frontiers

Supplementary Material

Deep sequencing of B cell receptor repertoires from COVID-19 patients reveals strong convergent immune signatures

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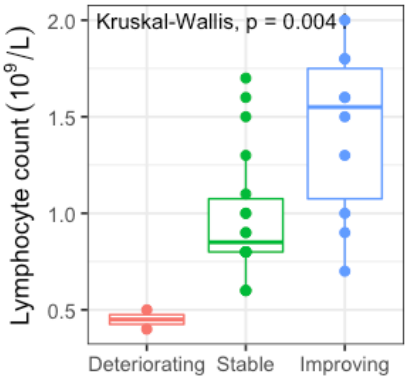
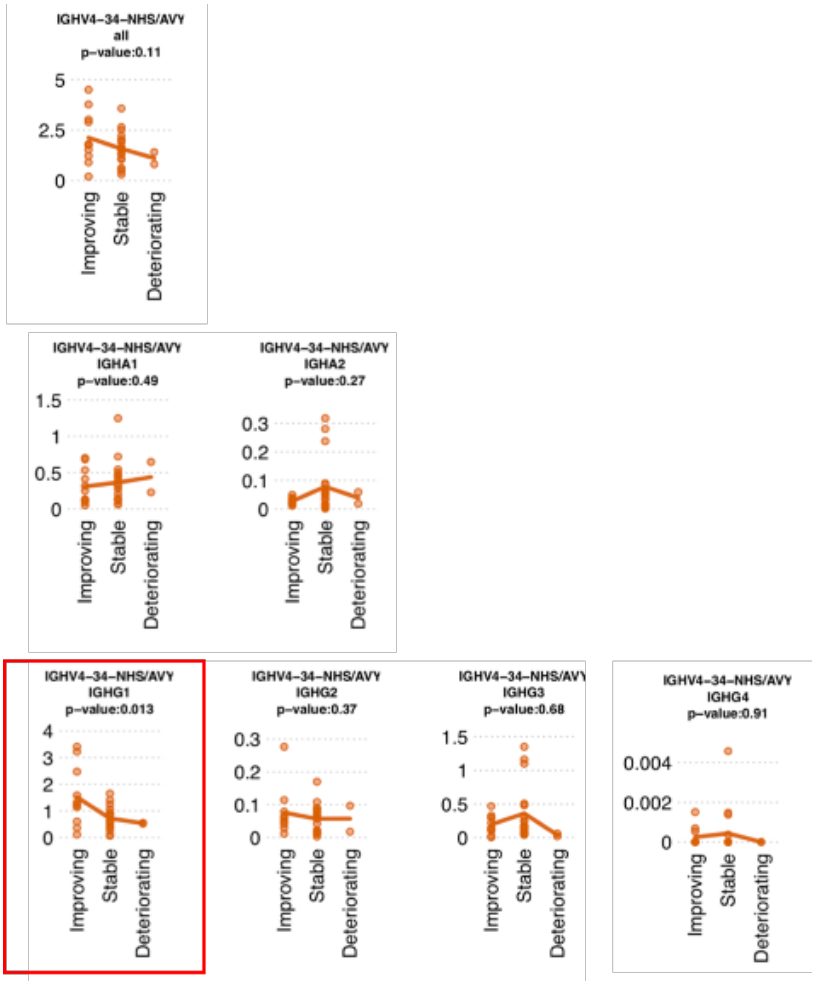
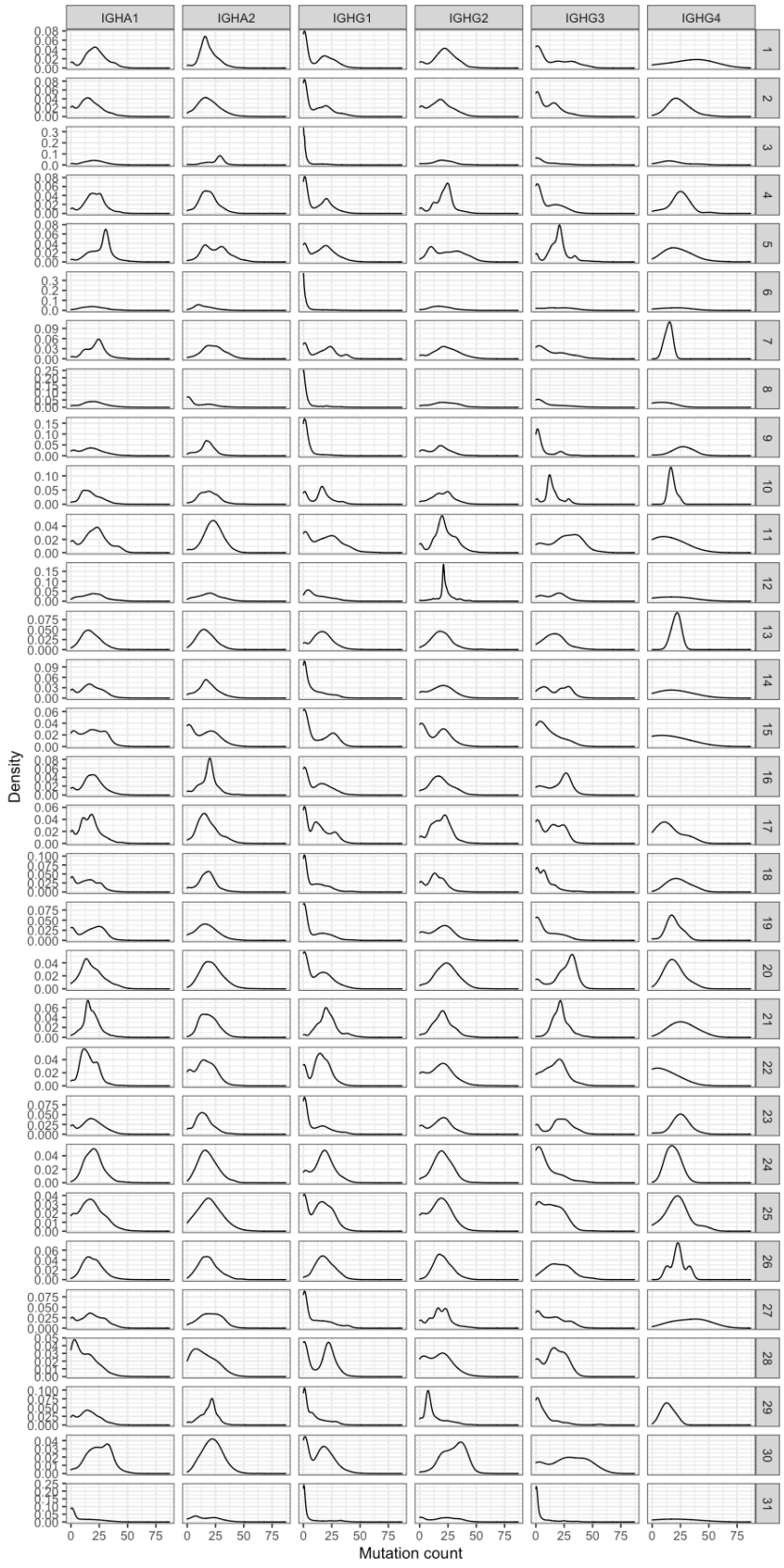
Keywords: COVID-19, SARS-CoV-2, B-cell repertoire, BCR, antibody, convergence



