of sequenced virus) X 100

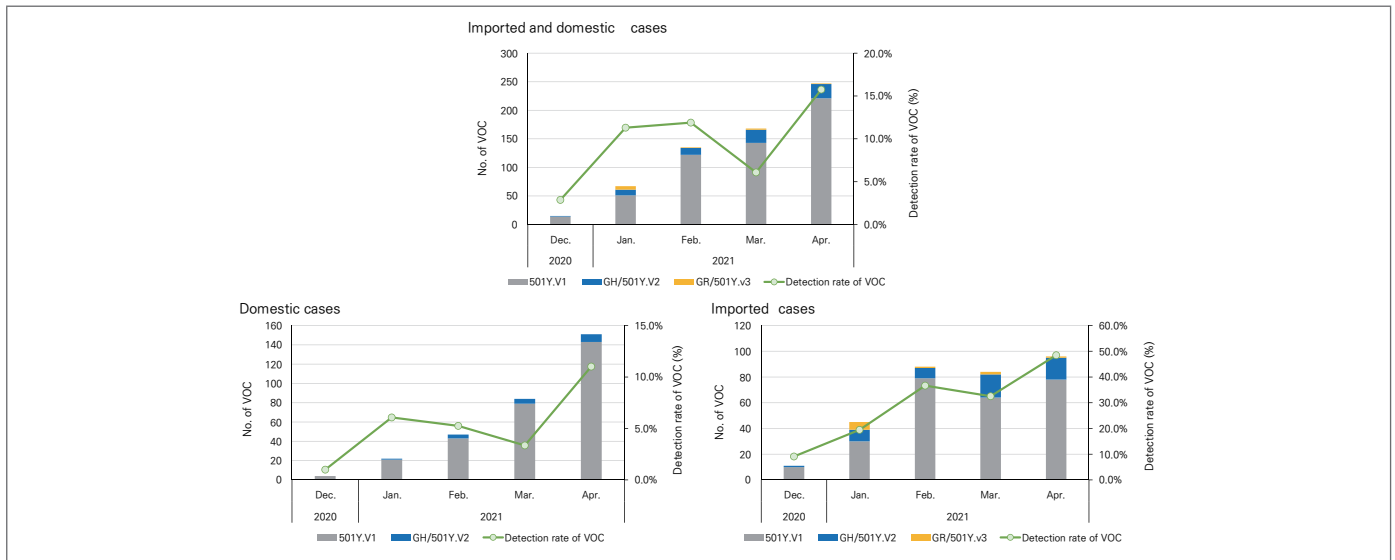


Figure 3. Monthly distribution of Coronavirus Disease-19 (COVID-19) variants

Table 2. The routes in which the Coronavirus Disease-19 (COVID-19) variants were identified in the Republic of Korea (Up to May 3, 2021)

Classification	Route	No. of countries	Countries
Variant of Concern (VOC)	Domestic	–	A total of 116
	Imported	48	A total of 261: Hungary (43), Pakistan (31), United States (23), Poland (22), Philippines (19), United Kingdom (19), UAE (14), Ghana (10), Jordan (8), Kazakhstan (8), German (4), Ethiopia (4), Canada (4), France (4), Serbia (3), Ukraine (3), Nepal (2), Montenegro (2), Mongolia (2), Brazil (1), Slovakia (2), Uganda (2), Iraq (2), Italy (2), India (2), Czechia (2), Turkey (2), Greece (1), Nigeria (1), Norway (1), Denmark (1), Russia (1), Libya (1), Mexico (1), Morocco (1), Maldives (1), Bahrain (1), Vietnam (1), Switzerland (1), Armenia (1), Egypt (1), Indonesia (1), Japan (1), China (1), Kenya (1), Kyrgyzstan (1), Tunisia (1)
	Domestic	–	A total of 18
	Imported	19	A total of 53: Bangladesh (11), Philippines (11), Tanzania (8), UAE (4), Mexico (3), South Africa (2), Equatorial Guinea (2), Taiwan (1), Malawi (1), United States (1), Bahrain (1), Burundi (1), India (1), Zambia (1), Djibouti (1), Zimbabwe (1), Cameroon (1), Qatar (1), Pakistan (1)
	Domestic	–	–
	Imported	4	A total of 10: Brazil(7), United States(1), Saudi Arabia(1), Canada(1)
Variant of Interest (VOI)	Domestic	–	A total of 384
	Imported	4	A total of 32: United States(28), Mexico(2), Canada(1), Poland(1)
	Domestic	–	A total of 4
	Imported	1	A total of 6: United States (6)
	Domestic	–	–
	Imported	4	A total of 8: Nigeria (4), Sudan (1), UAE (1), Cameroon (1), Philippines (1)
	Domestic	–	–
	Imported	1	A total of 6: Philippines (6)
452R.V3 (G)	Domestic	–	A total of 4
	Imported	1	A total of 29: India (28), Kazakhstan (1)

