



Article Preexisting Humoral Immunity Cross-Reacting with SARS-CoV-2 Might Prevent Death Due to COVID-19 in Critical Patients

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Abstract: The preexistence of humoral immunity, which cross-reacts with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) protein due to prior endemic low-pathogenic human coronavirus infection, has been reported, but its role in coronavirus disease 2019 (COVID-19) outcomes remains elusive. We evaluated serum samples obtained from 368 patients before the pandemic and 1423 independent serum samples from patients during the pandemic. We found that approximately 6~13% and 1.5% of patients had IgG cross-reactivity to the SARS-CoV-2 spike and nucleocapsid proteins in both cohorts. We evaluated the IgG cross-reactivity to the SARS-CoV-2 spike and nucleocapsid proteins in 48 severe or critical COVID-19 patients to evaluate if the elevation of IgG was evoked as a primary response (IgG elevation from 10 days after antigen exposure) or boosted as a secondary response (IgG elevation immediately after antigen exposure). Approximately 50% of patients showed humoral immune responses to the nucleocapsid protein of SARS-CoV-2. Importantly, none of the critically ill patients with this humoral immunity died, whereas 40% of patients without this immunity did. Taken together, subjects had humoral immunity to SARS-CoV-2 nucleocapsid but not spike before the pandemic, which might prevent critically ill COVID-19 patients from dying.

Keywords: SARS-CoV-2; COVID-19; humoral immune memory; mortality

1. Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, is a global pandemic, and it has reached almost every country worldwide [1]. Since it was first reported in late 2019 in China, about 525 million people have been infected with SARS-CoV-2 and 6.3 million people have died across world (as of 18 May 2022, according to the database provided by https://coronavirus.jhu.edu/map.html). This disease is characterized by a wide range of severe symptoms, and approximately 14 and 5 percent of patients



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Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). developed severe and critical diseases, respectively [1], especially during the pandemic period driven by virulent SARS-CoV-2 alpha and Delta variants. Patients with COVID-19 exhibit various disease severity which most strongly correlates with survival, and older patients generally show more severe disease and worse clinical outcomes compared with younger patients [2]. Although severe disease rates of COVID-19 declined after the emergence of the SARS-CoV-2 Omicron variant, several risk factors remained for severe illness, including older age, male, diabetes mellitus, hypertension, and obesity. The mortality rate of COVID-19 in East Asia is relatively low compared with other demographic areas. For example, the number of deaths due to COVID-19 in USA and Japan were 1 million and 30 thousand, respectively (as of 18 May 2022, according to the database provided by https://coronavirus.jhu.edu/map.html). One hypothesis to explain this regional difference is the preexistence of humoral immunity cross-reacting with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) protein due to prior endemic low-pathogenic human coronavirus infection (hCoVs) in East Asia. Consistent with this, recent evidence suggests the preexistence of humoral immunity cross-reacting with SARS-CoV-2 protein, potentially due to prior infection with endemic low-pathogenic hCoVs [3-6]. However, its role in COVID-19 outcomes remains elusive. In this study, we evaluated IgG responses to SARS-CoV-2 proteins using serum samples obtained from 368 patients before the pandemic and 1423 independent serum samples from patients during the pandemic. We further evaluated the clinical outcome of 48 COVID-19 patients with severe or critical disease in relation to IgG responses to SARS-CoV-2 proteins.

2. Materials and Methods

2.1. Patients and Samples

We utilized 368 (from 2004 to 2019) and 1423 (in 2020) serum samples obtained from patients who visited Kanazawa University Hospital without medical history of COVID-19. We further used 219 serum samples from 368 patients obtained as matched samples in 2020. In these patients, informed consent was obtained by an opt-out method. We enrolled 48 patients who were admitted to Kanazawa University Hospital or Nagasaki University Hospital with a diagnosis of COVID-19. A total of 27 and 21 patients were diagnosed with severe or critical disease on admission, respectively. Since these patients were admitted to the hospital from December 2020 to March 2021, all these patients were considered as infected with the SARS-CoV-2 alpha variant prevalent in that time in Japan. All serum samples were obtained on the day of hospitalization. The average time from symptom onset to hospitalization in this cohort was about 7 days. All COVID-19 patients provided written informed consent before enrollment. The study protocol was approved by the ethics committee of each hospital. The serum samples were stored in a -20 °C freezer and used for the quantification of IgG titers by enzyme-linked immunosorbent assay (ELISA).

2.2. SARS-CoV-2 IgG Antibody Quantification

We used the Quo Research ELISA system to evaluate the IgG titer against recombinant severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) nucleocapsid protein (amino acids 1–419) (IgG N) and spike protein (amino acids 16–1213) (IgG S) (Cellspect Co., Ltd., Morioka, Japan). Cutoff values of IgG N (0.5) and IgG S (0.2) at an optical density of 450 nm absorbance were determined according to the manufacturer's recommendations.

2.3. SARS-CoV-2 S1 and ACE2 Binding Neutralization Assay

The neutralizing activity of serum samples on the spike receptor-binding domain (S1 RBD) and angiotensin-converting enzyme 2 (ACE2) binding was measured using the SARS-CoV-2 Neutralizing Antibodies Detection kit (Adipogen AG, Liestal, Switzerland) according to the manufacturer's instructions. Percentage of inhibition was calculated according to the manufacturer's instructions. The positive control serum sample from a COVID-19 patient with neutralizing activity to S1 RBD and ACE2 binding was purchased from RayBiotech Life, Inc. (Peachtree Corners, GA, USA). The negative control serum sample was obtained from a physician without a history of COVID-19. Six serum samples were obtained at 7 days after the second vaccination shot from physicians who received the BNT162b2 vaccine.

2.4. Multi-Alignment Analysis

The amino acid alignment of the nucleocapsid antigen (N), spike S1 domain, and spike S2 domain of SARS-CoV-2 used for ELISA was compared with the SARS-CoV-2, SARS-CoV, and alpha (229E and NL63) and beta (OC43 and HKU1) human coronaviruses. An analysis was performed using GENETYX software ver. 13.1.1 (Genetyx, Tokyo, Japan), and similarity (gray boxes) and identity (black boxes) corresponding to the N RNA-binding domain (amino acids 50–173 of SARS-CoV-2), the S1 receptor-binding domain (amino acids 319–541 of SARS-CoV-2), and the S2 domain (amino acids 707–1213 of SARS-CoV-2) were analyzed. GenBank protein accession numbers for nucleocapsid RNA-binding domain were YP_009724397 (SARS-CoV-2), AAZ67043 (SARS-CoV), P33469 (OC-43), ABD96199 (HKU1), AIW52699.1 (229E), and YP_003771 (NL63). GenBank protein accession numbers for the S1 receptor-binding domain were QIH45093 (SARS-CoV-2), ACU31032 (SARS-CoV), ARE30017 (OC-43), BBA20986 (HKU1), AWH62679 (229E), and AKT07952 (NL63). GenBank protein accession numbers for the S2 domain were QIH45093 (SARS-CoV-2), ACU31032 (SARS-CoV), ARE30017 (OC-43), BBA20986 (HKU1), AWH62679 (229E), and AKT07952 (NL63).

2.5. Statistical Analysis

Kaplan–Meier curves of cumulative deaths in patients diagnosed with critical COVID-19 on admission were compared using log-rank tests with GraphPad Prism software ver. 9.2.0 (GraphPad Software, San Diego, CA, USA). Two-sided *p*-values of 0.05 or less were considered statistically significant.

3. Results

3.1. Homology of Amino Acid Sequences among SARS-CoV-2, SARS-CoV, and Alpha and Beta hCoVs

We performed a multi-alignment analysis of the nucleocapsid RNA-binding domain of SARS-CoV-2, SARS-CoV, and alpha (229E and NL63) and beta (OC43 and HKU1) human coronaviruses. Multi-alignment analysis revealed relatively conserved amino acid sequences among SARS-CoV-2, SARS-CoV, and alpha and beta hCoVs in the N RNA-binding domain and part of the S2 domain (Figures 1 and 2). In contrast, no homology was detected in the S1 receptor-binding domain (RBD) (Figure 3).

Nucleocapsid Antigen	1	MSD	NGPO-NORNAPRITEGGPSDSTGSNONGERSGARSKORRPOGLP	46
SARS CoV2 nucleocapsid	1	MSD	NGPO-NORNAPRITEGGPSDSTGSNONGERSGARSKORRPOGLP	46
SARS CoV nucleocapsid	1	MSD	NGPOSNORSAPRITEGGPTDSTDNNONGGRNGARPKORRPOGLP	47
OC43 nucleocapsid	1	MSETPGKOSSSRAS	NRSGN-GILKWADOSDOVRNVOTRGRRAOPKOTATSOOPSGGNV 5	59
HKU1 nucleocapsid	1	MSYTPGHYAGSRSS	NRSGILKKTSWADQSERNYQTFNRGRKTQPKFTVSTQPQGNT 5	58
229E nucleocapsid	1		MATVKWADASEPORG	15
NL63 nucleocapsid	1		MASVNWADDRAA 1	12
-				
Nucleocapsid Antigen	47	NNTASWFTALTQHGKE	-DLKFPRGQGVPINTNSSPDDQIGY-YRRATRRIRGGDGKMKDL	104
SARS CoV2 nucleocapsid	47	NNTASWFTALTQHGKE.	- <mark>DLKF</mark> PRGQGVPINTNSSPDDQI <mark>GY-YR</mark> RAT <mark>RRIR</mark> GG <mark>DG</mark> KMKDL1	104
SARS CoV nucleocapsid	48	NNTASWFTALTOHGKE	- <mark>E</mark> LR <mark>F</mark> P <mark>RGQGVPI</mark> NTNSG <mark>PD</mark> DQI <mark>GY-YR</mark> RAT <mark>RRVR</mark> GG <mark>DGKMKEL</mark> 1	105
OC43 nucleocapsid	60	VPYY <mark>SWFS</mark> GI <mark>TQ</mark> FQ <mark>K</mark> GI	K <mark>E</mark> FE <mark>FVEGQGPPI</mark> APGVP <mark>AT</mark> EAK <mark>GYW<mark>YR</mark>HNR<mark>GSFK</mark>TA<mark>DG</mark>NQRQL</mark> 1	119
HKU1 nucleocapsid	59	IPHY <mark>SWFS</mark> GI <mark>TQ</mark> FQ <mark>K</mark> GI	R <mark>D</mark> FK <mark>F</mark> SDGQGVPIAFGVP <mark>PS</mark> EAK <mark>GYW</mark> YRHSR <mark>RSFK</mark> TA <mark>DGQQKHL</mark> 1	118
229E nucleocapsid	16	RQGR <mark>IPYS</mark> LY <mark>SP</mark> LLVD:	S <mark>EQ-PWKVIPRNL</mark> VPINK <mark>KD</mark> KNK <mark>LIG</mark> YWNVQKRFRTR <mark>KG</mark> KRVDL 7	74
NL63 nucleocapsid	13	RKKF <mark>PPPS</mark> FY <mark>MP</mark> LLVS:	S <mark>DKAPYRVIPRNL</mark> VPIGK <mark>GN</mark> KDEQIG <mark>YW</mark> NVQ <mark>ERWR</mark> MR <mark>RGQRVDL</mark> 7	72
Nucleocapsid Antigen	105	SP <mark>RWY</mark> FYYLGTGP <mark>E</mark> AG	LPYGANK <mark>DGII</mark> WVATEGALNTPKDHIGTRNPANNAAIVLQLPQG 1	164
SARS CoV2 nucleocapsid	105	SPRWYFYYLGTGP <mark>EAG</mark>	LPYGANK <mark>DGIIWVA</mark> TEGALNTPKDH <mark>I</mark> GT <mark>RNP</mark> ANNAAIVLQLPQG 1	164
SARS CoV nucleocapsid	106	SPRWYFYYLGTGPEAS:	LPYGANKEGIVWVATEGALNTPKDHIGTRNPNNNAATVLQLPQG 1	165
OC43 nucleocapsid	120	LP <mark>RWY</mark> FYYLGTGP <mark>HA</mark> K	DQYGTDIDGVY <mark>WVA</mark> SNQADVNTPADIVDRDPSSDEAIPTRFPPG 1	179
HKU1 nucleocapsid	119	LP <mark>RWY</mark> FYYLGTGP <mark>YAN</mark>	ASYGESLEGVFWVANHQADTSTPSDVSSRDPTTQEAIPTRFPPG 1	178
229E nucleocapsid	75	SPKLHFYYLGTGPHKD	AKFRERVEGVVWVAVDGAKTEPTGYGVRRKNSEPEIPHFNQKLP 1	134
NL63 nucleocapsid	73	PP <mark>KVH</mark> FYYLGTGP <mark>HK</mark> D	LKFRORSDGVVWVAKEGAKTVNTSLGNRKRNOKPLEPKFSIALP	132
Nucleocapsid Antigen	165	TTLPKGFYAEGSRGGS	OASSRSSSRSRNSSRNSSRPGSSRGTSPARMAGNGGDAALALLLL 2	224
SARS CoV2 nucleocapsid	165	TTLPKGFYAEGSRGGS	QASSRSSSRSRNSSRNSTPGSSRGTSPARMAGNGGDAALALLLL 2	224
SARS CoV nucleocapsid	166	TTLPKGFYAEGSRGGS	OASSRSSSRSRGNSRNSTPGSSRGNSPARMASGGGETALALLLL 2	225
OC43 nucleocapsid	180	TVLPQGYYIEGS-GRS	APNSRSTSRTSSRASSAGS-RSRANSGNRTPTSGVTPDMADQIA 2	237
HKU1 nucleocapsid	179	TILPQGYYVEGS-GRS	ASNSRPGSRSQSRGPNNRS-LSRSNSNFRHSDSIVKPDMADEIA 2	236
229E nucleocapsid	135	NGVTVVE-EPDSRAPS	RSQSRSQSRSRGESKSQSRNPSSDRNHNSQDDIMKAVAAA 1	189
NL63 nucleocapsid	133	PELSVVEFEDRSNNSS	RASSRSSTRNNSRDSSRSTSRQQSRTRSDSNQSSSDLVAAVTLA	192
Sim	ilarlity	/ Identity		
SARS CoV-2	100%	100%		
SARS CoV	100%	01.8%		
SARS COV	100%	91.0%		
0043 8	51.3%	42.2%		
HKU1 8	86.1%	45.5%		
229E 7	74.1%	30%		
NI 63	70%	30%		

N RBD (RNA binding domain)

Figure 1. Multi-alignment analysis of the nucleocapsid RNA-binding domain of SARS-CoV-2, SARS-CoV,

and alpha (229E and NL63) and beta (OC43 and HKU1) human coronaviruses. Similarity and identity are indicated as orange boxes and red boxes, respectively.