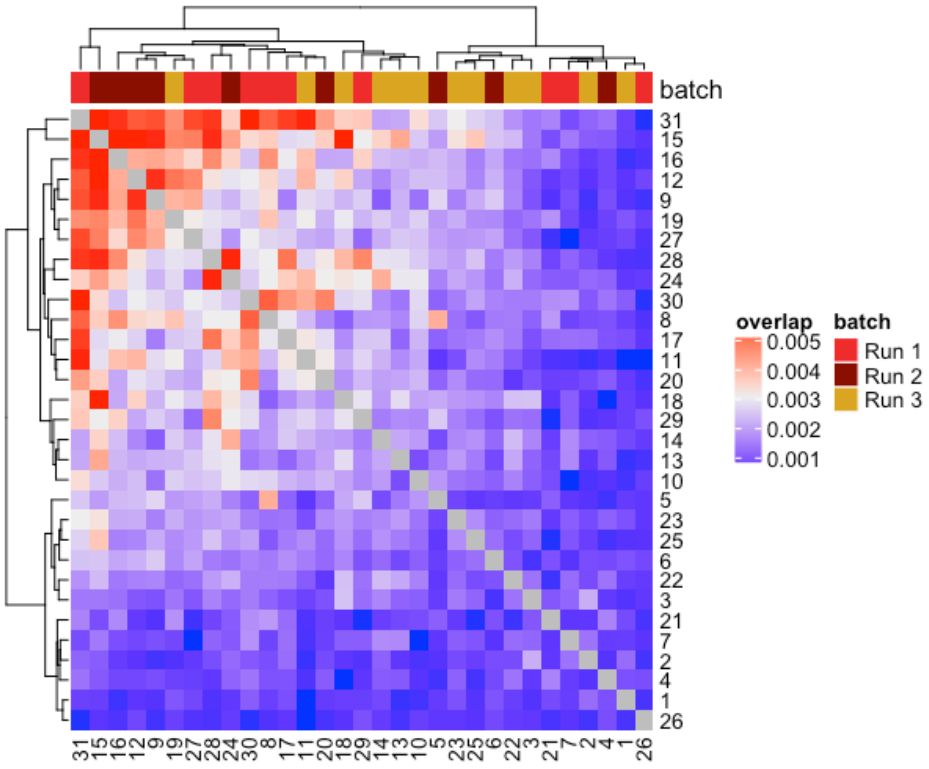
Supplementary Figure 1. Relationship between lymphocyte count and clinical status.



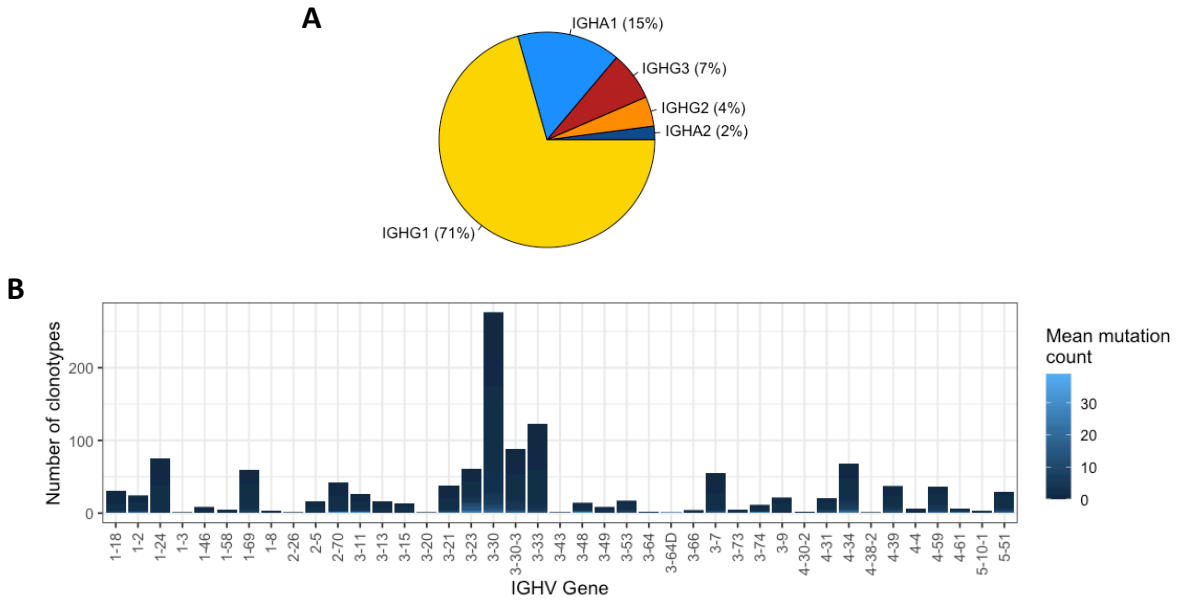
Supplementary Figure 2. The percentage of sequences containing the autoreactive "NHS and "AVY" motifs between COVID patients with improving, stable or worsening symptoms. IGHG1 (red box) was the only significant correlation. P-values are determined by MANOVA.



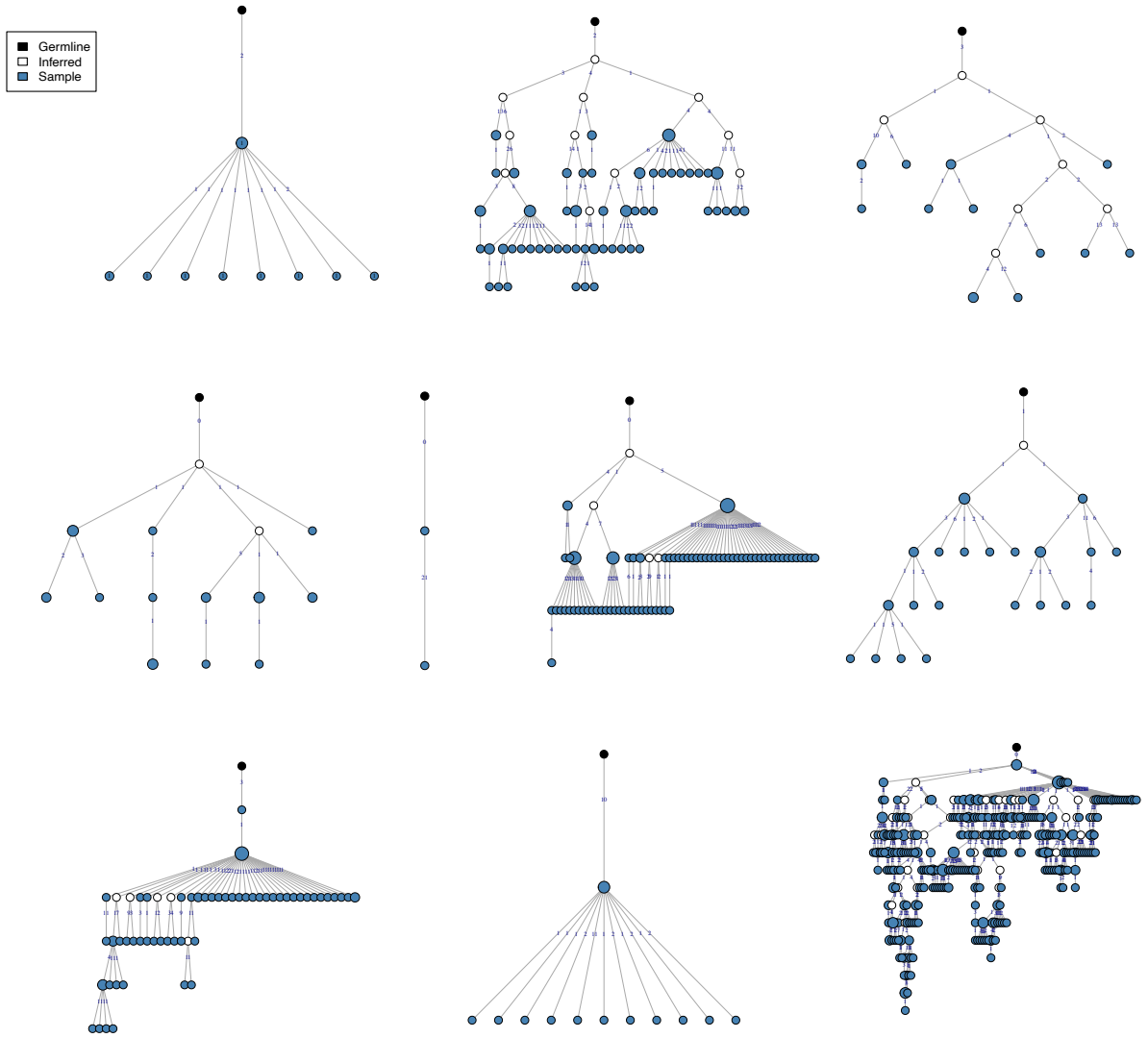
Supplementary Figure 3. Distribution of sequences with different numbers of mutations from germline. Each row is a different COVID-19 patient.



Supplementary Figure 4. Analysis of batch effects between the three sequencing runs. To normalise for different sequence numbers for each sample, a random subsample of 10,000 sequences per sample was taken. The clonotype convergence between each sample was then calculated using the jaccard index. Samples are hierarchically clustered in the heatmap based on this jaccard index.