Table 3. Route of infection and detection of VOCs in the Republic of Korea

	Total	Dec. 2020			Jan. 2021			Feb. 2021			March 2021			April 2021		
		501Y.V1	501Y.V2	501Y.V3	501Y.V1	501Y.V2	501Y.V3	501Y.V1	501Y.V2	501Y.V3	501Y.V1	501Y.V2	501Y.V3	501Y.V1	501Y.V2	501Y.V3
Total	632 (100%)	14	1	0	51	10	6	122	12	1	143	23	2	221	25	1
Imported cases	324 (51.3%)	10	1	0	30	9	6	79	8	1	64	18	2	78	17	1
At entry screening	135 (21.4%)	4	1	0	13	4	2	32	4	0	22	8	2	29	13	1
During home quarantine	183 (29.0%)	6	0	0	17	5	4	44	4	1	42	10	0	46	4	0
Others	6 (0.9%)	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Locally-acquired cases	308 (48.7%)	4	0	0	21	1	0	43	4	0	79	5	0	143	8	0
Contact with confirmed cases	279 (44.1%)	4	0	0	20	1	0	39	3	0	71	5	0	128	8	0
Under investigation (unclassified)	29 (4.6%)	0	0	0	1	0	0	4	1	0	8	0	0	15	0	0

\*Home quarantine exemption

Table 4. Epidemiological characteristics of VOCs in the Republic of Korea

Classification	Total	501Y.V1	501Y.V2	501Y.V3	<i>p</i> -value <sup>†</sup>
Total	632 (100.0%)	551 (87.2%)	71 (11.2%)	10 (1.6%)	
Gender					
Male	406 (64.2%)	351 (63.7%)	47 (66.2%)	8 (80.0%)	0.011
Female	226 (35.8%)	200 (36.3%)	24 (33.8%)	2 (20.0%)	
Nationality					
Koreans	426 (67.4%)	376 (68.2%)	40 (56.3%)	10 (100.0%)	0.530
Foreigners	206 (32.6%)	175 (31.8%)	31 (43.7%)	0 (0.0%)	
Age group(yrs)					
0–9	29 (4.6%)	26 (4.7%)	3 (4.2%)	0 (0.0%)	0.000
10–19	39 (6.2%)	36 (6.5%)	3 (4.8%)	0 (0.0%)	
20–29	146 (23.1%)	134 (24.3%)	10 (14.1%)	2 (20.0%)	
30–39	134 (21.2%)	112 (20.3%)	19 (26.8%)	3 (30.0%)	
40–49	119 (18.8%)	105 (19.1%)	13 (18.3%)	1 (10.0%)	
50–59	92 (14.6%)	87 (15.8%)	4 (5.6%)	1 (10.0%)	
60–69	53 (8.4%)	39 (7.1%)	12 (16.9%)	2 (20.0%)	
70–79	10 (1.6%)	8 (1.5%)	2 (2.8%)	0 (0.0%)	
80+	10 (1.6%)	4 (0.7%)	5 (7.0%)	1 (10.0%)	
Isolation place					
Residential treatment center	314 (49.7%)	266 (48.3%)	43 (61.9%)	5 (50.0%)	0.839
Hospital	314 (49.7%)	281 (51.0%)	28 (38.1%)	5 (50.0%)	
Home treatment	1 (0.2%)	1 (0.2%)	0 (0.0%)	0 (0.0%)	
Others*	3 (0.5%)	3 (0.5%)	0 (0.0%)	0 (0.0%)	