S2 domain

Snike Antigen	657	ASYO-TOTNSPREARSVASOSTLAYTMSLGAFNSVAYSNN-STATPTNETTSVTTETL	712
CADC Callo and he	67.0	ACTO TOTAL DEPENDENCE OF THE WAY OF THE VENUE OF THE TOTAL OF TO	
SARS COV2 Spike	672	ASIQ-IQINSPREAKSVASQ-SIIAIIMSLGAENSVAISNN-SIAIPINFIISVIIPIL	121
SARS CoV spike	644	ASYH-TASTLRSVGQKSIVAYTMSLGAENSIAYANN-SIATETNFSISVTTEVM	695
OC43 spike	753	VDYSKNRRSRRAITTGYRFTNFEPFTVNSVNDSLEPVGGLYEIOTESEFTIGNMEFTI	810
HKII1 spike	745	TOYAL PSSRRRRGTSSPYRFYTFFFFFNVSFVNDSVFTVGGLEFTOTPTNFTLAGHEFFT	804
acce opine			
229E spike	536	NGTYNCTDAVLTYSSFGVCADGSIIAVOPRNVSYDSVSAIVTANLSIPSNWITSVOVEYL	595
NL63 spike	719	NGGNNCTTAVMTYSNFGICADGSLIPVRPRNSSDNGISAIITANLSIPSNWTTSVQVEYL	778
Snike Antigen	713	PVSMTKTSVDCTMYTCCDSTFCSNLTLOVCSFCTOLNRALTCIAVFODKNTOFVFA	768
Spike Antigen	715		700
SARS COV2 spike	728	PVSMTRTSVDCTMYICGDSTECSNLLLQYGSFCTQLNRAFTGIAVEQDKNTQEVFA	783
SARS CoV spike	696	PVSMAKTSVDCTMYICGDSQECSNLLLQYGSFCTQLNRALTGVALEQDKNTQEVFA	751
OC43 spike	811	QTSSPKVTIDCAAFVCGDYAACKLOLVEYGSFCDNINAILTEVNELLDTTQLQVANSLMN	870
HKII1 snike	805	OT SSPRUTTOCSA FUCSNYAACHDLL SFYGTECONTNSTENEVNDLLDTTOLOVANALMO	864
220F spike	505	TETTTUDOSTUDOSTUDOUDOUDOUTOSCHTEDIDIOS	652
229E Spike	290	QTISTETVVDCSTTVCNGNVRCVELDKQTISACKITEDARKNSAHLESADVSEHLTF	052
NL63 spike	779	QITSTPIVVDCATYVCNGNPRCKNLLKQYTSACKTIEDAURLSAHLETNDVSSMLTF	835
Spike Antigen	769	OVKOIYKTPPIKDEGGENESOILPDPSKPSKRSFTPDLLENKVTLADAGETK-O	821
SARS Cov2 aniko	704	OVE OTVETRETERCONFORM DEPRESENTED FUNCTION OF THE O	026
SARS COV2 Spike	701	WA-WIRTFIRDIGINISUBPERSAFSARSETEDEENAVILABAGETA-V	030
SARS CoV spike	752	OVKOMYKTPAIKDFGGFNFSQILPDPSKPTKRSFIEDLLENKVTLADAGFMK-O	804
OC43 spike	871	GVTLSTKLKDGVNFNVDDINFSPVLGCLGSECSKASSRSAIEDLLEDKVKLSDVGFVE-A	929
HKU1 spike	865	GVTLSSNLNTNLHSDVDNIDFKSLLGCLGSOCG-SSSRSLLFDLLFNKVKLSDVGFVE-A	922
220F spike	653	DEEL AFTI ANUSSECOVIL SSUT DELESS SOURCESATEDITES VI VISCI CIUDAD	709
ZZSE Spike	000		
NL03 Spike	836	DSNAFSLANVISEGDINLSSVLPORNIRSSKIAGRSALDDLLDSKVVISGLGIVDVD	892
Spike Antigen	822	YGDCLGDIAARDLICAQKFNGLTVLPPLLTDEMIAQYTSALLAGTITSGWTFGAGAALOI	881
SARS CoV2 snike	837	YGDOLGD LAARDI I CAOKENGLTVI, PPL LTDEMI AOVTSALLAGTIT SCHTEGAGAAL OT	896
expe car	0.07	VCPOLODIANDI LCAOVENCI TVI DDI I TDEVIANUTANI VCCDA TA CONTRACTANI	0.64
SAKS COV Spike	805	ISECTODI SAKULICAUKENGLIV LEPLLI DEMIAAY TAALVSGTATAGWIFGAGAALQI	004
OC43 spike	930	YNNCTGGAEIRDLICVQSYKGIKVLPPLLSENQISGYTLAATSASLFPPWTAAAGV	985
HKU1 spike	923	YNNCTGGSEIRDLLCVOSFNGIKVLEPILSETQISGYTTAATVAAMFPPWSAAAGV	978
220F enika	710	YEVETREISTADIACAOYVNETWUIDEVADAFPMAMYTESITECTALECIT	765
NICO and he			0.40
NL63 spike	893	MKSCIKGLSIADLACAQIINGIMVLEGVADAERMAMIIGSLIGGMVLGGLISAAAI	948
Spike Antigen	882	PFAMQMAYRFNGIGVTQNVLYENQKLIANQFNSAIGKIQDSLSSTA	927
SARS CoV2 spike	897	PEAMOMAYRENGIGVTONVLYENOKLIANOFNSAIGKTODSLSSTA	942
SARS Cov anike	0 4 5	DEAMONA VERNATOVI VENOVOTANOVAVIATO	610
SARS COV Spike	005	PTANOMATRENGISVIONVLIENGKOTANOSTRAISCI	910
OC43 spike	986	PPYLNVQYRINGLGVTMDVLSONOKLIANAPNNALHAIQQGPDATN	1031
HKU1 spike	979	PESLNVQYRINGLGVTMDVLNKNQKLIANAFNKALLSIQNGFTATN	1024
229E spike	766	PESLAIOSRUNYVALOTDVI OENOKILAASENKAMTNIVDAFTGVNDAITOTSOALOTVA	825
NI63 enike	949	RESTATOART NYVALOT DVLOFNOKTLAASEN KATNNTVASESSVNDATTOTAFATHTYT	1008
MT02 SDIVE	777		
-			1000
-			1000
Spike Antigen	928	SALGELODVVNONAQALNTEVKOLSSNEGATSSVLNDELSRLDKVEAEVOIDREITGREO	987
Spike Antigen SARS CoV2 spike	928 943	SALGKUODVINONAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRLITERUO SALGKUODVINONAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRLITERUO	987 1002
Spike Antigen SARS CoV2 spike	928 943	SALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDILSRLDKVBAEVOIDRLIIGRLO SALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDILSRLDKVBAEVOIDRLIIGRLO TALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDILSRLDKVBAEVOIDRLIIGRLO	987 1002 970
Spike Antigen SARS CoV2 spike SARS CoV spike	928 943 911	SALGKI ODVVN ONA QALNTLVKOLS SNFGALS SVLNDFL SRLDKV DÅEV OLDRLI TGRLO SALGKI ODVVN ONA QALNTLVKOLS SNFGALS SVLNDFL SRLDKV DÆV OLDRLI TGRLO TANGKI ODVVN ONA QALNTLVKOLS SNFGALS SVLNDFL SRLDKV DÆV OLDRLI TGRLO DALDKV OLVVN UNA QALNTLVKOLS SNFGALS SVLNDFL SRLDKV DÆV OLDRLI TGRLO	987 1002 970
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike	928 943 911 1032	SALCKIODVVNONAQALNTLVKQISSNFCAISSVLNDHISRIDKVEAEVOIDRLITGRIO SALCKIODVVNONAQALNTLVKQISSNFCAISSVLNDHISRIDKVEAEVOIDRLITGRIO TALCKIODVVNONAQALNTLVKQISSNFCAISSVLNDHISRIDKVEAEVOIDRLITGRIO SALVKIOAVVNANAEALNNLLQUSNFFCAISASLOEILSRIDALEAEAOIDRLINGRIT	987 1002 970 1091
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike	928 943 911 1032 1025	SALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDHLSRLDKVBAEVOIDRLIIGRLO SALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDHLSRLDKVBAEVOIDRLIIGRLO TALGKIODVVNONAQALNTLVKQLSSNFGAISSVINDHLSRLDKVBAEVOIDRLIIGRLO SALVKIOZVVNANAEALNNLQQISNFFGAISSSLOEHLSRLDKLBE20IDRLINGRLT SALVAKIOSVVNANAQALNSLLQQIFNKFGAISSSLOEHLSRLDNLBAQVOHDRLINGRLT	987 1002 970 1091 1084
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike	928 943 911 1032 1025 826	SALGKIQDVVNONAQALNTLVKQLSSNFGAISSVLNDHLSRLDKVEAEVOIDRLITGRLQ SALGKIQDVVNONAQALNTLVKQLSSNFGAISSVLNDHLSRLDKVEAEVOIDRLITGRLQ TALGKIQDVVNONAQALNTLVKQLSSNFGAISSVLNDHLSRLDKVEAEVOIDRLITGRLQ SALVKIQAVVNONAQALNTLVKQLSSNFGAISSSLQEIUSRLDALEAEVOIDRLINGRLT SALAKIQSVVNANAQALNSLLQQLFNNFGAISSSLQEIUSRLDALEAEVOIDRLINGRLT TALNKIQDVVNQGNSLHHTSQLRQNFGAISSIQEIUSRLDALEAEVOIDRLINGRLT	987 1002 970 1091 1084 885
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 1025 826 1009	SALEKIODVVNONAQALMILVKQLSSNFGAISSVLNDHLSRLDKVEAEVOIDRLIIGRLO SALEKIODVVNONAQALMILVKQLSSNFGAISSVLNDHLSRLDKVEAEVOIDRLIIGRLO TALEKIODVVNONAQALMILVKQLSSNFGAISSVLNDHISRLDKVEAEVOIDRLIIGRLO SALVKIOAVVNANAEALNNHLQQLSNFFGAISASLQEILSRLDALDAEAOIDRLIIGRLO SALVKIOAVVNANAEALNNHLQQLSNFFGAISASLQEILSRLDALDAEAOIDRLIIGRLT TALNKIODVVNOGSLNHHISSLEONFGAISSSIQAIYBRLDDIIOADOVDRLIIGRLT TALNKIODVVNOGSSLNHHISSULRONFGAISSSIQAIYBRLDJIOADOVDRLIIGRLT	987 1002 970 1091 1084 885 1068
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 1025 826 1009	SALGKIODVYNONAOALNTLVKOLSSNFGAISSVINDULSRLDKVSAEVOIDRIITGRLO SALGKIODVYNONAOALNTLVKOLSSNFGAISSVINDULSRLDKVSAEVOIDRIITGRLO TALGKIODVYNONAOALNTLVKOLSSNFGAISSVINDULSRLDKVSAEVOIDRIITGRLO SALVKIOAVVNANAEALNNLGOLSNFGAISSSLOEILSRLDALSAEXOIDRIITGRLO SALVKIOAVVNANAEALNNLGOLSNFGAISSSLOEILSRLDALSAEXOIDRIITGRLO TALKKIODVYNOGGSLNHUTSOLGNFGAISSSLOEILSRLDNLSAOVOIDRIITGRLO TANKKIODVYNOGGSLNHUTSOLGNFGAISSSLOEILSRLDNLSAOVONDRLITGRLA TANKKIODVYNOGGSLNHUTSOLGNFGAISSIOAIYDRLDIIOADOOVDRLITGRLA	987 1002 970 1091 1084 885 1068
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 1025 826 1009	SALEKIODVWNONAQALNTLVKQLSSNFEAISSVLNDHLSRLDKVEAEVOIDRLITGRLO SALEKIODVWNONAQALNTLVKQLSSNFEAISSVLNDHLSRLDKVEAEVOIDRLITGRLO TALEKIODVWNONAQALNTLVKQLSSNFEAISSVLNDHLSRLDKVEAEVOIDRLITGRLO SALVKTQAVVNANAEALNNLLQLSNFEAISASLOEHSRLDALEAQUOIDRLINGRLT SALVKTQAVVNANAEALNNLLQUFNFEAISSSLOEHSRLDNLEAQUOIDRLINGRLT TALNKTQDVVNOQOSSLNHLTSQLRONFOAISSSIQAIVERLDILEAQUOIDRLINGRLT TALNKTQDVVNOQOSSLNHLTSQLRONFOAISSSIQAIVERLDILEAQUOVRLITGRLA LALNKIODVVNOQOSSLNHLTSQLRONFOAISSIQAIVERLDISLAQUOVRLITGRLA	987 1002 970 1091 1084 885 1068
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen	928 943 911 1032 1025 826 1009 988	SALGKUODVINONAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRIITGRUO SALGKUODVINONAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRIITGRUO TALGKUODVINONAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRIITGRUO SALVKUOAVVINANAOALNTUVKOUSSNEGAISSVINDULSRUDKVEAEVOIDRIITGRUO SALVKUOSVVINANAOALNTUVKOUSSNEGAISSIVAUDULSRUDALEAEVOIDRIITGRUO SALVKUOSVVINANAOALNSULOOUENSEGAISSIVOEUSRUDALEAEVOIDRIITGRUT TALNKIODVVINOGOSINHUTSOURONEGAISSIVAIYDRUDIIOADOOVDRUITGRUA IALNKUODVVINOGOSINHUTSOURONEGAISSIVAIYDRUDIIOADOOVDRUITGRUA IALNKUODVVINOGOSINHUTSOURONEGAISSIVAIYDRUDIIOADOOVDRUITGRUA IALNKUODVVINOGOSINHUTSOURONEGAISSIVAIYDRUDIIOADOOVDRUITGRUA	987 1002 970 1091 1084 885 1068
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike	928 943 911 1032 1025 826 1009 988 1003	SALGKI ODVVNONAQALNTLVKQI SSNFGAISSVINDH LSRIDKVEAEVOIDRIITGRIO SALGKI ODVVNONAQALNTLVKQI SSNFGAISSVINDH LSRIDKVEAEVOIDRIITGRIO TALGKI ODVVNONAQALNTLVKQI SSNFGAISSVINDH LSRIDKVEAEVOIDRIITGRIO SALUKI OAVVNANAQALNTLVKQI SSNFGAISSILDH LSRIDALFAEAOIDRIITGRIO SALUKI OAVVNANAQALNSLUQUINNEFGAISSILDEIUSRIDNIDAOVOIDRIITGRIO TALVKI ODVVNAQGSLINHLISOIQUIFNEFGAISSILDEIUSRIDNIDAOVOIDRIITGRIO IALVKI ODVVNQOGSLINHLISOIQUIFNEFGAISSILDEIUSRIDNIDAOVOIDRIITGRIO IALVKI ODVVNQOGSAINHLISOIQUIFNEFGAISSILDEIUSRIDNIDAOVOIDRIITGRIA IALVKI ODVVNQOGSAINHLISOILVAINEFGAISSILDEIUSRIDSI OADOOVDRIITGRIA SLOTVVTOOLIRAAEIRASANLAATKMSECVLGOSKRVDEGGKGVHLMSEPOSAEHGVVF	987 1002 970 1091 1084 885 1068 1047 1062
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike	928 943 911 1032 1025 826 1009 988 1003 971	SALGKIODVVNONAOALNTLVKOLSSNFGAISSVINDULSRIDKVEAEVOIDRLITGRIO SALGKIODVVNONAOALNTLVKOLSSNFGAISSVINDULSRIDKVEAEVOIDRLITGRIO TALGKIODVVNONAQALNTLVKOLSSNFGAISSVINDULSRIDKVEAEVOIDRLITGRIO SALWKIOAVVNANACALNNLVGOLSNFGAISSSVINDULSRIDALEAEAOIDRLITGRIO SALWKIOAVVNANACALNNLVGOLSNFGAISSSVINDULSRIDALEAEAOIDRLITGRIO TALSKIODVVNOGSSINHLISUCOFFAISSSIOALVERLSRIDALEAEAOIDRLITGRIA LANKIODVVNOGSSINHLISULROFFAISSSIOALVERLSSIOADVORUTIGRIA LANKIODVVNOGSSINHLISULRIFGAISSSIOALVERLSSIOADVORUTIGRIA LANKIODVVNOGSSINHLISULRIFGAISSSIOALVERLSSIOADVORUTIGRIA SLOTVVTOGLIRABEIRASANLAATKMSECVLGOSKRVDEGGGKYHLMSFPOSAEHGVVE SLOTVVTOGLIRABEIRASANLAATKMSECVLGOSKRVDEGGGKGYHLMSFPOSAEHGVVE	987 1002 970 1091 1084 885 1068 1047 1062 1030