Supplementary Figure 5. Properties of the 1,254 convergent clonotypes **(A)** Isotype subclass usage of the sequences with the 1,254 convergent clonotypes. **(B)** IGHV gene segment usage of the 1,254 convergent clonotypes.



Supplementary Figure 6. Lineage trees of the convergent clonotype that matched to the bronchoalveolar lavage fluid data. Each lineage tree represents the members of the clonotype from each of the ten patients it was present in. Each node represents a unique sequence within the clonotype lineage tree, with the size indicative of the number of duplicate sequences present. Numbers on the edges of adjoining nodes show the number of mutations between the sequences.

Supplementary Table 1. Summary of number of unique sequences, and number of clonotypes obtained for each COVID-19 patient.

Participant ID	Gender	Age	Status	Unique BCR Sequences	Clonotypes
1	Female	48	Improving	184,613	30,438
2	Male	44	Stable	287,865	60,806
3	Male	66	Improving	169,645	21,928
4	Male	71	Improving	210,148	24,243
5	Male	86	Stable	235,013	34,368
6	Female	63	Stable	122,610	13,366
7	Female	82	Improving	217,356	21,004
8	Female	69	Stable	123,741	16,296
9	Female	57	Improving	194,778	20,779
10	Male	69	Stable	202,162	17,103
11	Male	69	Improving	152,272	17,144
12	Male	65	Improving	121,320	12,089
13	Female	33	Deteriorating	47,901	15,556
14	Male	40	Stable	257,725	53,649
15	Male	55	Stable	33,124	9,668
16	Male	78	Stable	37,168	10,828
17	Female	70	Stable	198,822	20,332
18	Male	39	Improving	233,408	26,604
19	Male	36	Improving	51,346	22,354
20	Male	52	Stable	39,325	9,475
21	Male	76	Deteriorating	221,975	18,588
22	Female	71	Stable	54,684	9,327
23	Male	26	Stable	202,995	41,493
24	Female	87	Stable	31,049	6,842
25	Male	29	Stable	41,025	14,840
26	Male	49	Stable	171,278	21,689
27	Male	35	Stable	280,496	36,937
28	Female	59	Stable	29,641	8,797
29	Female	42	Stable	253,163	35,211
30	Male	37	Improving	60,364	15,180
31	Male	40	Improving	329,223	78,400
			Total:	4,796,235	745,334

Supplementary Table 2. Summary of number of unique sequences, and number of clonotypes obtained for each healthy control subject. Only IGHA and IGHG data are included.

Participant ID	Gender	Age	Unique BCR Sequences	Clonotypes
Co_C.001.2_PB	Male	39	7,820	4,426
Co_C.002.1_PB	Male	35	43,813	12,481
Co_C.003.1_PB	Male	26	5,981	4,148
Co_C.004.1_PB	Female	27	10,098	5,203
Co_C.005.1_PB	Female	26	27,345	9,238
Co_C.012.1_PB	Female	26	17,204	12,198
Co_C.013.1_PB	Female	24	9,201	5,080
Co_C.016.3_PB	Female	25	8,792	3,991
Co_C.017.2_PB	Male	41	13,720	7,293
Co_C.018.1_PB	Male	33	6,079	4,268
Co_C.020.1_PB	Female	28	8,127	2,540
Co_C.025.1_PB	Male	30	56,489	18,265
Co_C.026.1_PB	Female	29	40,625	18,091
Co_C.033.2_PB	Female	15	21,652	5,194
Co_C.038.1_PB	Female	26	46,079	17,419
Co_C.040.1_PB	Male	20	140,640	27,263
Co_C.042.1_PB	Female	31	85,509	18,822
Co_C.045.1_PB	Female	51	35,540	8,038
Co_C.046.1_PB	Female	11	70,534	24,515
Co_C.047.1_PB	Female	18	148,395	20,784
Co_C.048.1_PB	Female	45	65,230	13,277
Co_C.049.1_PB	Female	25	97,538	23,486
Co_C.051.1_PB	Male	22	1,376	1,074
Co_C.052.1_PB	Male	15	9,466	4,126
Co_C.055.1_PB	Male	43	8,061	3,894
Co_C.056.1_PB	Female	30	9,048	4,659
Co_C.060.1_PB	Male	31	34,139	10,322
Co_C.061.1_PB	Male	36	12,578	6,016
Co_C.062.1_PB	Female	14	1,709	1,134
Co_C.063.1_PB	Male	20	15,348	6,424
Co_C.065.1_PB	Female	23	37,262	9,525
Co_C.076.1_PB	Female	34	7,068	2,792
Co_C.077.1_PB	Female	26	18,637	3,726
Co_C.078.1_PB	Female	26	15,383	3,505
Co_P.166.1_PB	Female	36	40,549	7,489
Co_P.170.1_PB	Female	45	41,564	14,183
Co_P.178.1_PB	Female	34	13,803	3,767
Co_P.190.1_PB	Female	11	4,565	2,245
Co_P.191.1_PB	Male	18	5,789	2,705
Co_P.197.1_PB	Female	15	99,308	19,654
		Total:	1,342,064	373,260

Supplementary Table 3. CDRH3 AA sequences identified from bronchoalveolar RNAseq data. Highlighted in green is the one identified in our SARS-CoV-2 patient dataset.

bestVHit	bestJHit	aaSeqCDR3
IGHV2-26	IGHJ3	CARDSGRHLGPFDIW
IGHV1-2	IGHJ3	CATPYYYDGGLDAFDIW
IGHV3-74	IGHJ5	CARDLSRTNWFDPW
IGHV3-15	IGHJ4	CTTDLHDYGDSDYW
IGHV3-15	IGHJ4	CTTDFGGMITFGGVLRRI
IGHV3-21	IGHJ4	CARAQSRGGYDSFFDFW
IGHV3-21	IGHJ4	CGRGGPGTGIDYW
IGHV4-59	IGHJ5	CARGGQYNNWFAPW
IGHV3-74	IGHJ5	CVRDLSRTNWFDPW
IGHV3-15	IGHJ4	YTRDLHDYGDSDYW
IGHV3-23	IGHJ3	CAKIPSFLSDYDVHPNDAIDIW
IGHV5-10-1	IGHJ4	CARHPQGAQFSNLGTYYFDYW
IGHV4-59	IGHJ4	CARDGEYGGLAMW
IGHV5-51	IGHJ6	CARPGTYYDILTGYSNHGMDVW
IGHV4-39	IGHJ5	CARHASFRGTNYNWFDPW
IGHV3-53	IGHJ5	CARDTSTEDVAWWFDPW

Supplementary Table 4. Convergent clonotypes with high CDRH3 homology to antibodies in the CoV-AbDab. Name: ID of the sequence. Black text represents the convergent clonotypes from this study, and blue text represent antibodies from CoV-AbDab. Highlighted in yellow are those which would be considered to belong to the same clonotype and are represented in Table 1. CDRH3: CDRH3 amino acid sequence. Green residues represent sequence matches between the convergent clonotype and the CoV-AbDab sequence, and red residues represent mismatches. IGHV: IGHV gene segment of the sequence. Green text represents matches between the convergent clonotype and the CoV-AbDab query sequence, and red text represents mismatches. IGHJ: IGHJ gene segment of the sequence. Green text represents matches between the convergent clonotype and the CoV-AbDab query sequence, and red text represents mismatches. ND – not determined. Binds/Neutralises: Experimental confirmation of whether the sequence binds SARS-CoV-1 or SARS-CoV-2.