\*Death before COVID-19 confirmation etc. †  $\chi^2$  test

Table 5. Clinical characteristics of VOCs in the Republic of Korea

	Total	501Y.V1	501Y.V2	501Y.V3	p-value*
<b>Total</b>	632 (100.0%)	551 (87.2%)	71 (11.2%)	10 (1.6%)	
<b>Symptom</b>					
Symptomatic	367 (58.1%)	329 (59.7%)	31 (43.7%)	7 (70.0%)	0.026
Asymptomatic	265 (41.9%)	222 (40.3%)	40 (56.3%)	3 (30.0%)	
<b>Symptom classification</b>					
Fever only	53 (8.4%)	39 (7.1%)	12 (16.9%)	2 (20.0%)	0.006
Fever and respiratory symptoms	81 (12.8%)	79 (14.3%)	2 (2.8%)	0 (0.0%)	
Fever and other symptoms	25 (4.0%)	23 (4.2%)	2 (2.8%)	0 (0.0%)	
Respiratory symptoms without fever	153 (24.2%)	140 (25.4%)	10 (14.1%)	3 (30.0%)	
Acute loss of sense of smell or taste	7 (1.1%)	6 (1.1%)	1 (1.4%)	(0.0%)	
Others	48 (7.6%)	42 (7.6%)	4 (5.6%)	2 (20.0%)	
Asymptomatic	265 (41.9%)	222 (40.3%)	40 (56.3%)	3 (30.0%)	
<b>Severity</b>					
Death	3 (0.5%)	2 (0.4%)	1 (1.4%)	0 (0.0%)	0.523
Critical/severe	14 (2.2%)	11 (2.0%)	3 (4.2%)	0 (0.0%)	
Mild/ Asymptomatic	615 (97.3%)	538 (97.6%)	67 (94.4%)	10 (100.0%)	

\* $\chi^2$  test

Table 6. The rate of severe/critical and fatality of VOCs in the Republic of Korea

	COVID-19 (in Korea)	501Y.V1			501Y.V2			501Y.V3		
		Total	Confirmed of variance	Epidemic relation	Total	Confirmed of variance	Epidemic relation	Total	Confirmed of variance	Epidemic relation
Confirmed cases	122,634	1,344	551	793	141	71	70	14	10	4
Death	1,831	2	2	0	1	1	0	0	0	0
Severe/critical	3,223	25	11	14	12	8	4	0	0	0
Fatality	1.49%		0.15%			0.71%			0.00%	
Rate of severe/critical	2.63%		1.86%			8.51%			0.00%	
Rate of severe/critical (including death)	3.32%		2.01%			9.22%			0.00%	
Fatality (Age standardized*)		0.48% (0.32 times <sup>†</sup> )			0.12% (0.08 times <sup>†</sup> )			0.00%		
Rate of severe/critical (Age standardized*)		3.19% (1.21 times <sup>†</sup> )			2.19% (0.83 times <sup>†</sup> )			0.00%		
Rate of severe/critical (including death) (Age standardized*)		3.66% (1.10 times <sup>†</sup> )			2.19% (0.66 times <sup>†</sup> )			0.00%		

\*The age distribution of all corona19 confirmed patients in Korea is set as the standard population structure and calculated using an indirect method.

† Comparison with COVID-19 confirmed cases in Korea

Table 7. Characteristics of variants of concern (VOC) viruses by group case

Patient Occurrence Period			Occurrence status			Virus type
			Total	Laboratory confirmed cases	Epidemiological cases	
January	Group 1	1.7.-1.29.	38	13	25	501Y.V1
	Group 2	1.29.-1.30.	8	7	1	501Y.V1
January subtotal (Group 1 - Group 22)			46	20	26	
February	Group 3	2.10.-2.23.	31	7	24	501Y.V1
	Group 4	2.7.-2.17.	7	2	5	501Y.V1
	Group 5	2.4.-2.5.	5	3	2	501Y.V1
	Group 6	2.3.-2.13.	11	3	8	501Y.V1
	Group 7	2.22.-2.23.	3	3	0	501Y.V2
	Group 8	2.11.-3.1.	62	24	38	501Y.V1
	Group 9	2.16.-3.15.	24	1	23	501Y.V1
	Group 10	2.18.-3.3.	18	3	15	501Y.V1
	Group 11	2.27.-3.21.	25	14	11	501Y.V1
	Group 12	2.24.-3.16.	9	5	4	501Y.V1
February subtotal (Group 3 - Group 12)			195	65	130	
March	Group 13	3.6.-3.16.	80	12	68	501Y.V1
	Group 14	3.8.-3.10.	8	2	6	501Y.V1
	Group 15	3.20.-3.23.	6	1	5	501Y.V1
	Group 16	3.17.-3.25.	40	9	31	501Y.V1
	Group 17	2.24.-3.12.	6	6	0	501Y.V2
	Group 18	3.19.-3.21.	5	1	4	501Y.V1
	Group 19	3.21.-3.24.	8	1	7	501Y.V1
	Group 20	3.25.-3.27.	9	3	6	501Y.V1
	Group 21	3.26.-4.20.	20	6	14	501Y.V1
	Group 22	3.29.-4.14.	12	4	8	501Y.V1
	Group 23	3.29.-4.15.	21	6	15	501Y.V1
	Group 24	3.31.-4.21.	20	8	12	501Y.V1
	Group 25	3.31.-4.15.	20	4	16	501Y.V1
March subtotal (Group 13 - Group 25)			284	81	203	
April	Group 26	4.1.-4.25.	26	8	18	501Y.V1
	Group 27	4.2.-4.12.	8	5	3	501Y.V1
	Group 28	4.4.-4.8.	8	1	7	501Y.V1
	Group 29	4.4.-4.22.	39	6	33	501Y.V1
	Group 30	4.1.-4.27.	14	2	12	501Y.V1
	Group 31	4.6.-4.29.	24	4	20	501Y.V1
	Group 32	4.10.-4.17.	22	8	14	501Y.V1
	Group 33	4.5.-4.25.	53	6	47	501Y.V1
	Group 34	4.11.-4.12.	5	4	1	501Y.V1
	Group 35	4.11.-4.25.	7	3	4	501Y.V1
	Group 36	4.11.-4.27.	36	5	31	501Y.V1
	Group 37	4.3.-4.19.	11	1	10	501Y.V1