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike OC43 spike	928 943 911 1032 1025 826 1009 988 1003 971	SALGKI ODVINONAQALNTLVKQLSSNFGAISSVINDILSRIDKVEAEVOIDRLITGRID SALGKI ODVINONAQALNTLVKQLSSNFGAISSVINDILSRIDKVEAEVOIDRLITGRID TAGGKI ODVINONAQALNTLVKQLSSNFGAISSVINDILSRIDKVEAEVOIDRLITGRID SALGKI ODVINONAQALNTLVKQLSSNFGAISSVINDILSRIDKVEAEVOIDRLITGRID SALGKI ODVINONAQALNTLVKQLSSNFGAISSIDE ILSRIDNLEAEVOIDRLINGRIT TALNKI ODVINOQGNSLHHITSOURONFGAISSIDE ILSRIDNLEAOVOIDRLINGRIT TALNKI ODVINOQGNSLHHITSOURONFGAISSIDAIVELDI I ODOVORLITGRIA IALNKI ODVINOQGSALNHITSOURONFGAISSIDAIVELDI I ODOVORLITGRIA IALNKI ODVINOQGSALNHITSOURONFGAISSIDAIVELDI I ODOVORLITGRIA SLOTYVTOQLIRAAEIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOSAEHGVVF SLOTYVTOQLIRAAEIRASANLAATKNSECVLGOSKRVDECGGGYHLMSFPOSAEHGVVF SLOTYVTOQLIRAAEIRASANLAATKNSECVLGOSKRVDECGGGYHLMSFPOSAEHGVVF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092	SALGKIODVINONAOALNTLVKOLSSNFGAISSVIND LISRLDKVEAEVOIDRLITGRLO SALGKIODVINONAOALNTLVKOLSSNFGAISSVIND HISRLDKVEAEVOIDRLITGRLO TALGKIODVINONAOALNTLVKOLSSNFGAISSVIND HISRLDKVEAEVOIDRLITGRLO SALGKIOAVVNANAGALNTLVKOLSSNFGAISSVIND HISRLDKVEAEVOIDRLITGRLO SALGKIOAVVNANAGALNTLVKOLSSNFGAISSSVIND HISRLDALEAEAOIDRLITGRLO TALGKIOAVVNANAGALNTLVKOLSSNFGAISSSVIND HISRLDALEAEAOIDRLITGRLO ALGKIOAVVNANGGSINHLISUODFINFGAISSIOALVERLDALEAOOIDRLITGRLA LANKIODVVNOOGSINHLISULKOFFAISSIOALVERLUSIGADOVDRLITGRLA LANKIODVVNOOGSINHHISSULKINFGAISSIOALVERLUSIGADOVDRLITGRLA SLOTVVTOOLIRAAEIRASANLAATKWSECVLGOSKRVDEGGGYHLMSFPOSAEHGVVF SLOTVVTOOLIRAAEIRASANLAATKWSECVLGOSKRVDEGGGYHLMSFPOSAEHGVVF SLOTVVTOOLIRAAEIRASANLAATKWSECVLGOSKRVDEGGGYHLMSFPOSAEHGVVF ALNAVGOOLSDSILVKFSAROAMEKVNECVKSOSSRNDGGOGNHISSVONAGUSDSILVKFSAROAMEKVNECVLGOSKRVDEGGGYHLMSFPOSAEHGVVF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085	SALGKIODVINONAOALNTI VKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRIITGRLO SALGKIODVINONAOALNTI VKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRIITGRLO TALGKIODVINONAOALNTI VKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRIITGRLO SALGKIODVINONAOALNTI VKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRIITGRLO SALGKIODVINONAOALNTI VKOLSSNFGAISSVIND ILSRLDNI SALOVOIDRIITGRLO TALGKIODVINONANALAINNI LOOLSNFGAISSIDE ILSRLDNI SALOVOIDRIITGRLO TALMKIODVINOOGSLINHITSOIRONFGAISSIDE ILSRLDNI SALOVOIDRIITGRLO TALMKIODVINOOGSLINHITSOIRONFGAISSIDAIYD RLDI ICADOOVDRIITGRLO TALMKIODVINOOGSALNHITSOIRONFGAISSIDAIYD RLDI ICADOOVDRIITGRLO TALMKIODVINOOGSALNHITSOIRONFGAISSIDAIYD RLDI ICADOOVDRIITGRLO SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOSAEHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF SLOTYVTOOLIRAAEIRASANIAATKHSECVIGOSKRVDFGGGGYHLMSFPOAPHGVVF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886	SALGKI ODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONACALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONACALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONACALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONGSINTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO LALGKI ODVINONGGSINTLISULTAN INTRI ODVINONGGSINTLISULTAN SLOTVINOOLIRAAEINASANIAATKNEEVIGOSKRVDEGGGYHEMSFPOSAEHGVVF SLOTVINOOLIRAAEIRASANIAATKNEEVIGOSKRVDEGGGYHEMSFPOSAEHGVVF SLOTVINOOLIRAAEIRASANIAATKNEEVIGOSKRVDEGGGYHEMSFPOSAEHGVVF ALNAYSOOLSDEITVKSAROAMEKVNECVKSOSKRUFEGGGYHEMSFPOSAEHGVVF ALNAYSOOLSDEITVKSAROAMEKVNECVKSOSKRUFEGGGYHEMSFPOSAEHGVVF ALNAYSOOLSDEITVKSAROAMEKVNECVKSOSKRUFEGGGYHEILSVONAEYGALF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069	SALGKUOUVNONAOALMTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO TALGKUOUVNONAOALMTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO TALGKUOUVNONAOALMTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO SAUKUOAVVNANAOALMTUVKOUSSNFGAISSUOEUSRUDALEAEVOIDRLITGRUO SAUKUOAVVNANAOALMTUVKOUSSNFGAISSIOAUVDRUSAEVOIDRLITGRUO TALNKUOUVNAOGNSINHUTSOURONFGAISSIOAUVDRUSELSRUNDULSRUKT TALNKUOUVNAOGNSINHUTSOURONFGAISSIOAUVDRUSIGUS USAUKUOUVNAOGNSINHUTSOURONFGAISSIOAUVDRUSE SUOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGYHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGYHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGYHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGYHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGYHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGVHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGVHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGVHLMSFPOABHGVVF SLOTYVTOOLIRAAEIRASANDAATKMSECVLGOSKRVDEGGKGVHLMSFPOABHGVVF LUAYVSOLSDITUIRASARJAARTEKVNECVKSOSFRINEGGKGNHTIBUVONAPYGLIF ALVAYSOLSDITUIRAASRUAACKNECVKSOSFRINEGGKGNHTIBUVONAPYGLIF ALVAYSOLSDITUKTESRCAOGKNECVKSOSKRVDEGKGNGHTIBUVONAPYGLIF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069	SALGKI ODVINONAQALNTLVKOLSSNFCAISSVIND LISKLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTLVKOLSSNFCAISSVIND LISKLDKVEAEVOIDRLITGRLO TANGKI ODVINONAQALNTLVKOLSSNFCAISSVIND LISKLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTLVKOLSSNFCAISSVIND LISKLDKLEAEVOIDRLITGRLO SALGKI ODVINONAQALNTLVKOLSSNFCAISSILDE LISKLDNLEAEVOIDRLITGRLO TANGKI ODVINONAQALNTLVKOLSSNFCAISSILDE LISKLDNLEAEVOIDRLITGRLO TANGKI ODVINONGALNTLVKOLSSNFCAISSILDE LISKLDNLEAEVOIDRLITGRLO TANGKI ODVINOGGISLHTITSOLTONFCAISSILDE LISKLDNLEAEVOIDRLITGRLO LALNKI ODVINOGGISLHTITSOLTONFCAISSILDE LISKLDNLEAEVOVO SLOTVVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOSAEHOVVF SLOTVVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOSAEHOVVF SLOTVVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOSAEHOVVF ALNAYSOOLSDITLIKAGS RAITEKVNECVSOSS RINFCGNGHTLISLVONAEVGLIE ALVAYSOOLSDITLIKAGS RAITEKVNECVSOSS RINFCGNGHTLISLVONAEVGLIE ALVAYSOLSDITLIKAGS RAITEKVNECVSOSS RINFCGGNGHTLISLVONAEVGLIE ALVAFVSOULSNETVEVRSRELAOOKVNECVKSOSRIVEGCGGNETHISLVAAEEGLVF ALVAFVSOULSKITEVRSRELAOOKVNECVKSOSSRIVEGCGGNETHISLVNAEEGLVF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV3 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048	SALGKI OUVNONAOALNTLVKOLSSN FGAISSVIND LISELDKVEAEVOIDELITGELO SALGKI OUVNONAOALNTLVKOLSSN FGAISSVIND LISELDKVEAEVOIDELITGELO TALGKI OUVNONAOALNTLVKOLSSN FGAISSVIND LISELDKVEAEVOIDELITGELO SALGKI OUVNONAGALNTLVKOLSSN FGAISSVIND LISELDKVEAEVOIDELITGELO TALGKI OUVNONAEALNNL GOLSNEFGAISSLOE LISELDALEAEVOIDELITGELO TALGKI OVVNANAOALNTLVKOLSSN FGAISSSVIND LISELDKLEAEVOIDELITGELO TALGKI OUVNAOGHSLNHLTSOLRON FGAISSSIOAHYDELJGI OADOOVDELITGELA LANKI OUVNAOGHSLNHLTSOLRON FGAISSSIOAHYDELJSI OADOOVDELITGELA LANKI OUVVNOOGSLNHLTSOLRON FGAISSSIOAHYDELJSI OADOOVDELITGELA LANKI OUVVNOOGSLNHLTSOLRON FGAISSSIOAHYDELJSI OADOOVDELITGELA SLOTYVTOOLI RAAEIRASANLAATKNSECVLGOSKRVDEGGGGGHLMSFPOSAEHGVVF SLOTYVTOOLI RAAEIRASANLAATKNSECVLGOSKRVDEGGGGGHLMSFPOSAEHGVVF ALNAYSOOLSDITLIKAGSRNITEKVNECVKSOSSRINEGGONHIISLVONAEVGLYF ALNAYSOOLSDITLIKAGSRNITEKVNECVKSOSSRINEGGONHIISLVONAEVGLYF ALVAYSOOLSDITLIKAGSRNITEKVNECVKSOSSRINEGGONHIISLVONAEVGLYF ALVAYSOULSVITIKYTEVRSRCLAOCKNSOSSRINEGGONHIISLVONAEVGLYF ALVAYSOULSDITLIKAGSRNITEKVNECVKSOSSRINEGGONHIISLVONAEVGLYF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103
Spike Antigen SARS CoV2 spike OC43 spike UC43 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen Spike Antigen	928 943 911 1032 1025 8266 1009 988 1003 971 1092 1085 886 1069 1048	SALGKI ODVINONAOALNTLVKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAOALNTLVKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO TAGKI ODVINONAOALNTLVKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALVKI ODVINONAOALNTLVKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALVKI ODVINONAOALNTLVKOLSSNFGAISSILDE LSRLDNLEAEVOIDRLITGRLO TALSKI ODVINONAOALNTLVKOLSSNFGAISSILDE LSRLDNLEAEVOIDRLITGRLO TALSKI ODVINOORSLHHUTSOLONFOAISSILDE LSRLDNLEAEVOIDRLITGRLA IALNKI ODVINOORSLHHUTSOLRONFOAISSILDE LSRLDNLEAOVOIDRLITGRLA IALNKI ODVINOORSLHHUTSOLRONFOAISSILDE LSRLDNLEAOVOIDRLITGRLA IALNKI ODVINOORSLHHUTSOLRONFOAISSILDE LSRLDNLEAOVOIDRLITGRLA IALNKI ODVINOORSLHHUTSOLRINFOAISNI OA HYDRLDSI OADOOVDRLITGRLA IALNKI ODVINOORSALNHUTSOLRINFOAISNI OA HYDRLDSI OADOOVDRLITGRLA IALNKI ODVINOORSALNHUTSOLRINFOAISNI OA HYDRLDSI OADOOVDRLITGRLA IALNKI ODVINOORSALNHUTSOLRINFOAISNI OA HYDRLDSI OADOOVDRLITGRLA LALNKSI ODVINOORSALNHUTSOLRINFOAISNI OA HYDRLDSI OADOOVDRLITGRLA LALNKSOLSSI SILVESSALOAVEN (NECVISOS RUPECGRAVHINGSF POARHGVVF SLOTTVITOOLI RAABIRASAN JAATKNSECVEGOSKRVDECGRAVHINGSF POARHGVVF ALNAYSOOLSSI TUSSAAOAVEN (NECVISOS RUPECGRAVHINGSF POARHGVVF ALNAYSOOLSSI TUSSAAOAVEN (NECVISOS RUPECGRAVHI ISLVONAPYGLJE ALNAYSOOLSSI TUSSAAOAVEN (NECVISOS RUPECGRAVHI ISLVONAPYGLJE ALNAFVSOVINKYTEVSSRIAO OKNECVISOS RUPECGRAVHI SI SUNAAPSGOLF LINAYSOOLSSI TUSSI AADOOVEN TUSSOS RUPECGRAVITI SUNAAPSGOLF LNAFVSOVINKYTEVSSRIAOOVEN COVISOS RUPECGRAVITI SUNAAPSGOLF LNAFVSOVINKYTEVSSRIAOOVEN COVISOS RUPECGRAVITI SUNAAPSGOLF LNAFVSOVINKYTEVSSRIAOOVEN COVISOS RUPECGRAVITI SUNAAPSGOLF LINAFVSOVINKYTEVSSRIAOOVEN COVISOS RUPECGRAVITI SUNAAPSGOLF LNAFVSOVINKYTEVSSRIAOOVEN COVISOS RUPECGRAVITUSSI TUSAPJGOLF LHVYVER SUNAAPSTI TAPAICHDE-KAHFPREEVFVSNGTHHFVOORNEVEGOITTTDN	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048	SALGKLODVINONAOALNTLVKOLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO SALGKLODVINONAOALNTLVKOLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO TALGKLODVINONAOALNTLVKOLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO SALWKLOAVVNANAOALNTLVKOLSSNFGAISSSVLNDULSRLDALEAEVOIDRLITGRLO SALWKLOAVVNANAOALNTLVKOLSSNFGAISSSVLNDULSRLDALEAEVOIDRLITGRLO TALGKLOVVNANAOALNTLVKOLSSNFGAISSSVLNDULSRLDALEAEVOIDRLITGRLO TALGKLOVVNANAOALNTLVKOLSSNFGAISSSVLNDULSRLDALEAEVOIDRLITGRLO TALGKLOVVNANOGSSLNHUTSOLRONFGAISSSIOAFVDRLDSIOADOVDRLITGRLA LANKIODVVNAOGSSLNHUTSOLRONFGAISSSIOAFVDRLDSIOADOVDRLITGRLA LANKIODVVNAOGSSLNHUTSOLRONFGAISSSIOAFVDRLGGGRYHLMSFFOSABHGVVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDFGGRYHLMSFFOSABHGVVF ALNAYSOOLSDIILKAGSSRLHEVNECVKSOSSRINFCGNGNHILSLVONAFYGLYF ALNAYSOOLSDIILIKAGSSRLFEKNECVKSOSSRINFCGNGNHILSLVONAFYGLYF ALNAYSOOLSDIILIKAGSSRLFEKNECVKSOSSRINFCGGNGTHFFSIVNSABHGVVF ALNAFVSOULSDIILKSSRCJAOKNECVKSOSSRINFCGGNGTHFFSIVNSABPGLYF ALNAFVSOULSNIKYTEVSSRLAOCKNECVKSOSSRINFCGNGNHILSIVONAFYGLYF ALNAFVSOULSDIILKSSRLAOCKNECVKSOSSRINFCGNGNHILFSIVNSABFGLYF ALNAFVSOULSDIILIKAGSSRLFEKNECVKSOSNRVCFCGGNGTHFFSIVNSABPGLIF LUVFYSHITKYTEVRSSRLAOCKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF ALNAFVSOULSDIILIKAGSRLFACHGGKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF ALNAFVSOULSDIILIKAGSRLFACHGCKNOSONRVCFCGNNFILSIVONAFYGLJF LHVFYSHITKYTEVRSRLAOCKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF LHVFYSHITKYTEVRSRLAOCKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF ALNAFVSOULSDIILIKAGSRLFACHGGKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF LHVFYSHITKYTEVRSRLAOCKNECVKSOSNRVCFCGNNFILSIVONAFYGLJF	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119
Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen Spike Antigen SARS CoV2 spike SARS CoV2 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031	SALGKI ODVINONAOALNTLYKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAOALNTLYKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONAOALNTLYKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALVKI ODVINONAOALNTLYKOLSSNFGAISSVIND LSRLDKVEAEVOIDRLITGRLO SALVKI ODVINONAOALNTLYKOLSSNFGAISSIND LSRLDNLEAEVOIDRLITGRLO TALGKI ODVINONAEALNNLLOOLENNFGAISSIDE LSRLDNLEAEVOIDRLITGRLA IANNKI ODVINOOGNSLHHITSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA IANNKI ODVINOOGNSLNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA IANNKI ODVINOOGSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA IANNKI ODVINOOGSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA IANNKI ODVINOOGSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA IANNKI ODVINOOGSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA LANNKI ODVINOOSSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA LANNKI ODVINOOSSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA LANNKI ODVINOOSSALNHLTSOLGNFGAISSIDA HYDRLDSI DADOOVDRLITGRLA LANNKI ODVINOOSSALNHLTSOLATINT LINAYSOLSDITLIKAGSSALEKVNECVKSOSSRIV DEOGGAITH ISLVONAFYGLIF ALNAYSOLSDITLIKAGSSALEKVNECVKSOSSRIV DEOGGAITH ISLVONAFYGLIF ALNAYSOLSDITLIKAGSSRIELGONNECVKSOSSRIV DEOGGAITHESLVAABEGAVF LNAYSOULNKYTEVRSSRIAOOKNECVKSOSSNRVGEOGAITHESLVAABEGAUF LNAYSOULNKYTEVRSSRIAOOKNECVKSOSNRVGEOGGAITHESI VAABEGAUF LHVYVPOGHKFTTAPAICHEG-KAHFPREGVF VSNGTHHFVOCRNFYEDOIITTDN LHVTYPEOGKNFTTAPAICHEG-KAHFPREGVF VSNGTHHFVOCRNFYEDOIITTDN LHVTYPEOGKNFTTAPAICHEG-KAHFPREGVF VSNGTHFVOCRNFYEDOIITTDN LHVTYPEOGKNFTTAPAICHEG-KAHFPREGVF VSNGTHFFUORNFYEDOIITTDN	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1087
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike L29E spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike	928 943 911 10325 826 1009 988 1003 971 1092 1085 8866 1069 1048 1063 1031 1152	SALGKLOUVNONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDELITGELO SALGKLOUVNONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDELITGELO TALGKLOUVNONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDELITGELO SALWKLOAVVNANAOALNTLVKOLSSNFGAISSJVIND LISELDKVEAEVOIDELITGELO SALWKLOAVVNANAOALNTLVKOLSSNFGAISSJVIND LISELDKVEAEVOIDELITGELO TALGKLOUVNANAOALNTLVKOLSSNFGAISSJVIND LISELDKVEAEVOIDELITGELO SALWKLOAVVNANAOALNTLVKOLSSNFGAISSJVIND LISELDKVEAEVOIDELITGELO TALGKLOUVNAOGSJLNHITSOLRONFGAISSJVIND LISELDKVEAEVOIDELITGELO LANKIODVVNAOGSJLNHITSOLRONFGAISSJVIND LISELDALEAVOIDELINGELT TALNKIODVVNAOGSJLNHITSOLRONFGAISSJVIND LISELOADOVORLIIGELA SLOTIVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYLINDSFPOSABHGVVF SLOTIVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYLINDSFPOSABHGVVF ALNAVSOOLSDSTLVKFSAAOAKEKVNECVKSOSRINFEGGGGNHINDSLVONAFYGLIF ALVAVSOOLSDSTLVKFSAAOAKEKVNECVKSOSRINFEGGGNNHIDSLVONAFYGLIF ALVAVSOULSDITLIKAGSRAITEKVNECVKSOSRINFEGGGNNHIDSLVONAFYGLIF ALVAVSOULSDITLIKAGSRAITEKVNECVKSOSRINFEGGGNNHIDSLVONAFYGLIF ALVAVSOULSDITLKKEROLAGLOG-KAHFPREGVFVSNGTHNFVORNFYEDOIITTDN LHVTYVEAOEKNFTIAPAICHDG-KAHFPREGVFVSNGTHNFVORNFYEDOIITTDN LHVTYVESOEKNFTIAPAICHDG-KAHFPREGVFVSNGTHNFVORNFYEDOIITTDN LHVTYVESOEKNFTIAPAICHDG-KAHFPREGVFVSNGTHNFVORNFYEDOIITTDN LHVTYVESOEKNFTIAPAICHDG-KAHFPREGVFVSNGTHNFVORNFYEDOIITTDN LHVTYVESOEKNFTIAPAICHDG-KAHFPREGVFVSNGTSHFIORNFYSOUIITTDN	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1087 1209
Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145	SALGKIODVNONAQALNTU VKOLSSNFGAISSVIND ULSRLDKVEAEVOIDRLIGRLO SALGKIODVNONAQALNTU VKOLSSNFGAISSVIND ULSRLDKVEAEVOIDRLIGRLO TALGKIODVNONAQALNTU VKOLSSNFGAISSVIND ULSRLDKVEAEVOIDRLIGRLO SALGKIODVNONAQALNTU VKOLSSNFGAISSVIND ULSRLDKVEAEVOIDRLIGRLO SALGKIODVNONAQALNTU VKOLSSNFGAISSVIND ULSRLDKVEAEVOIDRLIGRLO TALMKIODVNAQALNSULQUENNFGAISSSIDE ULSRLDALBAEVOIDRLIGRLO TALMKIODVNAQALNSULQUENNFGAISSSIDE ULSRLDALBAEVOIDRLIGRLO TALMKIODVNAQALNSULQUENNFGAISSSIDE ULSRLDALBAEVOIDRLIGRLO TALMKIODVNAQALNSULQUENNFGAISSSIDE ULSRLDALBAEVOIDRLIGRLO TALMKIODVNAQALNSULQUENNFGAISSSIDAIYD RLDIIGADOVORULIGRLA TALMKIODVNAQASLHHUTSDURNFGAISNSIDAIYD RLDIIGADOVORULIGRLA LALNKIODVNAQASLHHUTSDURNFGAISNSIDAIYD RLDIIGADOVORULIGRLA LALNKIODVNAQASLHHUTSDURNFGAISNSIDAIYD RLDIIGADOVORULIGRLA LALNKIODVNAQASLHHUTSDURNFGAISNSIDAIYD RLDIIGADOVORULIGRLA LALNKIODVNAQASLHHUTSDURNFGAISNSIDAIYD RLDIIGADOVORULIGRLA LALNKSOLISSTIVKSAADAAEKNSCVKSOSSRNFGGAGHUNSFPOAPHGVVF LALALVSOLSDITLIKAGSRAAEKVNECVKSOSSRNFGGGAGHUSU VAAPGLYF LLNAFVSOULSDITLIKAGSRAAEKVNECVKSOSSRNFGGGAGHUSU VAAPGLYF LLNAFVSOULSDITLIKAGSRAAEKVNECVKSOSSRNFGGGAGHUSU VAAPGLYF LUNFVSHTLTKYTEVRASRDAOKVNECVKSOSSRNFGGGAGHUSU VAAPGLYF LUNFVSHTLTKYTEVRSSRLDOOKVNECVKSOSSRNFGGGAGHUSU VAAPGLITDU LHVTYVPAQEKNFTTAPAIGHG-KAHFPREGVF-VSNGTHNFVORNFYEDOITTDU LHVTYVPAQENNFTTAPAIGHG-KAHFPREGVF-VSNGTNFVORNFYEDOITTDU LHVTYVPSEVVIKVSVSOLOUSGANFFGFGNFFOOSNEVSOITTDU LHVTYVPSEVVIKVSVSOLOUGGENSKYFT-VNNNNYGSSVYVEEDIITDU LHVTYVPSESVINTAPAIGHG-KAHFPREGVF-VSNGTNFVORNFYSOLITTDU LHVTYVPSESVINTAPAIGHG-KAHFPREGVF-VSNGTNFVORNFYSOLITDUN LHVTYVPSESVINTAPAICHG-KAHFPREGVF-VSNGTNFVORNFYSOLITTDU	987 1002 970 1091 1084 885 1068 1068 1067 1062 1030 1151 1144 945 1128 1103 1119 1087 1209
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike UL63 spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike HKU1 spike 229E spike	928 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946	SALGKLODVINONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDPLITGELO SALGKLODVINONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDPLITGELO TALGKLODVINONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDPLITGELO TALGKLODVINONAOALNTLVKOLSSNFGAISSVIND LISELDKVEAEVOIDPLITGELO TALGKLODVINONAOALNTLVKOLSSNFGAISSJUELSELDALEAEAOTDPLITGELO TALGKLODVINONAOALNTLVKOLSSNFGAISSJUELSELDALEAEAOTDPLITGELO TALGKLODVINOOGSLINHITSOLROFFAISSJUELSELDALEAEAOTDPLINGELT TALSKLODVINAOGSLINHITSOLROFFAISSJUELSELDALEAEAOTDPLINGELT TALSKLODVINAOGSLINHITSOLROFFAISSJUAHVERLOSIGAOVORLITGELA LANKLODVINOOGSALNHITSOLROFFAISSJUAHVERLOSIGAOVORLITGELA LANKLODVINOOGSALNHITSOLRINFGAISSJUAHVERLOSIGAOVORLITGELA LANKLODVINOOGSALNHITSOLRINFGAISSJUAHVERLOSIGAOVORLITGELA LANKLODVINOOTIRAAEIRASANLAATKVSECVLOOSKRVDEGGGYHINSFPOSAEHGVIF SLOTVITOOLIRAAEIRASANLAATKVSECVLOOSKRVDEGGGYHINSFPOSAEHGVIF ALNAVSOOLSDSILVKFSAAOAMEKVNECVKSOSSRINFGGORGHITSLVAAAPGLIF ALNAVSOOLSDSILVKFSAADAMEKVNECVKSOSSRINFGGORGHITISLVONAPYGLIF ALNAVSOOLSDSITIKKSSRJOLOOKVNECVKSOSSRINFGGORGHITISLVONAPYGLIF ALNAVSOOLSDITIKSRADLAAEKNECVKSOSNRVGEGGORGHITSLVAAPEGLIF LINAFVSOVINKYTEVRSSRLAOOKVNECVKSOSNRVGEGORGHITSLVINSAPEGLIF LINAFVSOVINKYTEVRSSRLAOCKVNECVKSOSNRVGEGORGHITSLVINSAPEGLIF LHVFYVEAOKNFTTAPAIGHG-KAHFPREGVFVSNGTHNFVORNFYEPOIITTDN LHVTYVESOKHFTTAPAIGHG-KAHFPREGVFVSNGTNHFVORNFYEPOIITTDN LHVTYVESOCKNFTTAPAIGHG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTYVESOCKNFTTAPAIGHG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTYVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN LHVTVESOCKNFTTAPAIGHEG-KAHFPREGVFVSNGTSNFIFTORNFYSPOIITTDN	987 1002 970 1091 1084 885 1068 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1087 1209
Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike OC43 spike HKU1 spike 229E spike NL63 spike	928 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946	SALGKIOUVNONAOALNTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRIIGRIO SALGKIOUVNONAOALNTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRIIGRIO TAIGKIOUVNONAOALNTUVKOUSSNFGAISSVINDULSRUKVEAEVOIDRIIGRIO TAIGKIOUVNONAOALNTUVKOUSSNFGAISSVINDUSRUKVEAEVOIDRIIGRIO SALGKIOUVNANAOALNTUVKOUSSNFGAISSIOEILSRUDISAEVOIDRIIGRIO TAINKIOUVNANAOALNSULOOISNFGAISSIOEILSRUDISAEVOIDRIIGRIO TAINKIOUVNAOGNSUHUTSOURONFGAISSIOEILSRUDISAEVOIDRIIGRIO TAINKIOUVNAOGNSUHUTSOURONFGAISSIOEILSRUDISAEVOOIDRIIGRIO TAINKIOUVNAOGNSUHUTSOURONFGAISSIOEILSRUDISAEVOOIDRIIGRIO TAINKIOUVNAOGNSUHUTSOURONFGAISSIOAIYDRUDIIGADOVVORIIGRIA TAINKIOUVNAOGNSUHUTSOURONFGAISSIOAIYDRUDSIGADOVVORIIGRIA TAINKIOUVNAOGNSUHUTSOURONFGAISSIOAIYDRUDSIGADOVVORIIGRIA TAINKIOUVNAOGNSUHUTSOURANFGAISSIOAIYDRUDSIGADOVVORIIGRIA SLOTYVTOOLIRAAEIRASANIAATKNSECVLGOSKRVDECGKGYHINGSPOSABHGVVF SLOTYVTOOLIRAAEIRASANIAATKNSECVLGOSKRVDECGKGYHINGSPOABHGVVF ALNAYSOOLSDITIIKAGASRATEKVNECVKSOSRRNFGGGNHIISUVONABYGIYF ALNAYSOOLSDITIIKAGASRATEKVNECVKSOSRRNFGGGNHIISUVONABYGIYF ALNAYSOOLSDITIIKAGASRATEKVNECVKSOSRRNFGGGNSHIISUVONABYGIYF ALNAYSOULNYTEVRSRRUDOACVNECVKSOSRRNFGGGNHIISUVONABYGIYF HUNYYSTTIKYTEVRSRRUDAOKVNECVKSOSNRVGFGGNGHIFSUVNAAPGCIVF ALNAYSOULNYTEVRSRRUDAOKVNECVKSOSNRVGFGGNGHIFSUVNAAPGCIVF HUNYYFKYTAPAIGHG-KAHFPREVFVSNCTHFVNORNFYEFOIITTON HHTYVEAOKNFTTAPAIGHG-KAHFPREVFVSNCTHFVNORNFYEFOIITTON HHTYVESOULNYTEVSPOICIASORTIPSOYFVNNTNHYNGSYYTEFIIND HUNYFTKYVTAKVSPOICIASORTIPSOYFVNNNNHYNGSYYTEFIIND HUNYFTKYVTSPOICIASORTIPSOYFVNNNNHYGSYYTEFOITTON HESYKPTSFRVIVSPOICIASORTIPSOYFVNNNNHYGSYTYPEPITENN HUNYFTSPITSPITAPAIGHG-KAYFPREVFVNNNNHYGSYTEFISTIN HUNYFTSPITSPITAPAIGHG-KAYFPREVFVNNNNHYGSYTYPEPITENN HUNYFTSPITSPITAPAIGHG-KAYFPREVFVNNNNHYGSYTYPEPITENN HUNYFTSPITSPITAPAIGHG-KAYFPREVFVNNNNHYGSYTYPEPITENN HUNYFTSPITSPITAPAIGHG-KAYFPREVFVNNNNHYGSYTYPEPITENN HUNTYFTSPITAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAIGHTAPAI	987 1002 970 1091 1084 885 1068 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1209 1202
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike HKU1 spike 229E spike NL63 spike	928 943 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 946 1129	SALGKLODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKLODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKLODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKLODVINONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKLODVINONACALNTLVKOLSSNFGAISSJUELSRLDALEAEAOIDRLITGRLO SALGKLODVINONAGALNTLVKOLSSNFGAISSJUELSRLDALEAEAOIDRLITGRLO TALSKIODVINAOGISLNHLISOLROFFAISSJUELSRLDALEAEAOIDRLINGRLT TALSKIODVINOOGISLNHLISOLROFFAISSJUELSRLDALEAEAOIDRLINGRLT TALSKIODVINOOGISLNHLISOLROFFAISSJUELSRLDALEAEAOIDRLINGRLT LANKIODVINOOGISLNHLISOLROFFAISSJUELSRLDALEAOVOIDRLITGRLA LANKIODVINOOGISLNHLISOLRINFGAISNJUELSIJADOOVDRLITGRLA SLOTVITOOLIRAAEIRASANLAATKNEGUVEOSKRVDECGKGYHLMSFPOSAEHGVVF SLOTVITOOLIRAAEIRASANLAATKNEGUVEOSKRVDECGKGYHLMSFPOSAEHGVVF ALNAVSOOLSDSILVKISAADAEKNEGUVEOVKSOSRLDECGKGYHLMSFPOSAEHGVVF ALNAVSOOLSDSILVKISAADAEKNEGUVEOVKSOSSRLDECGKGNHIISLUONAEYGLE ALVYVSHILKYTEVRASSOLAOGKUNECVKSOSSRLDECGKGNHIISLUONAEYGLE ALVYSOLSDIILKAGSSAIEKVNECVKSOSSRLDECGKGNHIISLUONAEYGLE ALVYSOLINKYTEVRSSRLAOGKUNECVKSOSSRLDECGKGNHIISLUONAEYGLE HUNAVSOLSDIILKSSRLAOGUNECVKSOSSRLDECGKGNIISSUSAAEGUVI LHAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUONAEYGLIF LUNAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUONAEYGLIF LHAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUKAAEGUVI LHAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUKAAEGUVI LHAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUKAAEGUVI LHAFYSOULINKYTEVRSSRLAOCKUNECVKSOSINGUGEGGNIIISLUKAAEGUVI LHAFYSOULINKYTEVSSRLAOCKUNECVKSOSINGUGEGGNIIITSUNAAEGUVI LHAFYSOULINKYTEVSSRLAOCKUNECVKOONNINUTENSINGUKISCUITIDN HENTYPEGEKNITTAPAIGEGEKAHFPREGVFVSNIGTHNEVICONFYEDOIITTDN HENTYPEGEKNITTAPAIGUEGEKANFPREGVFVSNIGTHNEVICONFYEDOIITTDN HENTYPEGEKNITVSSCLUVSGORTAPKOYFVNINNINYNGSGYYEDEISDKN HENSINFTSKITUSSCLUVUSKONGUVENEVKLUKUKENYKEITSRIFTSRUFFESITINS HENSINFTSKITUSSCLUVUSKONGUVENEVKLUKENYKEITSRIFTSRUFFESITINS HENTIETSKITUSSCLUVUSKONGUVENEVKLUKENYKENYKEITSRUFFESITINS HENTIETSKITISSKITISSKITISSKEITYNIN HYNGSGYFTENTSRUFFESITISSKITESTITISSENETSEITSKITUSSCUVUSKONGUVENEVKLUKENYK	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 11128 1113 1119 1087 1209 1202 1005
Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike NL63 spike	928 943 911 1032 1025 8266 1009 988 1003 971 1092 1085 8866 1069 1048 1063 1031 1152 1145 9466 1129	SALGKLODWNONAQALNTLVKQLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO TALGKLODWNONAQALNTLVKQLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO TALGKLODWNONAQALNTLVKQLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO TALGKLODWNONAQALNTLVKQLSSNFGAISSVLNDULSRLDKVEAEVOIDRLITGRLO SALVKLOAWNANQALNTLVKQLSSNFGAISSIQAUYDRLDISRLDKEAEVOIDRLITGRLO TALKKLODWNONQGNSLNHUTSQLRONFGAISSIQAUYDRLDIIOADOVDRLITGRLA TALNKLODWNONQGNSLNHUTSQLRONFGAISSIQAUYDRLDIIOADOVDRLITGRLA TALNKLODWNONQGNSLNHUTSQLRONFGAISSIQAUYDRLDIIOADOVDRLITGRLA TALNKLODWNONQGNSLNHUTSQLRONFGAISSIQAUYDRLDJIOADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISSIQAUYDRLDJIOADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISSIQAUYDRLDJIOADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISNICAEUVRLDSIDADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISNICAEUVRLDSIDADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISNICAEUVRLDSIDADOVDRLITGRLA LALNKLODWNONGGNSLNHUTSQLRONFGAISNICAEUVRLGVF SLOTYVTOQLIRAABIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOAEHGVVF SLOTYVTOQLIRAABIRASANLAATKNSECVLGOSKRVDECGKGYHLMSFPOAEHGVVF ALNAVSOLSDITLIKAGSRAFEKVNECVKSOSSRINFCGNGHTIISLVONAEYGLYF ALNAVSOLSDITLIKAGSRAFEKVNECVKSOSSRINFCGNGHTIISLVONAEYGLYF ALNAVSOULSDITLIKAGSRAFEKVNECVKSOSSRINFCGNGHTIISLVONAEYGLYF ALNAVSOULSDITLIKAGSRAFEKVNECVKSOSSRINFCGNGHTIISLVONAEYGLYF ALNAVSOULSDITLIKAGSRAFEKVNECVKSOSSRINFCGNGHTIISLVONAEYGLYF LHVYVFNHTIKYTEVRSSRLAOOKNNECVKSOSSRINFCGSCNTHIFSLVNAEFGCJITTDN HHVIYVFNGTKNFTTAPAIGHDG-KAHFPRESVFVSNGTHNFVDORNFYZOLIITDN HHVIYVFSOCKNFTTAPAIGHDG-KAHFPRESVFVSNGTHNFVDORNFYZOLIITDN HENYMFIKYVTAKVSPCLILAGKRGIAFKGYFVSNGTHNFVDORNFYSGUITTDN HENYMFIKYVTAKVSPCLILAGKRGIAFKGYFVSNGTNFGSSYYDEPISNKULHTVN HENYMFIKYVTAKVSPCLILAGKRGIAFKGYFVSNGTNFGSSYNDEFSSQLITTDN HENYMFIKYVTAKVSPCLILAGKRGIAFKGYFVSNGTNFGSSYNDEFSSQLITENN HENYMFIKYVTAKVSCLUNGGNAENGPVFVSNGTNFGSSYNDEFSSQLITTDN HENYMFIKYVTAKVSCLUNGGTNYVRONLLYYFNFGSSYNDEFISNKULHTVL HTVLFTSFLFFKTVVVRSCLUNGGTNYVRONLLYFSRUFTSRLIFTSRLMEFSTKNL HENYMFIKYVTAKSSCLOVGTNGVVRONLLYFSNFFGTSRLIFTSRLMEFSTKANL HENYMFIKYVRAKASGLOVGTNGVVRONLLYFSNFFGTSRLIFTSRLMEFRYFTAPAI HTVLFTSFLFFKTVVKNGSCLOVGTNGVFVRONLLYFSNFFGTSRLIFTSRL	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1119 1087 1209 1202 1005 1188
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Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike ML63 spike HKU1 spike 229E spike NL63 spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen	928 943 911 1032 1025 8266 1009 988 1003 971 1092 1085 8866 1069 1048 1063 1031 1152 1145 9466 1031	SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLKVEAEVOIDRLITGKLO TALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSIQE LISKLDALEAEVOIDRLITGKLO SALGKI ODVINONQALNTLVKOLSSNFGAISSIQE LISKLDALEAEVOIDRLITGKLO SALGKI ODVINONQALNTLVKOLSSNFGAISSIQA HYDRLDI I OADOOVDRLITGKLO ALAKI ODVINONQASINHLTSOLRONFGAISSIQA HYDRLDI I OADOOVDRLITGKLA LANKI ODVINONGSINHLTSOLRONFGAISSIQA HYDRLDI I OADOOVDRLITGKLA LANKI ODVINONGSINHLTSOLRONFGAISSIQA HYDRLDI I OADOOVDRLITGKLA LANKI ODVINONGSINHLTSOLRONFGAISSIQA HYDRLDI I OADOOVDRLITGKLA LANKI ODVINONGSINHLTSOLRONFGAISSIQA HYDRLDI I OADOOVDRLITGKLA SLOTHVTOOLI IRAAEIRASANLAATKNSECVLGOSKRVDEGGGKGHLMSFPOSABHGVVF ALNAYSOLSDITII I KAGASRI LEKNECVKSOSSRI NEGGNONHI I SLIVONAPYGLYF ALNAYVSOLSDITI I KAGASRI LEKNECVKSOSSRI NEGGNONHI SLIVONAPYGLYF LIVYVSHI I KYTEVRSSRCJAOOKVNECVKSOSNRYGEGGNOTHI FSLIVASAPJGLIF LIVYVSHI I KYTEVRSRCJAOOKVNECVKSOSNRYGEGGNOTHI FSLIVASAPJGLIF LIVYVSEJU I KYTEVRSRCJAOOKVNECVKSOSNRYGEGGNOTHI FSLIVASAPJGLIF LHVTYVSACKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYENGOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVTYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOIITTDN LHVYVSEZKIFTTAPAICHDG-KAHFPREGVFVSNOTHHFVTORNFYESOITTDN L	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1119 1087 1209 1202 1105 1188 1163
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Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike 1KU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike CoC43 spike NL63 spike NL63 spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV3 spike	928 943 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946 1129 1104 1120 0088 1210	SALGKLODVNONAOALNTLVKQLSSNFGAISSVINDLILSRLDKVBÆVOIDRLITGRLO SALGKLODVNONAOALNTLVKQLSSNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO TALGKLODVNONAOALNTLVKQLSSNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SALGKLODVNONAGALNTLVKQLSSNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SALGKLODVNONAGALNTLVKQLSSNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SALGKLODVNONAGALNHLTSULGVINFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SALGKLODVNONGGSLINHLTSULRØNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SALGKLODVNONGGSLINHLTSULRØNFGAISSVINDLISRLDKVBÆVOIDRLITGRLO SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF SLOTVTOOLIRABEIRASANLAATKNSECVLGOSKRVDEGGGGVHLMSFPOSAEHGVVF ALMAYSOUSSDITUKFSAROAMEKVNECVKSOSSRINFGGGGNGTHISJUONAEYGLUF ALMAYSOUSSDITUKTSAROAMEKVNECVKSOSSRINFGGGGNGTHISSIVONAEYGLUF HUNTYVSSHILIKVTEVRASRODAOKNNECVKSOSSRINFGGGGNGTHISSIVNAFGLE SLOTVTOOLIRABEIRASANLAATKNSECVLGVSOSSRINFGGGGNGTHISSIVONAEYGLUF HUNTYVSSHILIKVTEVRSRODAOKNNECVKSOSSRINFGGGGNGTHISSIVINAEYGLUF HUNTYVSCHISITILTAGESGALTYPREGVFVSNGTHFFUGRNFYSEOLITTON HENVYSSHILIKVTEVRSRODAOKNNECVKSOSSRIVGFGGNGTHISSIVARAEYGLUF HUNTYVSCHISTITAPAIGHGG-KAHFPREGVFVSNGTHFUGRNFYSEOLITTON HHTVYVSCHTTAPAIGHEG-KAHFPREGVFVSNGTHFUGRNFYSEOLITTON HENVYSTRUKVKXSECLCVGGNGTAFKSGYFVNNNTNMYDSGYYMEFDISLN HESVEPTYVTAKVSECLCVGGNGVFFVSNGTHFUGRNFYSEOLITDN HENVYSTRUCKKSSELCVGGUTGVVGFVVSNGTHFUGRNFYSEOLITDN HENVYSSHILTNVTNVSELCINGVGVGFVVSNGTHFUGRNFYSEOLITDN HENVESTRUTNVTNVSELCINGVGFVVSNGTHFUSRINGSNYFGSSYMEFDISLTN HESVEPTSFKTUVSGELCVGGUTGVVGFVVSNGTHFUSRIFTSRUPERSKFF HUNTFSCHTTSPLICHGELSFKEELDXYFKNHTSPLODIGDISGNASVNT TFVSGNCDVIGIVNNTVDPLOEDISKEELDXYFKNHTSPLODIGDISGNASVNT TFVSGNCDVIGINNTVDPLOEDISKEELDXYFKNHTSPLODIGDISGNASVNT TFVSGNCDVIGINNTVDPLOEDISKEELDXYFKNHTSPLODIGDISGNASVNT	987 1002 970 1091 1084 885 1068 1047 1062 1103 1151 1144 945 1128 1103 1119 1202 1005 1188 1163 1179 1202 1147 1268
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike NL63 spike NL63 spike SARS CoV2 spike	928 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1069 1048 1031 1152 1145 946 1129 1048 1120 1088 1210	SALGKLODWNONAQALNTLUKOLSSNFGAISSUNDLUSELSKURVERUOTDELITGELO SALGKLODWNONAQALNTLUKOLSSNFGAISSUNDLUSELSKURVERUOTDELITGELO TALGKLODWNONAQALNTLUKOLSSNFGAISSUNDLUSELSKURVERUOTDELITGELO TALGKLODWNONAQALNTLUKOLSSNFGAISSUDHUSELDALERUOTDELITGELO SALWKLORWNANQALNTLUKOLSSNFGAISSUDHUSELDALERUOTDELITGELO TALGKLODWNONQALNTLUKOLSSNFGAISSUDHUSELDALERUOTDELITGELO TALGKLODWNANQALNTLUKOLSSNFGAISSUDHUSELDALERUOTDELITGELO TALGKLODWNANQALNHUTSOLRONFGAISSUDHUSELDALERUOTDELINGELT TALNKIODWNANQALNHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANQALNHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANQALNHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANQALNHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANQALNHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANGASHHUTSOLRONFGAISSUDHUSELSELDALERUOTDELINGELT TALNKIODWNANGASHHUTSOLRONFGAISSUDHUSESUDHUSEN SLOTYNOOLIRAAEIRASANLARTKUSECVEGOSKRUDEGGGRYHUMSEPOSAHHGWF ALNAYKSOLSDITLIKAGSSRHIEKUNECVKSOSSRINFEGGNENHILSLVONAFYGLY ALNAYKSOLSDITLIKAGSSRHIEKUNECVKSOSSRINFEGGNENHILSUVONAFYGLY ALNAFYSOULIRNITIKYSERNEGUEGEKKÖGSGNENTEGGNENHILSIVONAFYGLU HUVYVSALTIKYTEVRSSRLAOCKVNECVKSOSNENGGGGGRIFIFSUNAABEGUF ALNAFYSOULIKYTEVRSSRLAOCKVNECVKSOSNENGEGGGNENFEGENFYZGOLIITDN HUTYVESOEKNFTIAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTYVESOEKNFTIAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTYVESOEKNFTIAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSEKNFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVORNFYZGOLIITDN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVGRNFSSYMYZGUINTUN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVGRNFSSYMYZGUINTUN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVGRNFSSYMYZGUINTUN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVGRNFSSYMYZGUINTUN HUTVUSSENFTAPAICHG-KAHFPREVFVSNGTHNEVGRNFSSYMYZG	987 1002 970 1091 1084 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1209 1202 1005 1188 1163 1179 1147 1268
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike CoC43 spike HKU1 spike 229E spike NL63 spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV3 spike HKU1 spike 229E spike	928 943 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946 1129 1144 1120 1088 1210 1088 1210	SALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU SALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU TALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU TALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU SALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU TALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU TALGKI ODVINONAOALNTUVKOUSSIFCAISSUND ILSRUDKVEAEVOIDRLITGRU TALGKI ODVINONOGSILNHUISOUROFCAISSUOALUSULSEUDILAEAONOIDRLITGRU TALGKI ODVINOOGSILNHUISOUROFCAISSUOALUSULSEUDILAAEAONOPRIITGRU TALGKI ODVINOOGSILNHUISOUROFCAISSUOALUSULSEUDILAAEAONOPRIITGRU TALGKI ODVINOOGSILNHUISOUROFCAISSUOALUSULSEUDILAAEAONOPRIITGRU SLOTVITOOLIRAAEIRASANIAATKNEECVLOOSKRVDECGGGYHIMSFPOSAEHGVIF SLOTVITOOLIRAAEIRASANIAATKNEECVLOOSKRVDECGGGYHIMSFPOSAEHGVIF SLOTVITOOLIRAAEIRASANIAATKNEECVLOOSKRVDECGGGYHIMSFPOSAEHGVIF ALNAYSOOLSDITUKTSAAOAMEKVNECVKSOSRRUFECGGGYHINSFPOSAEHGVIF ALNAYSOOLSDITIKASRAAEKVNECVKSOSRRUFECGGGGTHIISUVONAEYGLIF ALNAYSOOLSDITIKASRAAEKVNECVKSOSRRUFECGGGGGTHIISUVONAEYGLIF ALNAYSOOLSDITIKSASRAEAOOCKNECVKSOSRRUFECGGGGTHIISUVAAEYGLIF ALNAYSOOLSDITIKSASRAEAOOCKNECVKSOSRRUFECGGGGTHIISUVAAEYGLIF ALNAYSOOLSDITIKYTEVRSSREAOOKONECVKSOSRRUFECGGGGTHIISUVAAEYGLIF ALNAYSOOLSDITIKSTEVESSREAOCKNECVKSOSRRUFECGGGTGTHIFSUVASABGGLIF IEV-YVEAGEKNFTTAPAIGHDG-KAHFPREGVFVSNGTHHFVORNFYEEGUITTON HHTVYPSCHTTAPAIGHDG-KAHFPREGVFVSNGTHHFVORNFYEEGUITTON HHTVYPSCHTTAPAIGHDG-KAHFPREGVFVSNGTHFFORNFYEEGUITTON HHTVYFYCUNTAVSSECLIGGGRAFAKGYFVSNGTHFFORTSSYNTEESUVSSABUGUITTON HHTVPSCHTTAPAIGHDG-KAHFPREGVFVSNGTHFFORTSSYNTEESUVSSABUGUITTON HHTVPSCHTTAPAIGHDG-KAHFPREGVFVSNGTHFFORTSSYNTEESUVSSABUSCUITTON HHTVPSCHTTAPAIGHDG-KAHFPREGVFVSNGTHFFORTSSYNTEESUVSSABUSCUITTON HHTVPSTRUVTAVSSECLIGUGGUNGVENGENISSIONTGGSYNTEESUVSSABUSCUITTON HHTVPSTRUVTAVSSECLIGUGGUNGVENGENISSIONTGGSYNTEESUVSSABUSCUITTON HHTVPSTRUVTAVSSECLIGUGGUNGVENGENISSIONTGGSYNTEESUVSSABUSCUITTON HHTVPSTRUVTAVSSECLIGUGGUNGVENGENISSIONTGGSYNTESINASVNII HTVLETOVISSAAUSSECLIGUGUNSSEELDSYFKNHTSSPUDLGGISGNASVNII VYNSTGAVVIGUNNTVYDELO	987 1002 970 1091 1084 885 1068 1068 1068 1068 11068 11068 1107 11144 945 1128 1103 1119 1202 1005 11087 1209 1202 1005 1168 1163 1179 1147 1268 1268 1268 1268