Name	CDRH3	IGHV	IGHJ	Binds	Neutralises	Reference
C154	AKQ-AGPYCSGGSCYSAPFDY	3-30	4	CoV-1, CoV-2	CoV-2	Robbiani et al., 2020
ALC_3983948	**AKV-SGPYCSGGSCYSFYFDY**	**3-30**	**4**			
ALC_4259294	**AKMGGGPYCSGGSCYSNYFDY**	**3-30**	**4**			
COV2-2901	ARSYDILTGYRDAFDI	3-53	3	CoV-2		
COV2-2068	ARSYDILTGYRDAFDI	3-53	3	CoV-2	CoV-2	Zost et al., 2020
COV2-2767	ARSYDILTGYRDAFDI	3-53	3	CoV-2		
COV2-2790	ARSYDILTGYRDAFDI	3-53	3	CoV-2	CoV-2	
ALC_2318471	**VRNYDILTGYSDAFDI**	**3-53**	**3**			
COV2-2007	AKVSATYYYYYYGMDV	3-30	6	CoV-1, CoV-2		Zost et al., 2020
CC12.17	AKSSGSYYYYYYGMDV	3-30	6	CoV-2	CoV-2	Rogers et al., 2020
ALC_2318830	**AKVMTTYYYYYYGMDV**	**3-30**	**6**			
REGN10977	ARTPFYYDSSGYYLDY	1-69	4	CoV-2	CoV-2	Hansen et al., 2020
COVA2-14	ARVR-YYDSSGYYEDY	1-69	4	CoV-1, CoV-2		Brouwer et al., 2020
ALC_1780442	**ARYD-YYDSSGYYLDY**	**1-69**	**4**			
COV2-2270	AITYYYDSSGYWWDD	1-69	4	CoV-1, CoV-2		Zost et al., 2020
ALC_1781971	**ASTYYYDSSGYWFDY**	**1-69**	**4**			
COVA2-40	AGRYCSGGRCGWFDP	4-4	5	CoV-2		Brouwer et al., 2020
ALC_1784026	**ESRYCSGGSCGWFDP**	**4-4**	**5**			
COV2-2147	ARSTSGSYYYGMDV	3-30-3	6	CoV-1, CoV-2		Zost et al., 2020
COV2-2341	ARSTSGSYYYGMDV	3-30-3	6	CoV-1, CoV-2		
COV2-2160	ARSTSGSYYYGMDV	3-30-3	6	CoV-1, CoV-2		
COV2-2159	ARSTSGSYYYGMDV	3-30-3	6	CoV-1, CoV-2		
CV27	ARSFGGSYYYGMDV	3-30	6	CoV-2		Seydoux et al., 2020
CV34	ARSYGGSYYYGMDV	3-30-3	6	CoV-2		
ALC_1248726	**ARAYSGSYYYGMDV**	**3-53**	**6**			
ALC_1249094	**ARGTRGSYYYGMDV**	**3-30-3**	**6**			
ALC_1255857	**ARGFGGSYYYGMDV**	**3-53**	**6**			
ALC_1251900	**ARAYSGSYYYGMDV**	**3-7**	**6**			
COV2-2639	ARAGGGSYRGPFDY	3-30	4	CoV-1, CoV-2		Zost et al., 2020
2M-14E5	ARSGGGSYRGPFDY	3-30	4	CoV-2		
ALC_1245591	**ARVIGGSYRGPFDY**	**3-30-3**	**4**			
COV2-2006	ARPQSGGYYAPLDY	3-30-3	4	CoV-1, CoV-2		Zost et al., 2020

ALC_1246650	**ARPYSGSYYAPLDY**	**3-30-3**	**4**			
S304	ARGDSSGYYYYFDY	3-13	4	CoV-1, CoV-2	CoV-1, CoV-2	Pinto et al., 2020
ALC_1245048	**ARGYSSGYYYYFDY**	**3-13**	**4**			
COV2-2027	AIYGYYYYGLDV	3-30	6	CoV-2		Zost et al., 2020
ALC_480504	**AVYGYYYYGMDV**	**3-30**	**6**			
ALC_481016	**ASYGYYYYGMDV**	**3-30-3**	**6**			
COVA2-04	ARDLERAGGMDV	3-53	6	CoV-2	CoV-2	Brouwer et al., 2020
ALC_498298	**ARDLEAAGGMDV**	**3-66**	**6**			
CA1	AREGYCSGGSCYSGYYYYYGMDV	1-18	6	CoV-2	CoV-2	Shi et al., 2020
ALC_4634307	**AREGYCSGGSCYTDYYYYYGMDV**	**3-7**	**6**			
ALC_4258298	**ARDTYCSGGSCY--YYYYYGMDV**	**3-7**	**6**			
COV2-2445	ARRRSSSRYSSGWYMYYYYMDV	3-33	6	CoV-2		Zost et al., 2020
COV2-2173	ARRRSSSRYSSGWYMYYYYMDV	3-20	6	CoV-2		
COV2-2191	ARRRSSSRYSSGWYMYYYYMDV	3-20	6	CoV-2		
ALC_4259233	**ARDVSSSWYSSGWY-YYYYMDV**	**3-7**	**6**			
COVA1-19	ARWKS-DYYDSSGYYPAAFDI	3-21	3	CoV-2		Brouwer et al., 2020
ALC_4259226	**ARWRRTYYYDSSGYYPDAFDI**	**3-21**	**3**			
C150	ARPTAVAAAGNYFYYYGMDV	3-74	6	CoV-2		Robbiani et al., 2020
ALC_3663937	**ARDSGVAAAGNY-YYYGMDV**	**3-7**	**6**			
12E	ARVGYYGDYAWGYYYYGMDV	1-18	6	CoV-1	CoV-1	WO2005060520
ALC_3293962	**ARH--YGDYVFGYYYYGMDV**	**4-39**	**6**			
256	ARDGYGSGS-DYYYYYYMDV	3-30	6	CoV-1	CoV-1	Sui et al., 2006
ALC_3985973	**ARGGYGSGSYYNYYYYYMDV**	**1-69**	**6**			
CV23	ARV-WGYCSGGSCYVDAFDI	1-3	3	CoV-2		Seydoux et al., 2020
ALC_3664160	**ARVGLGYCSGGSCY-SAFDI**	**4-34**	**3**			
COV2-2146	ARRSYRSSWYYYYGMDV	3-48	6	CoV-2		Zost et al., 2020
COV2-2263	ARRSYRSSWYYYYGMDV	3-48	6	CoV-2		
ALC_2822775	**ARVGYSSSWYYYYGMDV**	**1-69**	**6**			
0317-A9	ATATAMDGYYYYYGMDV	1-24	6	CoV-2		Chi et al., 2020
ALC_2317864	**AVNTAMD-YYYYYGMDV**	**3-21**	**6**			
COV2-2844	ARAQGGN-YYYGMDV	3-30-3	6	CoV-1, CoV-2		Zost et al., 2020
COV2-2564	ARAQGGN-YYYGMDV	3-30-3	6	CoV-1, CoV-2		
ALC_1782084	**ARGQGGSQYYYGMDV**	**4-54**	**6**			
COVA3-01	ARGPAATYYYYMDV	4-59	6	CoV-1, CoV-2		Brouwer et al., 2020
COVA3-09	ARGPAATYYYYMDV	3-9	6	CoV-2		
ALC_1244470	**ATGVAATYYYYMDV**	**4-61**	**6**			
COV2-2832	ARGDGGYYSPFDY	3-66	4	CoV-2	CoV-2	Zost et al., 2020
ALC_815774	**ARSRGGYYSPFDY**	**3-30-3**	**4**			
COV2-2919	ARTMATINAFDI	2-70	3	CoV-2	CoV-2	Zost et al., 2020
ALC_482575	**ARIMATINAFDI**	**2-70**	**3**			
COV2-2178	ARVGSSSWYFDY	3-7	4	CoV-1, CoV-2		Zost et al., 2020
ALC_482648	**ARVPSSSWYFDY**	**3-11**	**4**			
C109	AIQLWLRGGYDY	3-7	4	CoV-2		Robbiani et al., 2020
ALC_481831	**AVQLWLRGGFDY**	**4-59**	**4**			

BD-494	ARDLVVYGMDV	3-53	6	CoV-2	CoV-2	Cao et al., 2020
BD-498	ARDLVVYGMDV	3-53	6	CoV-2	CoV-2	
BD-505	ARDRVVYGMDV	3-53	6	CoV-2	CoV-2	
BD-507	ARDLVVYGMDV	3-53	6	CoV-2	CoV-2	
ALC_265226	**ARVLTVYGMDV**	**3-33**	**6**			
BD-604	ARDLGPYGMDV	3-53	6	CoV-2	CoV-2	Du et al., 2020
ALC_269736	**ARGAGPYGMDV**	**3-11**	**6**			
C210	ARDLMAYGMDV	3-53	6	CoV-2	CoV-2	Robbiani et al., 2020
ALC_261066	**ARDSTAYGMDV**	**4-34**	**6**			
CV10	ARGFDY	4-59	4	CoV-1, CoV-2		Seydoux et al., 2020
ALC_7192	**ARGFDY**	**1-2**	**4**			
ALC_7213	**ARGFDY**	**1-18**	**4**			
ALC_7353	**ARGFDY**	**5-51**	**4**			
ALC_7448	**ARGFDP**	**4-34**	**5**			

Supplementary Table 5. Details of the 463 convergent clonotypes that matched to samples in the Nielsen *et al*. data.