Table 7. (Continued) Characteristics of variants of concern (VOC) viruses by group case

Patient Occurrence Period		Occurrence status			Virus type
		Total	Laboratory confirmed cases	Epidemiological cases	
Group 38	4.14.-4.23.	43	3	40	501Y.V1
Group 39	4.18.-4.20.	8	1	7	501Y.V1
Group 40	4.21.-5.1.	11	4	7	501Y.V1
Group 41	4.23.-4.30.	77	7	70	501Y.V2
Group 42	4.22.-4.25.	19	4	15	501Y.V1
Group 43	4.14.-4.30.	48	3	45	501Y.V1
Group 44	4.13.-4.21.	10	4	6	501Y.V1
Group 45	4.16.-4.17.	5	3	2	501Y.V1
Group 46	4.8.-4.14.	39	1	38	501Y.V1
Group 47	4.15.-4.29.	3	1	2	501Y.V1
Group 48	4.19-4.19.	5	2	3	501Y.V1
Group 49	4.13.-4.21.	32	3	29	501Y.V1
Group 50	4.22.-4.29.	16	1	15	501Y.V1
April subtotal (Group 25 - Group 50)		569	90	479	
Total		1,094	256	838	



**Table 8.** Demographic characteristics of patients with variants of concern (VOC) virus population cases (including epidemiological cases)

	April	Total
	N (%)	N (%)
<b>Total</b>	<b>569 (100.0)</b>	<b>1,094 (100.0)</b>
<b>Sex</b>		
Male	280 (49.2)	578 (52.8)
Female	289 (50.8)	516 (47.2)
<b>Age group</b>		
0-9	36 (6.3)	90 (8.2)
10-19	43 (7.6)	76 (6.9)
20-29	114 (20.0)	224 (20.5)
30-39	88 (15.5)	174 (15.9)
40-49	107 (18.8)	183 (16.7)
50-59	80 (14.1)	179 (16.4)
60-69	49 (8.6)	97 (8.9)
70-79	16 (2.8)	30 (2.7)
80+	36 (6.4)	41 (3.7)
<b>Region</b>		
Seoul	19 (3.3)	41 (3.7)
Busan	2 (0.4)	23 (2.1)
Daegu	0 (0.0)	3 (0.3)
Incheon	7 (1.2)	24 (2.2)
Gwangju	3 (0.5)	2 (0.2)
Daejeon	1 (0.2)	0 (0.0)
Ulsan	141 (24.8)	306 (28.0)
Sejong	0 (0.0)	1 (0.1)
Gyeonggi	311 (54.7)	470 (43.0)
Gangwon	0 (0.0)	9 (0.8)
Chungbuk	21 (3.7)	61 (5.6)
Chungnam	2 (0.4)	1 (0.1)
Jeonbuk	21 (3.7)	21 (1.9)
Jeonnam	0 (0.0)	17 (1.6)
Gyeongbuk	1 (0.2)	24 (2.2)
Gyeongnam	39 (6.9)	90 (8.2)
Jeju	1 (0.2)	1 (0.1)