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Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike NL63 spike NL63 spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike OC43 spike HKU1 spike 229E spike NL63 spike NL63 spike	928 943 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1051 1145 946 1129 1104 1120 1145 1220 1203 1088 1210	SALGKIODVINONAQALNTUVKQUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO TALGKIODVINONAQALNTUVKQUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO TALGKIODVINONAQALNTUVKQUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRUO SALGKIODVINONAQALNTUVKQUSSNFGAISSVINDULSRUKVEAEVOIDRLITGRU TALGKIODVINONAQALNTUVKQUSSNFGAISSIDELISRUBLEAEVOIDRLITGRU TALGKIODVINONAQALNTUVKQUSSNFGAISSIDELISRUBLEAEVOIDRLITGRU TALKKIODVINONQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDRLITGRU TALNKIODVINOQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDRLITGRU TALNKIODVINOQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDRLITGRU TALNKIODVINOQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDRUTTGRU TALNKIODVINOQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDSIDADOVDRUTTGRU TALNKIODVINOQOSILHUTSDURONFGAISSIDALISRUKVEAEVOIDSIDADOVDRUTTGRU SLOTYVTOQUIRAAEIRASANIAATKISECVLGOSKRVDECGKGYHLMSFPOABHGVVF SLOTYVTOQUIRAAEIRASANIAATKISECVLGOSKRVDECGKGYHLMSFPOABHGVVF SLOTYVTOQUIRAAEIRASANIAATKISECVLGOSKRVDECGKGYHLMSFPOABHGVVF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGONHIISLVONAEYGLYF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGCMCHILSLVONAEYGLYF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGCMCHILSEVONAEYGLYF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGCMCHILSEVONAEYGLYF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGCMCHILSEVONAEYGLYF ALNAYSOOLSDITIIKAGSRATEKVNECVKSOSPRINFCGCMCHILSEVONAEYGLYF LHVYVSHTIKYTEVRSRRLAOQKNEUVSOSRIVCFCGMCHILSEVONAEYGLYF DINKYTEVYSTITAPICHCG-KAHFPREVFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCORGIAPKOYFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCORGIAPKOYFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSCIJCONGIAPKOYFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHFVICRNFYSEOIITDN HEYYMFIKYVINKYSPCIJCJSORGIAPKOYFVSNCTHFVICRNFYSEOIITDN HEYYMFIKYNINKAAGIOVDEIDSKEELDKYFKNHTSPDVDIGGISGNASVNI VYMSTQANYTKAPYVNINTYDPLOEEDSKEELDKYFKNHTSPDVDIGGISGNASVNI VYMSTQANYTKAPYVNINTYDPLOEEDSKEELDKYFKNHTSPDVDIGGISGNASVNI VYMSTQA	987 10022 970 1091 1084 885 1068 1068 1068 11068 11030 1151 1144 945 11030 1151 1128 11031 1128 11031 1129 12025 1188 1163 1179 1147 1262 1265 1248
Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike NL63 spike NL63 spike Spike Antigen SARS CoV2 spike SARS COV2 spike	9288 943 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1069 1048 1069 1145 1145 1145 1129 1104 1120 1088 2210 1120 1120 1120 1120 1120	SALGKLODVVNONAQALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLIGRLO SALGKLODVVNONAQALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLIGRLO TALGKLODVVNONAQALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLIGRLO SALGKLODVVNONAQALNTLVKOLSSNFGAISSJUDILSRLDKVBÆVOIDRLIGRLO SALGKLODVVNONAQALNTLVKOLSSNFGAISSJUDILSRLDKVBÆVOIDRLIGRLO SALGKLODVVNONAQALNTLVKOLSSNFGAISSJUDILSRLDALBÆVOIDRLIGRLO TALGKLODVVNOQGSLNHITSQLRONFGAISSJUDILSRLDALBÆVOIDRLIGRLO TALNKIDDVVNOQGSLNHITSQLRONFGAISSJUDILSRLDALBÆVOIDRLIGRLO LANKIDDVVNOQGSLNHITSQLRONFGAISSJUDILSSIDATUDRLOG SALGKLODVVNOQGSLNHITSQLRONFGAISSJUDISSIDATUDRLOG SALGKLODVVNOQGSLNHITSQLRONFGAISSJUDISSIDATUDSIDADOVDRLIGRLA LANKIDDVVNOQGSLNHITSQLRONFGAISSJUDISSIDATUDSIDADOVDRLIGRLA SLOTIVTOQLIRABEIRASANLARTKNSEVLGOSKAVDEGGGAVINDSFGAGSHINGSFOSADHGVVF SLOTIVTOQLIRABEIRASANLARTKNSEVLGOSKAVDEGGGAVINDSFGAGSHINGSFOSADHGVVF LNAVSOQLSDSTLVKFSAADAKEKNECVKSOSRINDEGGGAVHINGSFDSAHGVVF LNAVSOQLSDSTLVKFSAADAKEKNECVKSOSRINDEGGGAVHINGSFDSAHGVVF LNAVSOQLSDITLIKAGSRDLAQKVNECVKSOSRINDEGGANHILSLVONAFYGLF ALVASVENTITYTVRASRDLAQKVNECVKSOSRINDEGGANHILSLVONAFYGLF LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSRINDEGGANHILSLVONAFYGLIF LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSRINTEGGANHILSLVONAFYGLIF LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSNINGEGGANTISSVONFFD LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSNINGEGGANTISSVONFFD LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSNINGEGGANTISSVONFFD LNAFVSOVINKYTEVRASRDLAQKVNECVKSOSNINGEGGANTISSVONFFD LHVTVEDGEKNFTIAPAIGHG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HFYVEDGEKNFTIAPAIGHG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVYVESOEKNFTIAPAIGHDG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOEKNFTIAPAIGHDG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOEKNFTIAPAIGHDG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTIAPAIGHDG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTAPAIGHDG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTAPAIGHDEG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTAPAIGHDEG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTAPAIGHDEG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HHVVESOCKNFTAPAIGHDEG-KAFFREGVFVSNGTHFFDORNFFSOVITTDN HTVDEGENFTAPAIGEUSTUSSTANI HVVESOCKNFTAPAIGHDEGENSVEN	987 10022 970 1091 1084 885 1047 1068 1047 1108 1144 945 1128 1144 945 1129 1087 1209 1087 1188 1163 1179 1147 1268 1262 1264 1264
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike NL63 spike NL63 spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV3 spike OC43 spike NL63 spike HKU1 spike 229E spike NL63 spike Spike Antigen	928 943 943 911 1032 1025 826 1009 988 1003 971 1092 1085 886 806 1069 1048 1063 1051 1145 946 1120 1145 1145 1142 1200 1088 1210 1088 1210 1145 1145 1145 1145 1145 1145 1145 11	SALGKIODVINONAQALNTUVKOUSSNFGAISSUNDULSRUKVEAEVOIDRLIGRU ALSKIODVINONAQALNTUVKOUSSNFGAISSUNDULSRUKVEAEVOIDRLIGRU TALGKIODVINONAQALNTUVKOUSSNFGAISSUNDULSRUKVEAEVOIDRLIGRU TALGKIODVINONAQALNTUVKOUSSNFGAISSUDULSRUKVEAEVOIDRLIGRU ALGKIODVINONAQALNTUVKOUSSNFGAISSUOEUSRUDALEAEVOIDRLIGRU ALLSNGUVNANAQALNTUVKOUSSNFGAISSUOEUSRUDALEAEVOIDRLIGRU TALKIODVINOOGNSUNHUTSOLRONFGAISSUOEUSRUDEGGGYHLMSFOO SAUGKIODVINOOGNSUNHUTSOLRONFGAISSUOEUSRUVEGGGGYHLMSFOOSAENGUF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOSAENGUF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLMSFOOAENGUVF SLOTYVTOOLIRAAEIRASANLAATKNSECVLGOSKRVDEGGGGYHLISLVONAEYGLYF ALNAYSOOLSDITLIKAGSRAFEKVNECVKSOSRRUFGGGGYHLISLVONAEYGLYF ALNAYSOOLSDITLIKAGSRAFEKVNECVKSOSRRUFGGGGYHLISLVONAEYGLYF ALNAYSOOLSDITLIKAGSRAFEKVNECVKSOSRRUFGGGYHLISEVONAEYGLYF LHVYVSHUIKYTEVRSSRLAOGKNEUVSCVSOSRVGEGGYHLISEVONAEYGLITTDN HEYYKSOULNYTYERSSRLAOGKNEUVSCVSOSRVGEGGYHLISEVONAEYGLITDN HHTYVSOCUNYTAEVSSRLAOGKNEUFYF- VNNTHYHENGRYFEGOIITDDN HEYYKFISKIVSSGLUSGERIENKOEYF- VNNTHYHENGRYFEGOIITDDN HEYYKFISKIVNYSEGLUSGERIENKOEYF- VNNTHYHENGRYFESOIITDN HEYYKFISKIVNYSEGLUSGERIENKOEYF- VNNTHYHENGSYYNEETENN HEYVHIKVYNKAKSGLUSGENEIKKOEYF - VNNTHYHENGSYYNEETENN HEYVHIKVYNKAKSGUVGINGUSENESCUNVENUNYNNYFESINS UHTVLFISKIVNXSSGLUSGENEISKOUVNUNYNENGSYNNI TYNGNOUVIGIVNNTYDPLOEENSKEELDKYFKNHTSPUDIGBISGNASVVNI TYNGNOUTIINNTYDPLOEENSKEELDKYFKNHTSPUDIGBISGNASVVNI TYNGNOUTIINNTYDPLOEENSKEELDKYFKNHTSPUDIGBISGNASVVNI TYNGNUTIINNTYDPLOEENSKEELDKYFKNHTSPUDIGBISGNASVVNI TYNGNUTIINNTYDPLOEENSKEELDKYFKNHTSPUDIGBISGNASVNI VVMSTQANYKKARSELOVNITYDPLOEENSKEELDKYFKNHTSPUDIGBISGN	987 10022 970 1091 1084 885 1068 8047 1062 1030 1151 1128 1128 1129 1202 1005 1209 1209 1209 1209 1209 1209 1209 1209
Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike NL63 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike Spike Antigen SARS CoV2 spike	9288 943 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1069 1048 1069 1048 1051 1152 1145 1129 1104 1120 1088 1220 1089 1104 1120 1120 1120 1169 1120 1120 1120 1120 1120 1120 1120 112	SALGKLODVNONAQALNTLVKOLS NFGAISVIND LISKLÖKVBÆVOIDRLIGKLO ALGKLODVNONAQALNTLVKOLS NFGAISVIND LISKLÖKVBÆVOIDRLIGKLO TALGKLODVNONAQALNTLVKOLS NFGAISVIND LISKLÖKVBÆVOIDRLIGKLO TALGKLODVNONAQALNTLVKOLS NFGAISSVIND LISKLÖKVBÆVOIDRLIGKLO ALGKLODVNONAQALNTLVKOLS NFGAISSIDELS LIDLALÆROIDRLIGKL TALGKLODVNONAQALNTLVKOLS NFGAISSIDELS LIDLALÆROIDRLIGKL TALGKLODVNONAQALNTLVKOLS NFGAISSIDELS LIDLALÆROIDRLIGKL TALGKLODVNONAGALNHUTSULGVENFGAISSIDELS LIDLALÆROIDRLIGKL TALGKLODVNONOGSLINHITSULROFNIK SLOTVNOOGNISHHUTSULROFNIK SLOTVNOOGSLINHUTSULROFNIK SLOTVNOOLIRABEIRASNIATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE SLOTVNOOLIRABEIRASNIATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE LIRANKIODVNNOGSLÄNHUTSULRATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE LIRANKIODVNNOGSLÄNHUTSULRATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE LIRANKIODVNNOGSLÄNHUTSULRATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE LIRANKIODVNNOGSLÄNHUTSULRATKNSECVLOGSKRVDEGGGYHMESFPSABHGVVE LIRANKIODVNNOGSLÖKUKSARA LIRANKIODVNNOGSLÖKUKSARA LIRANKIODVNNOGSLÖKUKSARA LIRANKIODVNNOGSLÖKUKSAR LIRANKSOLSDITIKAGSRÄTEKNECVKSOSSRINEGGNGNHITSLVONAPYGLE LIRANKSOLSDITIKAGSRÄTEKNECVKSOSSRINEGGNGNHITSLVONAPYGLE LIRANKSOLSDITIKKASSRILAGOKVNECVKSOSSRINEGGNGNHITSLVONAPYGLE LINANSSOLSDITIKKASSRILAGOKVNECVKSOSSRINEGGNGNHITSLVONAPYGLE LINAVSSOLSDITIKKASSRILAGOKVNECVKSOSSRIVEGGNGTHFTSIVNABEGLITTDN HVTVESOKKPTTAPAIGHGG-KAHFPREGVFVSNGTHNEVORNFYEGOLITTDN HVTVESOKKPTTAPAIGHGG-KAHFPREGVFVSNGTNEFTSONFYGEOLITTDN HHVVLSTVVAKSSELOTIGVKLÖNGVNEVF-VSNGTNEFTSONFYEGOLITTDN HHVVLSTVKNKAKASSIGVUSULSONNIVLYSDEJCLOSGRAFTAPKOVFVSNGTNEFTSONFYGEOLITTDN HHVVLKDVKANSSELCVGORGTAPKOGFF HKONDSMFTGSSYNGEDTISSVNI HVVLSTGKNTNVVNDELOGELDSEKEELDKYFKNHTSPLVDLGGISGINASVNNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLGGISGINASVNNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLGGISGINASVNNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLGGISGINASVNNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLSDISD-TINASVNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLSDISD-TINASVNI TEVSGNODVIGIVNNTVDELOGELDSEKEELDKYFKNHTSPLVDLSDISD-TINASVNI TEVS	987 10022 970 1091 1084 885 1068 1047 1062 11030 1151 11144 945 1128 1103 1119 1087 1202 1005 1188 1163 1179 1147 1268 1268 1265 1248