Cluster Centre CDRH3	IGHV gene	IGHJ gene	Total Matches	Seropositive Matches	Seronegative Matches
CARRFDYW	3-23	4	6	5	1
CARGFDYW	1-18	4	5	5	0
CARGFDPW	4-34	5	5	5	0
CARVFDYW	3-30	4	5	4	1
CARVNSGSYLGAFDIW	3-30	3	5	4	1
CARGFDYW	1-2	4	4	4	0
CAREVLVYFDYW	3-33	4	4	4	0
CARVLSYYGMDVW	3-23	6	4	4	0
CARSSGYYYFDYW	3-30	4	4	4	0
CARVVSYYYGMDVW	3-21	6	4	4	0
CARVASYYYGMDVW	3-23	6	4	4	0
CTRNDFWSGYYFDYW	3-7	4	4	4	0
CARTYSGSYTDAFDIW	3-30	3	4	4	0
CAREGVVGATTGLDYW	3-30	4	4	4	0
CARDGVVTATTGLDYW	3-33	4	4	4	0
CARDRIVGGTTGLDYW	3-33	4	4	4	0
CTTVVYYYDSSGYSNDAFDIW	3-15	3	4	4	0
CARGYSSGWYFDYW	3-30	4	4	3	1
CARVPSSSWYFDYW	3-11	4	4	3	1
CTTGGRLW	3-15	4	3	3	0
CASGFDYW	1-69	4	3	3	0
CARGVDPW	1-2	5	3	3	0
CARDVGAQFDYW	3-30	4	3	3	0
CARDLYTFGMDVW	3-53	6	3	3	0
CAVYGYYYYGMDVW	3-30	6	3	3	0
CAKVRGGYYYFDYW	3-30	4	3	3	0
CAHRRSYYDAFDIW	2-5	3	3	3	0
CTSNDFWSGYSDYW	3-49	4	3	3	0
CARLGGTAWYFDLW	3-7	2	3	3	0
CATDGIVGATGLDYW	3-33	4	3	3	0
CAVPRGYSYGPFDYW	3-48	4	3	3	0
CTRGDFWSGYWSDYW	3-49	4	3	3	0
CSRPYSGSYYSYFDYW	3-30	4	3	3	0
CARTYSGSYYSWFDPW	3-30-3	5	3	3	0
CARVRSGSYYDAFDIW	3-30-3	3	3	3	0
CARVRGGSYYGVFDYW	3-30	4	3	3	0
CAKTVSGSYYSPFDYW	3-30	4	3	3	0
CARVPGGSYYGPFDYW	3-30	4	3	3	0
CARSNSGSYYHAFDIW	3-30-3	3	3	3	0
CARVSSGSYFGAFDIW	3-30-3	3	3	3	0
CATARAGSYYYGMDVW	3-23	6	3	3	0
CAKVRGGSYRDAFDIW	3-30	3	3	3	0
CASSGSGSYYSPFDYW	3-30	4	3	3	0
CARTYSGSYYGAFDIW	3-23	3	3	3	0
CAKTYSGSYYSSFDYW	3-30	4	3	3	0
CARAYSGSYYYGMDVW	3-7	6	3	3	0
CARAYSGSYWAAFDIW	3-30	3	3	3	0
CARGYYDSSGYYNWFDPW	3-13	5	3	3	0

CARGRTVTTLYYYYGMDVW	4-39	6	3	3	0
CARDSVLRYFDWTYYYYGMDVW	3-11	6	3	3	0
CARVGYCSSTSCYSYYYYGMDVW	3-33	6	3	3	0
CARGRPLDAFDIW	4-31	3	3	2	1
CARDSTAYGMDVW	4-34	6	3	2	1
CASVHSSSWFFDYW	3-7	4	3	2	1
CARSGSYYGPFDYW	3-30	4	3	2	1
CAKDSYSSSWYFDYW	3-30	4	3	2	1
CARDSGPYYYGMDVW	3-30-3	6	3	2	1
CARGFNYYDSSGFDYW	3-30	4	3	2	1
CERDRSVCSSTSCYYYYGMDVW	3-30	6	3	2	1
CARGRYYYDSSGYSYYYYGMDVW	1-69	6	3	2	1
CATSGYW	1-24	4	2	2	0
CTTWGGYW	3-15	4	2	2	0
CAKGVDVW	3-23	6	2	2	0
CAQGLDYW	4-59	4	2	2	0
CAMGFDDW	4-59	4	2	2	0
CAKSDGMDVW	3-9	6	2	2	0
CAKDVGGNYGYW	3-23	4	2	2	0
CAREYLVDLDYW	3-33	4	2	2	0
CARTPGPYFDYW	3-30	4	2	2	0
CARVVYDYFDYW	3-53	4	2	2	0
CARGYRDYGDYW	3-33	4	2	2	0
CARVLSYYGMDVW	4-34	6	2	2	0
CARMTTVTTYDYW	2-70	4	2	2	0
CARYSSSSDFDYW	1-69	4	2	2	0
CARAVNFGWFDPW	1-18	5	2	2	0
CVRDWGEYYFDYW	3-53	4	2	2	0
CARGVWDLWYFDLW	4-34	2	2	2	0
CARQQWLRGRFDYW	4-39	4	2	2	0
CARETGSGSYPDYW	3-33	4	2	2	0
CARVLGTYYYMDVW	3-30	6	2	2	0
CARDLSYGDYNDYW	3-33	4	2	2	0
CATLVDYYYYMDVW	3-9	6	2	2	0
CARGGGYGHYFDYW	3-30-3	4	2	2	0
CVGELLPYYGMDVW	3-33	6	2	2	0
CAVQLWLRGGFDYW	4-59	4	2	2	0
CAKVMAVAGTGDYW	3-30	4	2	2	0
CARVLVPVYGMDVW	3-30	6	2	2	0
CARVLSPLYGMDVW	3-33	6	2	2	0
CARDYGDYGGLDYW	3-30	4	2	2	0
CSKDIYGSGSYPDYW	3-9	4	2	2	0
CVTPRGYSYGPFDYW	3-21	4	2	2	0
CATGGRYYYYGMDVW	3-30	6	2	2	0
CARDPVAVAGPFDYW	3-30	4	2	2	0
CAREGVGATYYFDYW	3-30	4	2	2	0
CARVQGGYYYGMDVW	3-30	6	2	2	0
CAKGYSSSWYFFDYW	3-9	4	2	2	0
CATPRVYSYGPFDYW	3-23	4	2	2	0
CARTSGSYYSPFDYW	3-30-3	4	2	2	0
CARDREAVAGPFDYW	3-30	4	2	2	0
CAREGVGATYYFDYW	3-33	4	2	2	0
CTRTDFWSGYYPDDW	3-49	4	2	2	0

CAKDVGYSSGLPDYW	3-9	4	2	2	0
CTRYDFWSGYFSDYW	3-49	4	2	2	0
CARGYSSYYWYFDLW	3-30	2	2	2	0
CAREGIVGATGLDYW	3-30	4	2	2	0
CATLRGGYYYGMDVW	3-9	6	2	2	0
CASPRSGSYYGAFDIW	3-30-3	3	2	2	0
CARTKSGSYWYYFDYW	3-30	4	2	2	0
CARVRSGSYLSHFDYW	3-30	4	2	2	0
CARVSSGSYYGWFDYW	3-30-3	4	2	2	0
CARDRSGSYYHGMDVW	3-30	6	2	2	0
CASSYSGSYLSAFDIW	3-30-3	3	2	2	0
CVRAVAGTYYYGMDVW	3-30	6	2	2	0
CSRSGSGSYYGWFDPW	3-30-3	5	2	2	0
CATSPATVTTGWFDPW	1-24	5	2	2	0
CARGSYGSYYYGMDVW	3-30	6	2	2	0
CARVYSGSYFSPFDYW	3-30-3	4	2	2	0
CARVYGGSYLGAFDIW	3-30	3	2	2	0
CAKTNSGSYYYGMDVW	3-30	6	2	2	0
CAKGPYGSGSYYVDYW	3-9	4	2	2	0
CARGPRGYSYGYVDYW	3-21	4	2	2	0
CAREGDYYYYYGMDVW	3-33	6	2	2	0
CAREGVITGTTGLDYW	3-33	4	2	2	0
CARVSGGSYYGNFDYW	3-30-3	4	2	2	0
CARVRGGSYWGDFDYW	3-30	4	2	2	0
CAREGQTTVTTGIDYW	3-33	4	2	2	0
CATTSIVGATSWFDPW	1-24	5	2	2	0
CARQEDYYDSSGFDYW	3-33	4	2	2	0
CARTRSGSYLYYFDYW	3-30	4	2	2	0
CARAYSGSYFNWFDPW	3-30-3	5	2	2	0
CARDYSGSYLGLFDYW	3-30-3	4	2	2	0
CARPYSGSYYWWFDPW	3-23	5	2	2	0
CARDVAVAGDDAFDIW	3-33	3	2	2	0
CARTRGGGYFDAFDIW	3-30-3	3	2	2	0
CAKGVSGYYLDAFDIW	3-30	3	2	2	0
CARTYSGSYRNWFDPW	3-33	5	2	2	0
CARVPGGSYFGAFDIW	3-30-3	3	2	2	0
CARVYGGSYIGYFDYW	3-30	4	2	2	0
CARETLDSTSSDFDYW	3-30	4	2	2	0
CARGSSGNYCYGMDVW	3-30	6	2	2	0
CARRNSSGWYGDWFDPW	2-5	5	2	2	0
CARATMIVVVVGAFDIW	4-31	3	2	2	0
CSKDRPYDYVWGSLDYW	3-30	4	2	2	0
CAKDWGYDYGDYGPDYW	3-30	4	2	2	0
CATRYCSGGSCSLFDYW	4-4	4	2	2	0
CARYDYYDSSGYYLDYW	1-69	4	2	2	0
CTKADCSSTSCQNWFDPW	3-9	5	2	2	0
CAKVGYSYGYPVYYFDYW	3-30	4	2	2	0
CARVSYDSSGYYYYFDYW	3-13	4	2	2	0
CARGGYSYGYYYYGMDVW	3-53	6	2	2	0
CARSPITMIVVVNAFDIW	4-34	3	2	2	0
CAREGTYCGGDCYSGLDYW	3-33	4	2	2	0
CARTYYDILTGHNYGMDVW	2-70	6	2	2	0
CARDSYSSSSYYYYYGMDVW	3-7	6	2	2	0

CARGRYSSSWYGVRNWFDPW	4-59	5	2	2	0
CAKVSGPYCSGGSCYSFYFDYW	3-30	4	2	2	0
CARGWPSSSWYEYYYYYGMDVW	4-34	6	2	2	0
CAKVVGVYCSGGSCYGGYFDYW	3-30	4	2	2	0
CTRGVPGYW	4-34	4	2	1	1
CARSDGYNFDYW	4-59	4	2	1	1
CARDGGVLFDYW	3-23	4	2	1	1
CARDTSGWYLDYW	3-30-3	4	2	1	1
CARVLSYYGMDVW	3-30-3	6	2	1	1
CAGGSYYYGMDVW	3-33	6	2	1	1
CARDRGYSYGSFDYW	3-33	4	2	1	1
CARVLSGWYVGWFDPW	1-69	5	2	1	1
CARVYSGSYYPAFDIW	3-21	3	2	1	1
CAKGSWYSSSWYYFDYW	3-30	4	2	1	1
CAKDRSGSYGYYGMDVW	3-30	6	2	1	1
CARGGYSSSWYYYYGMDVW	3-13	6	2	1	1
CARGFDYW	5-51	4	1	1	0
CARGFVLW	4-59	4	1	1	0
CAKGGDMDVW	3-30	6	1	1	0
CAKVGGYFDYW	3-9	4	1	1	0
CASWVNWFDPW	4-34	5	1	1	0
CTSLSAPTDYW	3-74	4	1	1	0
CPRGLEWELLNW	3-33	4	1	1	0
CARESGSGLDYW	3-30-3	4	1	1	0
CARWGGSGLDYW	3-30	4	1	1	0
CARSVVSYFDYW	3-53	4	1	1	0
CATSFYYYMDVW	3-21	6	1	1	0
CARGGGDYVDYW	3-30-3	4	1	1	0
CARDVGGYFDLW	3-30	2	1	1	0
CARYHGSALDYW	3-30-3	4	1	1	0
CAKEGIVLLDYW	3-30	4	1	1	0
CARDSGSYLGWW	3-30	4	1	1	0
CASLAGSGFDYW	3-30-3	4	1	1	0
CARYSSGYYFDYW	3-21	4	1	1	0
CATEGLLDAFDIW	3-30	3	1	1	0
CARVLSGYGFDYW	3-30	4	1	1	0
CARDPYGGGFDYW	3-30-3	4	1	1	0
CARDGLSYGLDYW	3-30	4	1	1	0
CARDSYSSGLDYW	3-7	4	1	1	0
CAREGSGWTIDYW	3-30	4	1	1	0
CAKVAAAGTTDYW	3-9	4	1	1	0
CAREHGDYGFDYW	3-7	4	1	1	0
CVGELPYYGMDVW	3-30	6	1	1	0
CARNGGNNWFDPW	3-30-3	5	1	1	0
CARDGTLEPLDYW	1-69	4	1	1	0
CGRGYGDYWFDPW	3-53	5	1	1	0
CARDLYDDAFDIW	3-66	3	1	1	0
CARRYGVRPFDYW	2-70	4	1	1	0
CARGAGPYGMDVW	3-11	6	1	1	0
CVRARDGYNHFDYW	3-30-3	4	1	1	0
CAKVSSYGYYFDYW	3-23	4	1	1	0
CATSLLWFGELLYW	3-30	4	1	1	0
CARGSSGYYYFDYW	3-30-3	4	1	1	0

CAKVYRSGNAFDIW	3-23	3	1	1	0
CTGSTGYYYGMDVW	3-33	6	1	1	0
CARSDGYNSYFDYW	3-30	4	1	1	0
CARWLGGYYGMDVW	3-30-3	6	1	1	0
CSRDYGDYGGMDVW	3-30	6	1	1	0
CVREDYGDFGFDYW	3-30	4	1	1	0
CARDYRFGELGDYW	3-33	4	1	1	0
CASSSSPYYGMDVW	3-33	6	1	1	0
CAVGLGYYYGMDVW	3-23	6	1	1	0
CARDWAVGATTDYW	3-33	4	1	1	0
CARRPVGVTPFDYW	5-51	4	1	1	0
CAKMYGSGSYIDYW	3-9	4	1	1	0
CARGGTLYDAFDIW	3-30-3	3	1	1	0
CARSYSGYVPFDYW	2-70	4	1	1	0
CARGWGGYYYFDYW	3-30	4	1	1	0
CARTKTGYYYFDYW	3-30	4	1	1	0
CARIMATINAFDIW	2-70	3	1	1	0
CASTTYYYYYMDVW	1-18	6	1	1	0
CARDVAVGDAFDSW	3-33	3	1	1	0
CVRVVAATVSFDYW	2-70	4	1	1	0
CAKLTYGDSPFDYW	3-9	4	1	1	0
CASGSGSYYYFDYW	3-30	4	1	1	0
CARYTGDYYGMDVW	5-51	6	1	1	0
CARDGGLAAAFDYW	3-33	4	1	1	0
CATELLWRYGMDVW	3-30	6	1	1	0
CAKDPYGDLAFDYW	3-23	4	1	1	0
CARDGGLVRGVDYW	3-33	4	1	1	0
CTRDDFRSGYTNYW	3-49	4	1	1	0
CARELSGWYGFDYW	3-33	4	1	1	0
CARDRRLAEEFDYW	3-33	4	1	1	0
CARDGTVTRTFDYW	3-33	4	1	1	0
CTQDDFWSGYGHYW	3-49	4	1	1	0
CGRDEYSSGWYFDYW	3-33	4	1	1	0
CAKGRGYSYGYFDYW	3-30	4	1	1	0
CTTGSGSYLGWFDPW	1-24	5	1	1	0
CASGYSGSYWYFDYW	3-30	4	1	1	0
CVLGSGSYYTPFDYW	3-30	4	1	1	0
CARIYSSSWPSFDYW	2-70	4	1	1	0
CARDSRGYSYGFDYW	3-33	4	1	1	0
CARGGIAVADAFDIW	3-30	3	1	1	0
CERAVVAAHNWFDPW	3-21	5	1	1	0
CARGPRSSSDYFDYW	3-23	4	1	1	0
CARDYLGYSYGSDYW	3-7	4	1	1	0
CARVLVVNYYGMDVW	3-30	6	1	1	0
CARDSIVSGWLFDYW	3-33	4	1	1	0
CARQLTYYYYGMDVW	3-30	6	1	1	0
CTRYDFWGGYYVDYW	3-49	4	1	1	0
CARTSSGYYSKFDYW	3-30	4	1	1	0
CARVGGIAVAGLDYW	3-30	4	1	1	0
CARDLSGSYTYFDYW	3-30	4	1	1	0
CATELLYYYYGMDVW	3-33	6	1	1	0
CARDQRSSGWYVDYW	3-33	4	1	1	0
CARTWAAAGLGADYW	2-70	4	1	1	0