Spike Antigen SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike CoC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike CoC43 spike HKU1 spike 229E spike NL63 spike NL63 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike CoC43 spike HKU1 spike 229E spike NL63 spike Spike Antigen SARS CoV2 spike	9288 943 943 911 1032 826 1009 988 1003 971 1092 1085 8866 1069 1048 1063 1031 1145 9466 1129 1104 1142 11088 1210 1008 1108 1203 1006 1189	SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO TALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONAQALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONAGALNTLVKOLSSNFGAISSVIND LISKLEKVEAEVOIDRLITGKLO SALGKI ODVINONGENSINHITSOLRONFGAISSSIQAIYDRLDJI OADOOVDRLITGKLO LALNKI ODVINOOGNSINHITSOLRONFGAISSSIQAIYDRLDJI OADOOVDRLITGKLO LALNKI ODVINOOGNSINHITSOLRONFGAISSSIQAIYDRLDJI OADOOVDRLITGKLO LALNKI ODVINOOGSSINHITSOLRONFGAISSSIQAIYDRLDJI OADOOVDRLITGKLO SLOTYVTOOLI IRAABI IRASANLAATKNSECVLGOSKRVDEGGGKGHLMSFPOSABHGVVF SLOTYVTOOLI IRAABI IRASANLAATKNSECVLGOSKRVDEGGGKGHLMSFPOSABHGVVF ALNAYVSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNGHLTISL VONAPYGLIYF ALNAYVSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNGHLTISL VONAPYGLIYF ALNAYVSOLSDSTIVKSSRCIAOCKNSOSSRINEGGGNGHLTISL VONAPYGLIYF LIVYVFALTIKYTEVRSSRCIAOCKNSOSSRINEGGGNGHLTISL VONAPYGLIYF ALNAFVSOVINKYTEVRSSRCIAOCKNSOSSRINEGGNGHTISL VONAPYGLIYF LIVYVFACGLISDTII KAGSSRI IEKVNECVKSOSNRYGEOGNGHTISL VONAPYGLIYF LIVYVFACGLISDTII KAGSSRI IEKVNECVKSOSNRYGEOGNGHTISL VONAPYGLIYF LIVYVFACGLISDTI IKAGSSRI IEKVNECVKSOSNRYGEOGNGHTISL VONAPYGLIYF LIVYVFACGLISCHTTAPAICHG-KAHFPREGVFVSNGTHHFVIORNFYEFOIITTDN HVTYVFACGLISCHTTAPAICHGG-KAHFPREGVFVSNGTHHFVIORNFYEFOIITTDN LHVTYVFACGLISGCKNETTAPAICHGG-KAHFPREGVFVSNGTHHFVIORNFYEFOIITTDN HENVYFINYTAVSDELCILGAGRAFIAPKGYFIKONDSMFIGSSYYFEFISOIITTDN LHVTYVFACULTAVSTARDOCLILAGARAFIAPKGYFIKONDSMFIGSSYYFEFISOIITTDN HENVYFINYTAVSDELCILGAGRAFIAPKGYFIKONDSMFIGSSYYFEFISOIITTDN HENVYFINYTAVASGELCILGAGRAFIAPKGYFIKONDSMFIGSSYYFEFISON HEVVLFTAPYVITAVSDELCILGARGAFIAPKGYFIKONDSMFIGSSYYFEFISON HEVVLFTANSVANASSICVOGINGVVROPKNISSINASVNI TYVGSG CDVIGIINNTYDPLOEDISFKEELDKYFKNHTSPUNDLGDISGNASVNI TYVGSG CDVIGUNNTYDPLOEDISFKEELDKYFKNHTSPUNDLGGISSTNASVNI TYVGSG CDVVIGUNNTYDPLOEDISFKEELDKYFKNHTSPUNDLGGISG	987 10022 970 1091 1084 885 1068 8047 1062 1030 1151 1128 1128 1128 1129 1202 1005 1163 1179 1147 1262 1065 1248 1197 1227
Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike Spike Antigen SARS CoV2 spike SARS CoV2 spike	9288 943 943 911 1032 826 1009 9888 1003 971 1092 1085 1069 1048 1069 1048 1069 1048 1052 1145 1145 1145 1129 1104 1120 1088 1120 1088 1164 1180 1148	SALGKLODVNONAOALNTLVKOLSSNFGAISSVINDILSRLDKVBÆVOIDPLITGRLO SALGKLODVNONAOALNTLVKOLSSNFGAISSVINDILSRLDKVBÆVOIDPLITGRLO TALGKLODVNONAOALNTLVKOLSSNFGAISSVINDILSRLDKVBÆVOIDPLITGRLO TALGKLODVNONAQALNTLVKOLSSNFGAISSVINDILSRLDKVBÆVOIDPLITGRLO TALGKLODVNONAQALNTLVKOLSSNFGAISSJUPLSRLDALBÆVOIDPLITGRLO SALMKLOAVNANABALNNILGOLSNFFGAISSJUPLSRLDALBÆVOIDPLITGRLO TALSKLODVNNOGSSLNHITSULFØISSIGAIVDRUGTUSSIGANOOVDRLITGRLA TALSKLODVNNOGSSLNHITSULFØISSIGAIVDRUGTUSSIGANOOVDRLITGRLA LANKLODVNNOGSSLNHITSULFØISSIGAIVDRUGGKVEGGGGVHLMSFPOSABHGVVF SLOTVTOOLIRABEIRASANLAATKVSECVLGOSKRVEGGGGVHLMSFPOSABHGVVF SLOTVTOOLIRABEIRASANLAATKVSECVLGOSKRVEGGGGVHLMSFPOSABHGVVF ALNAVSOOLSDSITVKFSAADAAKKVSCVKGOSKRVEGGGGGVHLMSFPOSABHGVVF ALNAVSOOLSDSITVKFSAADAÆKVNECVKSOSSRINGEGGGGNHISSUVAAPGLE ALNAVSOOLSDSITVKFSAADAÆKVNECVKSOSSRINGGGGGGNHISSUVAAPGLE ALNAVSOOLSDSITVKFSAADAÆKVNECVKSOSSRINGGGGGNHISSUVAAPGLE ALNAVSOOLSDSITVKFSAADAÆKVNECVKSOSSRINGGGGGGTHIFSLVNAAPGLE ALNAVSOOLSDITIKKASSRLADGKVNECVKSOSSRINGGGGGNHISSUVAAPGLE ALNAVSOOLSDITIKSABJEDGEGKAVFFGGVFVSNGTHFVORNFVEGUTITDN HYTVFSQUENKTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHFTIAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KAHFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KANFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KANFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KANFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KANFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTTAPAIGHGG-KANFPREGVFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKHTAPAIGUTEGUTIGTAPAOUTFVSNGTHNFVORNFVEGUTITDN HUVFYFYUGKKNTAVSSTRUCHSTANTONTONTONTONTONTONTONTONTONTONTONTONTON	987 1002 970 1091 885 1068 1047 1062 1030 1151 1144 945 1128 1103 1119 1087 1209 1087 1209 1147 1209 1147 1268 1268 1268 1147 1268 1268 1197 1125 1248
Spike Antigen SARS CoV2 spike SARS CoV spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SPike Antigen SARS CoV2 spike SPike Antigen SARS CoV2 spike SARS CoV2 spike SPike Antigen SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike SARS CoV3 spike CC43 spike	9288 943 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946 1120 1088 1210 1088 1210 1088 1210 1088 1210 1145 1203 1069 1148 1203 1069 1148 1203 1069 1152 1152 1152 1155 1155 1155 1155 115	SALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONAQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO TALGKI ODVINONQALNTI VKOLSSN FGAISSVIND ILSRLDKVEAEVOIDRLITGRLO SALGKI ODVINONQALNTI VKOLSSN FGAISSVIND ILSRLDKLEAEVOIDRLITGRLO SALGKI ODVINONGOSILNHITSOLRON FGAISSSIQAIYD RLDI I OADOOVDRLITGRLO TALNKI ODVINOOGSILNHITSOLRON FGAISSSIQAIYD RLDI I OADOOVDRLITGRLO SLOTYVTOOLI RAABI RASANLAATKNSECVLGOSKRVDEGGGGYLDMSFPOSABHGVVF SLOTYVTOOLI RAABI RASANLAATKNSECVLGOSKRVDEGGGGYLDMSFPOSABHGVVF ALNAYKSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKYFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKYFSAAOAMEKVNECVKSOSSRINEGGGNAHIISL VONAPYGLIF ALNAYKSOLSDSTIVKYFSAAOAMEKVNECVKSOSNENGEGGGGTHIPSIVNSPEDITITUN IHVYYFYTYSSOLSDSTIVKYFSAAOAMEKVNECVKSOSNENGEGGGGTHIPSIVNSPEDITITUN HVYYFSACINFYTYPISSRIDAOCKNECVKSOSNENGEGGGGTHIPSIVNSPEDITITUN IHVYYFYTYSSOLSDSTIVKYFYTTAAICHDG-KAHFPREDVFVSNGTHHFVTORNFYBEQIITTUN HHVYVFYTYSSOLSDI LIKAGSSNID AKTERVYFYTYSSOLSDI TUNSSAAF HTVLETTYNTSORGENTTAAICHDG-KAHFPREDVFVSNGTHHFVTORNFYBEQIITTUN HHVYVESSOKUPTTAAICHDG-KAHFPREDVFVSNGTHHFVTORNFYBEQIITUN HHVYVESSOKUPTTAAICHDG-KAHFPREDVFVSNGTHHFVTORNFYBEQIITUN HHVYVESSOKUPTTAAICHDG-KAHFPREDVFVSNGTHHFVTORNFYBEQIITUN HHVYVENSOKANFYTAAICHSINSSONNI HTVLETTYNINSKNNSSONNI HTVLETTYNINSSYNI HTVLETTYNINSKYNNNSSONNI STAGANGVYGGVUGUNNIYVDELGELDSFKEELDXFFKNHTSSPUDIGGI SGNASVNNI HTVLETTYNINSKYNNNSSONNI TYVGNNGGNNYKKAPYVHINSSINNSSKELDVNINTYNDELGELDSFKEELDXFFKNHTSSPUDIGDI SGNASVNNI TYVGNGGNYTKAPYVNINSSELOUNGEL	987 1002 970 1091 1084 885 1068 885 1068 1068 1103 1114 1144 1128 1128 1129 1202 1005 1147 1262 1045 1248 1197 1227 1316
Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike NL63 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike	928 943 943 941 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1069 1048 1069 1048 1152 1145 1152 1145 1203 1004 1129 1104 1120 1088 1210 1088 1210 1089 1085 1089 1085 1085 1085 1085 1085 1085 1085 1085	SALGKLODVVNONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLITGRLO SALGKLODVVNONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLITGRLO TALGKLODVVNONAOALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLITGRLO TALGKLODVVNONAGALNTLVKOLSSNFGAISSVIND ILSRLDKVBÆVOIDRLITGRLO SALGKLODVVNONAGALNTLVKOLSSNFGAISSJUP ILSRLDLALBADOIDRLITGRLO TALGKLODVVNONAGALNTLVKOLSSNFGAISSJUP ILSRLDLALBADOIDRLITGRLO TALSKLODVVNOGSLNHITSULFORFGAISSJUP ILSRLDLALBADOIDRLINGRLT TALSKLODVVNOGSLNHITSULFORFGAISSJUP ILSRLDLALBADOIDRLINGRLT TALSKLODVVNOGSLNHITSULFANFGAISSJUP ILSRLDLALBADOIDRLINGRLT TALSKLODVVNOGSLNHITSULFANFGAISSJUP ISSJUP ILSRLDLALBAOVOPRLITGRLA LANKLODVVNOGSLNHITSULFANFGAISSJUP ISSJUP ISS	987 1002 970 1091 1084 885 1068 1068 1068 1047 1062 1068 1151 1144 945 1128 1144 945 1128 1144 945 1129 1202 1202 1202 1148 1262 1165 1248 1197 11268 1248 1197 1127 1310
Spike Antigen SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike SARS CoV2 spike SARS CoV2 spike OC43 spike HKU1 spike 229E spike NL63 spike SARS CoV2 spike	9288 943 943 911 1032 826 1009 988 1003 971 1092 1085 886 1069 1048 1063 1031 1152 1145 946 1129 1104 1120 1088 1210 1088 1210 1189 1164 1189 1263 1066	SALGKLOUVVNONAQALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO SALGKLOUVVNONAQALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO TALGKLOUVVNONAQALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO TALGKLOUVVNONAQALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO TALGKLOUVVNONAQALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO TALGKLOUVVNONAALNITUVKOLSSNFGAISSVLNDLISELDKVEAEVOIDPLITGELO TALGKLOUVVNANAQALNITUVKOLSSNFGAISSVLNDLISELDKLEAEVOIDPLITGELO TALGKLOUVVNANGALNITUSULOODINFGAISSSIQAIYDRLDISIQADOVDRLITGELA TALNKIODVVNOOGISLNHITSOLRONFGAISSSIQAIYDRLDISIQADOVDRLITGELA TALNKIODVVNOOGISLNHITSOLRONFGAISSSIQAIYDRLGGGKYLDEGGGKYLLMSFPOSAEHGVVF SLOTYVTOOLIRAAEIRASANLAAIKNSECVLGOSKRVDEGGGKYLLMSFPOSAEHGVVF ALNAYKOOLSDITLIKAGSRNITAAIKNSECVLGOSKRVDEGGGKYLLMSFPOSAEHGVVF ALNAYKSOOLSDITLIKAGSRNITEKNECVKSOSSRINEGGGNNHILSLVONAEYGLM ALNAYKSOOLSDITLIKAGSRNITEKNECVKSOSSRINEGGGNNHILSLVONAEYGLM ALNAYKSOOLSDITLIKAGSRNITEKNECVKSOSSRINEGGGNNHILSLVONAEYGLLF ALNAYKSOOLSDITLIKAGSRNITEKNECVKSOSSRINEGGGNNHILSIVONAEYGLU HVYVENAITKYTEVRSSRLAOCKVNECVKSOSNRVGEGGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSSRLAOCKVNECVKSOSNRVGEGGGNTHISSIVONAEYGLU HVYVEDGULTYTUVLAKSBOLOGUKNECVKSOSNRVGEGGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSSRLAOCKVNECVKSOSNRVGEGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSSRLAOCKVNECVKSOSNRVGEGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSRLAOCKVNECVKSOSNRVGEGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSRLAOCKVNECVKSOSNRVGEGGNTHISSIVONAEYGLU LHNYFVENUTKYTEVRSRLAOCKVNECVKSOSNRVGEGGNTHEFUNGNNFYSGUITTDN HENYFYFVINAKYSOLICIGAGIAPKOYFVSNGTHNFVORNFYSGUITTDN HENYFYFVINAKYSOLICIGSORGIAPKOYFINONDSNHFGSSYYTEPITENN HENYGRUVIGUVNNTYDELOELISKEELDKYFKNHTSPIVULGGISGINASVVNI TEVSGRODVIGUVNNTYDELOELISKEELDKYFKNHTSPIVULGDISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPIVULGISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPIVULGISGINASVVNI VVMNTGANNFKAFTYINNSIDNISDELOELSKEELDKYFKNHTSPIVDLGDISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPIVULGISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPIVULGISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPIVULGISGINASVVNI TEVSGRODVIGUNNTYDPLOELDSKKELDKYFKNHTSPI	987 1002 970 1091 1084 885 1068 1068 1047 1062 1151 1144 1147 1202 1005 1188 1163 1179 1202 1105 1248 1179 1248 1197 1224 1197 1225 13166 1310