CARSRGGYYSPFDYW	3-30-3	4	1	1	0
CARESVAALDAFDIW	3-30	3	1	1	0
CARARGGSYSYFDYW	3-30	4	1	1	0
CARGYGDYVPNFDYW	4-34	4	1	1	0
CAREGVTATVYFDYW	3-74	4	1	1	0
CARESIVVVPAADYW	3-74	4	1	1	0
CSRNYYDSSDAFDIW	3-30	3	1	1	0
CARTLVLSYYGMDVW	3-33	6	1	1	0
CARVLVLYYYGMDVW	3-30-3	6	1	1	0
CATNDYYYYYMDVW	3-33	6	1	1	0
CVRDMSGSYYGPFDYW	3-30	4	1	1	0
CATVHSGSYLGYFDYW	3-30	4	1	1	0
CASAGSGSYRGWFDPW	3-30	5	1	1	0
CPRGYSGSYFSAFDIW	3-30	3	1	1	0
CARVYSGSYYSHFDYW	3-30	4	1	1	0
CARTWSGSYLSWFDPW	3-30-3	5	1	1	0
CVRSYSGSYFSWFDPW	3-30	5	1	1	0
CTRYYSGSYYYGMDVW	3-30-3	6	1	1	0
CATTRGGSYYGAFDIW	3-30	3	1	1	0
CVRGVGGGYYYGMDVW	3-30-3	6	1	1	0
CATVPIFGVVSWFDPW	1-24	5	1	1	0
CERETGDSSSSYFDYW	3-30	4	1	1	0
CARVVGANYYYGMDVW	3-30	6	1	1	0
CASVSSGYYYGAFDYW	3-30	4	1	1	0
CARSVYGDYYYYMDVW	4-59	6	1	1	0
CARTYSGSYYTPFDYW	3-30-3	4	1	1	0
CSRVSVVYYYYGMDVW	3-48	6	1	1	0
CARESIVVVHDAFDIW	3-30	3	1	1	0
CARTYYYDSSGYWDYW	3-30	4	1	1	0
CATTYSGSYKGYFDYW	3-30	4	1	1	0
CATSPAALRSNWFDPW	1-24	5	1	1	0
CAKDPVGATYDALDIW	3-23	3	1	1	0
CARTYSGIYLAPFDYW	3-30	4	1	1	0
CARARGGYYSRPFDYW	3-30	4	1	1	0
CARSGSGSYFAYFDYW	3-30	4	1	1	0
CARGWSGSYRTYFDYW	3-30-3	4	1	1	0
CATGPVVVAATWFDPW	1-24	5	1	1	0
CSRPGSGSYLSWFDPW	3-30	5	1	1	0
CATSAVAGTWGWFDPW	1-24	5	1	1	0
CATSPAIAVAGWFDPW	1-24	5	1	1	0
CARHWDNFWSGYYHYW	5-51	4	1	1	0
CATGPVAGTSNWFDPW	1-24	5	1	1	0
CARVLSGSYWGWFDPW	3-30	5	1	1	0
CPRALWGNYYYGMDVW	3-30-3	6	1	1	0
CARSRGGSYSNAFDIW	3-30	3	1	1	0
CARTSRGSYYDAFDIW	3-30	3	1	1	0
CARGSSGTYYYGMDGW	3-30	6	1	1	0
CARVSYDSLTGYYDYW	3-13	4	1	1	0
CARTNIAAAGTAVDYW	2-70	4	1	1	0
CARTSGGSYRGWFDPW	3-30-3	5	1	1	0
CASSNSGSYWGAFDIW	3-30	3	1	1	0
CARDVGSGWYGYFDYW	3-33	4	1	1	0
CATGPTGSYYDYFDYW	3-30	4	1	1	0

CASPYSGSYYSHFDYW	3-30	4	1	1	0
CARSSRGSYLNWFDPW	3-30	5	1	1	0
CARELIAAAGYYFDYW	3-33	4	1	1	0
CARSRSGSYSSAFDYW	3-30	4	1	1	0
CATSEVAGPLNWFDPW	1-24	5	1	1	0
CPRGYSGSYYEYFQHW	3-30	1	1	1	0
CARVGGGSYFNWFDPW	3-30-3	5	1	1	0
CASPRGGSYYGEFDYW	3-30-3	4	1	1	0
CARDLSGSYYYGLDVW	3-30-3	6	1	1	0
CARDSSGSYYGPNDYW	3-30-3	4	1	1	0
CARVYSGSYRGFFDYW	3-33	4	1	1	0
CARVTYGNYYYGMDVW	3-30	6	1	1	0
CATGPPFGVVSWFDPW	1-24	5	1	1	0
CARVHSGSYYGDFDYW	3-30-3	4	1	1	0
CARPYSGSYWSYVDYW	3-30-3	4	1	1	0
CARSYSGSYYHAFDIW	3-33	3	1	1	0
CAKTLSGSYYSPFYYW	3-30	4	1	1	0
CARPYSGSYFAQFDYW	3-30-3	4	1	1	0
CANPYSGSYRDAFDIW	3-30	3	1	1	0
CARAYSGSYYYGMDVW	3-53	6	1	1	0
CARGRGGGYHDAFDIW	3-30	3	1	1	0
CVTTTIFGVKGWFDPW	1-24	5	1	1	0
CARGTRGSYYYGMDVW	3-30-3	6	1	1	0
CARDLVGAAYYGMDVW	3-33	6	1	1	0
CARVTGANYYYGMDVW	3-30	6	1	1	0
CARSKGGGYYPPFDYW	3-30	4	1	1	0
CARTYSGSYYSYFDDW	3-30-3	4	1	1	0
CARVYSGSYRGHFDYW	3-30	4	1	1	0
CAKGKMGGYYYGMDVW	3-30	6	1	1	0
CARTNGGGYYYGMDVW	3-33	6	1	1	0
CASASGGNYYYGMDVW	3-30-3	6	1	1	0
CARGWSSGWSYYFDYW	3-53	4	1	1	0
CARGLRFLEWYYFDYW	4-34	4	1	1	0
CATASVFGVANWFDPW	1-24	5	1	1	0
CARSRSGSYTSWFDPW	3-30-3	5	1	1	0
CARVSSGSYRSAFDIW	3-30-3	3	1	1	0
CARGFGGSYYYGMDVW	3-53	6	1	1	0
CARSLGGSYYVAFDIW	3-30	3	1	1	0
CARTSGSYYYYFGMDVW	4-59	6	1	1	0
CARDTYYDILTGYYLYW	3-21	4	1	1	0
CARGVDLYYYYYGMDVW	4-34	6	1	1	0
CARSGYYYDSSGYSDYW	3-21	4	1	1	0
CARRYYGYYYYYGMDVW	4-39	6	1	1	0
CATPRYYYDSSGTFDYW	3-23	4	1	1	0
CAKFADYYDSSGYYDYW	3-9	4	1	1	0
CARDTNYDILTGYYSYW	3-21	4	1	1	0
CAREGQIAVAGTGLDYW	3-33	4	1	1	0
CATSPPMAAAGNWFDPW	1-24	5	1	1	0
CARDVDASGYYYGMDVW	3-7	6	1	1	0
CATGGGYYYYYYGMDVW	3-30	6	1	1	0
CARDLAVAGTSEYFQHW	3-33	1	1	1	0
CAREVIAVAGSNWFDPW	3-30	5	1	1	0
CARESLYGDYGGAFDIW	3-33	3	1	1	0

CARAGGSGSYYGWFDPW	3-30-3	5	1	1	0
CARVGRTIFGVVTNFDYW	4-31	4	1	1	0
CARRGYYDSSGYYYFDYW	5-51	4	1	1	0
CAREYYYDSSGYYPRDYW	1-18	4	1	1	0
CATSPSIAAAGNNWFDPW	1-24	5	1	1	0
CSKDYDSSGYYSDAFDIW	3-23	3	1	1	0
CATGPYCGGDCYGAFDIW	1-69	3	1	1	0
CARSNYDFWSGYLPFDYW	3-7	4	1	1	0
CVRNYDILTGYSDAFDIW	3-53	3	1	1	0
CAREGYSSSWSLYYFDYW	3-33	4	1	1	0
CARDVFYDFWSGYYFDYW	1-3	4	1	1	0
CAKNGYSYGYGGYYFDYW	3-30	4	1	1	0
CAKDSNGSGSYHDAFDIW	3-23	3	1	1	0
CARASYDSSGYYAYFDYW	3-13	4	1	1	0
CAREVDIVVVPAAPFDYW	1-46	4	1	1	0
CASGAVAGYYYYYGMDVW	3-21	6	1	1	0
CARDDYDYVWGSYSTDYW	3-30	4	1	1	0
CAKDRYYYDSSGYYYFDYW	3-23	4	1	1	0
CARSYYDILTGYLAAFDIW	2-5	3	1	1	0
CARIPYDILTGSLYGMDVW	2-70	6	1	1	0
CATIAAAGTHYYYYGMDVW	3-48	6	1	1	0
CASDYYDSSGYYNDWFDPW	3-30	5	1	1	0
CTTDRLGATYYYYYGMDVW	3-15	6	1	1	0
CSRDYYDSSGYYNNWFDPC	3-30-3	5	1	1	0
CARTHYGGNYYYYYGMDVW	3-13	6	1	1	0
CARYCSSTSCYTDDAFDIW	4-39	3	1	1	0
CARGGYSYGWSYYYGMDVW	3-53	6	1	1	0
CARVKRITIFGVVTHFDYW	4-59	4	1	1	0
CARGYYDILTGYYREFDYW	2-70	4	1	1	0
CATNFAYCGGDCYSRFDYW	1-24	4	1	1	0
CARGRGIQLWNYYYGMDVW	4-31	6	1	1	0
CATTSPYCSSTSCPRWFDPW	1-24	5	1	1	0
CSRGRYSSSWYGVAEYFQHW	4-34	1	1	1	0
CATDLYCSGGSCYSFGMDVW	3-23	6	1	1	0
CATLAAAGPEWYYYYGMDVW	3-21	6	1	1	0
CVRRRYSSSWPDYYYGMDVW	5-51	6	1	1	0
CARSYCSSTSCYGYYYMDVW	4-59	6	1	1	0
CARGGLAVAGTYYYYGVDVW	3-21	6	1	1	0
CARDPDYYDSSGYYVGFDYW	3-30-3	4	1	1	0
CARLTTVTTNYYYYYGMDVW	1-69	6	1	1	0
CARGRYSSSWYGVRNWFDPW	4-31	5	1	1	0
CARVVGGYCSSTSCYYFDYW	1-18	4	1	1	0
CATVGVYCTNGVCSNWFDPW	1-24	5	1	1	0
CARDLTYYYDSSGWGHFDYW	3-30	4	1	1	0
CAREVYDSSGYYYEDWFDPW	3-74	5	1	1	0
CARGYWNYVRYYYYYGMDVW	1-69	6	1	1	0
CARGTTVTTLFYYYYGMDVW	4-39	6	1	1	0
CVRGIVVVPAAHYYYYGMDVW	1-18	6	1	1	0
CARHPDIAVAGYYYYYGMDVW	4-59	6	1	1	0
CARWGWGSGSPNYYYYYMDVW	1-69	6	1	1	0
CARSGAGYSYGYAYYYYMDVW	1-69	6	1	1	0
CARGRWFGELLSYYYYGMDVW	4-4	6	1	1	0
CARVGLGYCSSTSCYTAFDIW	4-39	3	1	1	0

CARESGGYCSGGSCPNWFDPW	1-46	5	1	1	0
CARGRWFGELLSYYYYGMDVW	4-31	6	1	1	0
CARVGVLRYFDWQAYYYGMDVW	4-39	6	1	1	0
CARGGVYYYDSSGYYLDAFDIW	1-2	3	1	1	0
CARGRIAAAGLCNYYYYGMDVW	4-34	6	1	1	0
CVRGRRITIFGVVIDSFGMDVW	4-34	6	1	1	0
CARVTVLRYFDWSYYYYGMDVW	4-31	6	1	1	0
CARDSRFWEWLLYSYYYYMDVW	3-21	6	1	1	0
CARVTYYYDSSGYPFYWYFDLW	3-13	2	1	1	0
CARNGLYYYDSSGYYLDAFDIW	3-23	3	1	1	0
CARTGVLRYFDWSYYYYGMDVW	4-61	6	1	1	0
CARVPLLRYFDWTYYYYGMDVW	4-59	6	1	1	0
CARVGVLRYFDWLLHYYGMDVW	4-39	6	1	1	0
CAKVVGPYCSGGSCYSGQLDYW	3-30	4	1	1	0
CARGGYGSGSYYNYYYYYMDVW	1-69	6	1	1	0
CARDSVLRYFDWLPYYYGMDVW	4-61	6	1	1	0
CARDSYSSSWLGSYYYYGMDVW	3-7	6	1	1	0
CARDRYCSSTSCYRDYYYGMDVW	1-18	6	1	1	0
CARGWIVVVPAATYYYYYGMDVW	4-34	6	1	1	0
CARDRYCSGGSCYVYYYYGMDVW	1-18	6	1	1	0
CARVSYSSSWYWGDYYYYGMDVW	1-69	6	1	1	0
CARDTYCSGGSCYYYYYYGMDVW	3-7	6	1	1	0
CARVWGAGYSSGWYYYYYYMDVW	4-59	6	1	1	0
CARDVSSSWYSSGWYYYYYMDVW	3-7	6	1	1	0
CAKMGGGPYCSGGSCYSNYFDYW	3-30	4	1	1	0
CARGYTMVRGVIPRYYYYYMDVW	3-13	6	1	1	0
CARVGYCSSTSCYVPYYYYGMDVW	1-2	6	1	1	0
CARDVDIVVVPAATNYYYYGMDVW	3-21	6	1	1	0
CARDVTYYDILTGYYPQYYYYGMDVW	3-33	6	1	1	0
CARHLYYYDSSGYYYPPYYYYGMDVW	3-30	6	1	1	0
CARYQYYYDSSGYYYPTPYYYGMDVW	3-30-3	6	1	1	0
CARVGGGMDVW	1-46	6	1	0	1
CVKERQWLAYFDYW	3-30	4	1	0	1
CARGRYYDSSGLDYW	3-74	4	1	0	1
CARELVAGYYGMDVW	3-30	6	1	0	1
CARDSYSSSWYFDYW	3-30	4	1	0	1
CARGRGSYYGWFDPW	3-30	5	1	0	1
CARGYSSGYYYYFDYW	3-13	4	1	0	1
CARDPSSSWYIYFDYW	3-30	4	1	0	1
CASDPYYYDSSGLLDYW	3-21	4	1	0	1
CARSYDILTGYLYFDYW	3-30	4	1	0	1
CARVRYYDSSGYYSPFDYW	1-69	4	1	0	1
CARDLAVAATYYYYYGMDVW	3-7	6	1	0	1
CARDSGVAAAGNYYYYGMDVW	3-7	6	1	0	1