Figure 2. Cont.

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3%
2%

Figure 2. Multi-alignment analysis of the spike S2 domain of SARS-CoV-2, SARS-CoV, and alpha (229E and NL63) and beta (OC43 and HKU1) human coronaviruses. Similarity and identity are indicated as orange boxes and red boxes, respectively.

Spike Antigen	300 TSNFRVOP	TE <mark>SIVR</mark> FPNITNL	PFGEVFNATRFASV)	AWNRKRISNCVA	ADYSVLYN <mark>S</mark> ASF	35
SARS CoV2 spike	315 TSNFRVOP	TE <mark>SIVR</mark> FPNITNL	PFGEVFNATRFASV)	AWNRKRISNCVA	ADYSVLYN <mark>S</mark> ASF	37
SARS CoV spike	306 TSNFRVSP	THEVIRFPNITNRC	PFDKVFNASRFPNV	AWERTKISDCVA	ADYTVLYN <mark>S</mark> TSF	36
OC43 spike	419 QLGNLGYL	QS <mark>S</mark> NY <mark>R</mark> IDTTATS <mark>C</mark>	QL <mark>Y</mark> YN <mark>LPA</mark> ANVSVSF	RFNPSTWNKRFGE	FIEDSVFV <mark>P</mark> QPT	47
HKU1 spike	402 QLGSSGFL	QS <mark>S</mark> NY <mark>K</mark> IDISSSS	QL <mark>Y</mark> YS <mark>LPL</mark> LNVTINN	VFNPSSWNRRYGE	FGSFNV <mark>S</mark> SYD	45
229E spike	184 GALPKTVR	EF <mark>V</mark> IS <mark>R</mark> TGHFYIN <mark>G</mark>	YR <mark>Y</mark> FS <mark>LGN</mark> VEAVNFN	WTNAATTVC-TV	/ALASYAD <mark>V</mark> LVN	24
NL63 spike	367 GILPPTVR	EI <mark>V</mark> VA <mark>R</mark> TGQFYIN <mark>G</mark>	FK <mark>Y</mark> FD <mark>L</mark> G <mark>F</mark> IEAVNFN	NVTTASATDFWTV	/AFATFVD <mark>V</mark> LVN	42
		-				
Spike Antigen	360 ST <mark>F</mark> KCYG <mark>V</mark>	SPTKLNDLCFTNVY	AD <mark>SF</mark> VIRGDEVRQI	A <mark>P</mark> GQ T GKIAD <mark>Y</mark> NY	KLPDDFTGCVI	41
SARS CoV2 spike	375 STFKCYG <mark>V</mark>	SPTKLNDLCFTNVY	AD <mark>SF</mark> VIRGDEVRQI?	A <mark>P</mark> GQ T GKIAD <mark>Y</mark> NY	KLPDDFTGCVI	43
SARS CoV spike	366 ST <mark>F</mark> KCYG <mark>V</mark>	SPSKLIDLCFTSVY	AD <mark>TF</mark> LIRSSEVRQVA	A <mark>P</mark> GE <mark>T</mark> GVIAD <mark>Y</mark> NY	KLPDDFTGCVI	42
OC43 spike	479 GV <mark>F</mark> TNHS <mark>V</mark>	VYAQHCFKAPKNF4	PC <mark>SS</mark> CPGKNNGIGT(CPAGTNHLTCD		52
HKU1 spike	460 VV <mark>Y</mark> SDHC <mark>F</mark>	SVNSD-FCPCADPS	SVV <mark>NS</mark> CVKSKPLSAIO	C <mark>P</mark> AG <mark>T</mark> KYRHC <mark>D</mark> LI	DTTTLYVKNWCR	51
229E spike	243 VS <mark>Q</mark> TAIA <mark>N</mark>	IIYCNSVINRLRCI)QL <mark>SF</mark> DVPDGFYSTSI	P <mark>IQPV</mark> ELPVS <mark>I</mark> VS	SLPVYHKHTFIV	30
NL63 spike	427 VS <mark>A</mark> TKIQ <mark>N</mark>	LYCDSPFEKLQCE	CHL <mark>QF</mark> GLQDGFYSANH	F <mark>L</mark> DD <mark>N</mark> VLPET <mark>Y</mark> VA	ALPIYYQHT	48
Spike Antigen	420 AWNSNNLD	SKVGGNYNYLYRLF	RKSNLKPFERDISTE	EIYQAGSTPCNGV	EGFNCYFPLQS	47
SARS CoV2 spike	435 AWNSNNLD	SKVGGNYNYLYRLF	RKSNLKPFERDISTE	CIYQAGSTPCNGV	EGENCYFPLQS	49
SARS COV spike	426 AWNTAKQD	QGQY-Y-YRSS	RETELEPPERDLISI	DENGV	RTLST	46
OC43 spike	526 NLCTLDPI	SFKAPDTYKCPQTF	(SLVGIGEHCSGLAVE	KSDYCGNNS	CTCQPQAFLGW	58
HKU1 spike	519 CSCLPDPI	STYSPNTCPQKF	WVVGIGEHCPGLGI	NEEKCGIQLNHI	CSCSPDAFLGW	57
229E spike	303 LHVNFEHQ	RG-PGKCYNCRPSV	INITLANFNETKGPI	LCVDTSHFTTQFV	-DNVKLAR	35
NL63 spike	484 -DINFTAT	ASFG <mark>G</mark> SCYV <mark>C</mark> KPHQ	VNIS <mark>L</mark> -NGNTS	/CVRT <mark>S</mark> HFSI <mark>R</mark> YI	YNRVKSGS <mark>P</mark> GD	53
Spike Antigen	490 VCEODINC	VODVDUUUT SEE	TTUNDATUCCD	NIT UPNPCUNENE		E 2
SARS CoV2 spike	405 VCFOPING	VOI VEI NUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU	TINADATUCCONNE	NI UNNECONENE		55
SARS COV spike	467 VDEVDNUD	TEVONTOWNUSEE	TINADATUCCO	CI VENOCUNENE	INCL KGTOULTD	52
OC43 spike	582 SADSCLOG	DECUTEANETLHDY	NNGLTCSTDLOKAN	FIFLGVCVNYDI	YGISGOGIEVE	64
HKU1 enike	577 SEDSCISN	NDCNTESNETENGT	NSGTTCSNDLL	FVSTGVCVNVDI	VETTOOCTERE	63
229E spike	358WSASIN	TGNCPESEGKVNNE	VKFGSVCFSLKDIP	GCAMPTMANLVN	HKSHNTGSLYV	41.
NL63 spike	539 SSWHIYLK	SGTCPESESKLNNE	OKEKTICESTVEVE	SCNEPLEATWHY	TSYTTYGALYV	59
	Similarlit	y Identity				
SARS CoV-2	1009	× 100%				
SARS CoV	92.69	× 70.7%				
0042	42.40	0 10.170				
0043	43.49	/0 8.5%				
HKU1	419	% 8.7%				
229E	53.19	% 17%				

S1 RBD (receptor binding domain)

Figure 3. Multi-alignment analysis of the spike S1 receptor-binding domain of SARS-CoV-2, SARS-CoV, and alpha (229E and NL63) and beta (OC43 and HKU1) human coronaviruses. Similarity and identity are indicated as orange boxes and red boxes, respectively.

3.2. Humoral Immunity to SARS-CoV-2 before and during Pandemic

10.2%

38.2%

NI 63

Since we found the relatively conserved region of the N RNA-binding domain and a part of S2 domain among SARS-CoV-2, SARS-CoV and endemic low-pathogenic hCoVs, we decided to evaluate the presence of IgG cross-reacting to the N, S1 and S2 domains in sera obtained before the SARS-CoV-2 pandemic. Among 368 serum samples obtained before 2019, 13.3% already contained IgG bound to N (IgG N) whereas IgG bound to S (IgG S) were rarely detected (1.4%) (Figure 4a). IgG N titers varied according to season, becoming highest in winter (25%) and lowest in summer (9.3%) (Figure 4b), suggesting that the acquisition of IgG N occurred in the winter when hCoVs were seasonally prevalent. The neutralizing activity of serum samples on SARS-CoV-2 S1 RBD and ACE2 binding was measured, and IgG S-positive sera showed no inhibitory effects on binding to SARS-CoV-2 S1 RBD and ACE2 (Figure 4c, green bars). These data suggested that the IgG S detected before the pandemic most likely recognized the S2 domain conserved in SARS-CoV-2 and hCoVs (Figure 2), and this immune memory acquisition was a rare event without an inhibitory effect on virus-receptor binding. Humoral immunity to SARS-CoV-2 N and S was tested in an additional 1423 patients without a medical history of COVID-19 during the pandemic. Again, 6.6% and 1.5% of their serum samples showed positivity to IgG N and IgG S, respectively (Figure 4d). Among them, 18 of 1423 cases had IgG S but not

IgG N (Figure 4c, light blue bars), and again these sera showed no inhibitory effects on binding to SARS-CoV-2 S1 RBD and ACE2. Only two patients (0.14%) had both IgG N and S, and only these serum samples showed neutralizing activity against S1 RBD and ACE2 binding (Figure 4c, orange bars). These data indicated that the presence of IgG N or S alone designates the humoral immune memory to N or S induced by endemic hCoVs, whereas simultaneous IgG responses to N and S reflect the SARS-CoV-2 post-infection status during the pandemic. Thus, the asymptomatic SARS-CoV-2 infection rate in Kanazawa Japan in November and December 2020 was estimated as 0.14%.



Figure 4. Humoral immunity to SARS-CoV-2 N and S proteins in sera obtained before and during pandemic. (**a**) IgG N and S titers of serum samples obtained before the COVID-19 pandemic (n = 368). X and Y axes indicate the OD values at 450 nm absorbance evaluated by the Quo Research ELISA system. (**b**) IgG N titers of serum samples obtained before the COVID-19 pandemic according to season (n = 368). Serum samples obtained from March to May, June to August, September to November, and December to February were regarded as samples obtained in spring, summer, autumn, and winter, respectively. (**c**) Neutralizing activity of serum samples regarded as IgG S (+) before and during the pandemic on S1 RBD and ACE2 binding. (**d**) IgG N and S titers of serum samples obtained during the COVID-19 pandemic (n = 1423). X and Y axes indicate the OD values at 450 nm absorbance evaluated by the Quo Research ELISA system.

The above data indicated that the positive rate of IgG N during the pandemic (6.6%) was relatively lower compared with that before the pandemic (13.3%). Lifestyle dramatically changed during the pandemic and potentially reduced the frequency of hCoVs exposure, which might result in the low frequency of IgG N positivity during the pandemic. Since 219 patients' sera from 368 pre-pandemic cases were obtained in 2020, we evaluated the serial changes of IgG N titers before and during the pandemic in these 219 cases. We found that 32 of 35 IgG N positive patients before the pandemic showed negative IgG responses to N during the pandemic, whereas 16 of 184 IgG N-negative patients had positive IgG responses to N during the pandemic (Figure 5). These data suggested that IgG N titers are variable and not stable, potentially associated with the status of being exposed to pathogens, which might be related to lifestyle changes such as wearing masks and adhering to social distance during the COVID-19 pandemic in 2020.



Figure 5. Heatmap images of IgG NC titers of serial serum samples from the same cases obtained before and during the COVID-19 pandemic (n = 219). One hundred sixty-eight serum samples (76.7% of tested cases) had no IgG N before and in 2020 (not depicted here). A total of 32 of 35 patients that were positive for IgG N before 2020 became negative in 2020 (indicated as group A), whereas 16 of 184 patients that were negative for IgG N before 2020 became positive in 2020 (group B). Yellow and blue cells depict high and low IgG NC titers (OD values at 450 nm absorbance), respectively.

3.3. Humoral Immunity and Clinical Outcome in Critical COVID-19 Patients

We evaluated the value of IgG N measurements on the clinical outcome of COVID-19 patients. IgG responses to N and S were evaluated in 48 COVID-19 patients who received intensive care; 27 and 21 of these patients were diagnosed with severe or critical disease on admission, respectively. IgG N elevation was already present in 23 patients (48%), whereas only 2 patients (4.2%) showed IgG S elevation within 14 days (Figure 6a,b). Rapid elevation of IgG N was detected in a subset of COVID-19 patients within 7 days, whereas IgG S elevation was only noted at 11 days or later from symptom onset (Figure 6b). These data clearly indicated the different immune responses to N and S in severe/critical COVID-19 patients. Rapid IgG N elevation could be attributed to the boost effect due to the presence of humoral immune memory acquired by prior hCoVs infection, whereas the lack of rapid IgG S elevation was due to this being the participant's first exposure to the unique S protein of SARS-CoV-2. Since none of severe COVID-19 patients died, we focused on the characterization of the clinical outcome of 21 critical disease patients. Among the known risk factors such as age, obesity, hypertension and diabetes, age was associated with high mortality with borderline significance (Figure 6c, p = 0.074). Moreover, all 11 patients with humoral immune memory to N survived, whereas 4 of 10 without humoral immune memory died (Figure 6d, p = 0.022), suggesting a role of humoral immunity in reducing mortality.



Figure 6. Humoral Immunity to SARS-CoV-2 in hospitalized COVID-19 patients. (a) IgG N titers of COVID-19 patients diagnosed with severe (green circles) or critical (red circles) disease. (b) IgG S titers of COVID-19 patients diagnosed with severe (green circles) or critical (red circles) disease. (c) Kaplan–Meier survival curves of critical COVID-19 patients according to age (blue bar; age < 65, red bar; age \geq 65). (d) Kaplan–Meier survival curves of critical COVID-19 patients with (red bar) or without (blue bar) humoral immune responses to SARS-CoV-2 N.

4. Discussion

Recent evidence suggests the pre-existence of humoral and cellular immunity crossreacts with SARS-CoV-2 proteins potentially acquired by seasonal endemic hCoVs infection before the pandemic [3–6]. Although its role on the outcome of COVID-19 remains elusive, a recent study indicated that T cell immune responses may have played a fundamental role in the clinical outcome of COVID-19 patients who recovered or died during intensive care hospitalization [7]. In general, children are less susceptible to severe COVID-19, and a recent study suggested that a significant proportion of children had detectable cross-reactive antibodies to SARS-CoV-2 proteins potentially evoked by endemic hCoVs infection [2]. Indeed, B cells in human tonsillar tissues obtained from children who were negative for COVID-19 prior to the pandemic could generate SARS-CoV-2 reacting antibodies [8]. These data suggest the role of pre-existing humoral and cellular immunity in cross-reacting to SARS-CoV-2 in terms of disease severity and clinical outcome for COVID-19 patients.

A recent study indicated that pre-existing polymerase-specific T cells expansion plays a crucial role in the clearance of SARS-CoV-2 before the clinical manifestation of COVID-19 [9], suggesting that replication complex proteins as well as spike proteins could be targets for vaccines against SARS-CoV-2 infection. Consistently, our data indicated that cross-reactive humoral immunity to SARS-CoV-2 N might have preventive effects on the mortality of critical COVID-19 patients. Indeed, a study suggested that recent endemic hCoVs infection was associated with less-severe COVID-19 [10]. SARS-CoV-2 N might enhance the infectivity of S particles [11], which may be abolished by the humoral immune responses targeting N. Thus, measurements of humoral immunity potentially acquired by endemic hCoVs may have a prognostic value for the clinical outcome of COVID-19 patients.

Our data demonstrated that about 50% of critical COVID-19 patients in Japan showed antibody responses to SARS-CoV-2 N. A recent study utilized a single cell sequencing approach to clarify the evolution of memory B cells acquired by SARS-CoV-2 [12]. Interestingly, with severe COVID-19, substantial populations of endemic hCoVs-reactive antibody-secreting cells were identified, signifying preexisting immunity evoked by SARS-CoV-2. Importantly, although monoclonal antibodies targeting SARS-CoV-2 N were rapidly generated, they showed non-neutralizing and non-protective effects on SARS-CoV-2 infection using an animal model. Consistently, our data showed that humoral immune memory to SARS-CoV-2 N did not prevent infection, indicating the importance of vaccinations specifically targeting SARS-CoV-2 S RBD.

Our study has several limitations. A primary limitation of this study was that the number of severe/critical COVID-19 patients recruited was small, and we could not fully compare the protective effects of humoral immune status and other known risk factors such as age, obesity, hypertension and diabetes by multivariate analysis due to the small sample size. This study only evaluated the IgG reactivity to SARS-CoV-2 N and S but no other structural/non-structural proteins. Furthermore, serum samples were collected only once at different timepoints after symptom onset on the day of hospitalization, due to the shortage of medical resources and staff, which hampered the time-course analysis of IgG N and S in these patients. Besides, we arbitrarily hypothesized that the presence of IgG N within 10 days after symptom onset in COVID-19 patients might be due to the presence of immune memory to SARS-CoV-2 N acquired by prior hCoVs infection. However, multiple factors can affect both the induction and duration of antibody responses. Immune memory should be ideally evaluated using a B cell ELISPOT assay using N antigen, which we could not conduct due to technical issues at this time. Disease severity is the strongest risk factor for COVID-19 patients' mortality irrespective of IgG N responses. Future studies are urgently required to test the frequency of memory B cells responding to SARS-CoV-2 N in the general population.

5. Conclusions

Subjects had humoral immunity to SARS-CoV-2 N before the pandemic, and early humoral immune responses were observed in approximately 50% of hospitalized severe/critical COVID-19 patients in Japan. Although this humoral immunity did not prevent infection, it might prevent critically ill patients from dying.

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