



## Full-genome sequences of the first two SARS-CoV-2 viruses from India

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**Background & objectives:** Since December 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has globally affected 195 countries. In India, suspected cases were screened for SARS-CoV-2 as per the advisory of the Ministry of Health and Family Welfare. The objective of this study was to characterize SARS-CoV-2 sequences from three identified positive cases as on February 29, 2020.

**Methods:** Throat swab/nasal swab specimens for a total of 881 suspected cases were screened by *E* gene and confirmed by *RdRp* (1), *RdRp* (2) and *N* gene real-time reverse transcription-polymerase chain reactions and next-generation sequencing. Phylogenetic analysis, molecular characterization and prediction of B- and T-cell epitopes for Indian SARS-CoV-2 sequences were undertaken.

**Results:** Three cases with a travel history from Wuhan, China, were confirmed positive for SARS-CoV-2. Almost complete (29,851 nucleotides) genomes of case 1, case 3 and a fragmented genome for case 2 were obtained. The sequences of Indian SARS-CoV-2 though not identical showed high (~99.98%) identity with Wuhan seafood market pneumonia virus (accession number: NC 045512). Phylogenetic analysis showed that the Indian sequences belonged to different clusters. Predicted linear B-cell epitopes were found to be concentrated in the S1 domain of spike protein, and a conformational epitope was identified in the receptor-binding domain. The predicted T-cell epitopes showed broad human leucocyte antigen allele coverage of A and B supertypes predominant in the Indian population.

**Interpretation & conclusions:** The two SARS-CoV-2 sequences obtained from India represent two different introductions into the country. The genetic heterogeneity is as noted globally. The identified B- and T-cell epitopes may be considered suitable for future experiments towards the design of vaccines and diagnostics. Continuous monitoring and analysis of the sequences of new cases from India and the other affected countries would be vital to understand the genetic evolution and rates of substitution of the SARS-CoV-2.

**Key words** Epitope - genomes - India - Kerala - next-generation sequencing - phylogeny - real-time reverse transcription-polymerase chain reaction - severe acute respiratory syndrome coronavirus 2

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The *Coronaviridae* family encompasses viruses with a single-stranded, positive-sense RNA genome of size approximately 26-32 kb. Initially, the virus was associated with human and animal infections that caused intestinal as well as respiratory infections<sup>1,2</sup>. In 2002, the severe acute respiratory syndrome (SARS) coronavirus (CoV) outbreak that claimed the lives of many people in China raised the alarm towards these viruses<sup>2</sup>. Further, after a decade, another human pathogenic virus emerged, Middle East respiratory syndrome CoV (MERS-CoV) that affected the Middle Eastern countries<sup>2</sup>. Current knowledge identifies six virus groups that can infect humans<sup>3</sup> in the *Coronaviridae* family, which includes SARS-CoV (now termed as SARS-CoV-1) and MERS-CoV.

Recently in December 2019, China reported cases with pneumonia of unknown aetiology in the Hubei province, Wuhan city<sup>4</sup>. Further analysis of these cases was carried out to identify the causative agent of pneumonia<sup>5</sup>. Virus isolation and genomic characterization of the complete sequence of the virus through next-generation sequencing (NGS), identified it as a novel CoV, named 2019-nCoV<sup>3</sup>. The virus characterization revealed that it is an enveloped RNA virus with a genome size of 29,903 bp. The phylogenetic analysis of the sequence showed that it belonged to the *Sarbecovirus* subgenus of genus *Betacoronavirus* and the family *Coronaviridae*. The sequence was closely related (~87.5% sequence similarity) to two bat-derived SARS-like CoV strains (bat-SL-CoVZC45 and bat-SL-CoVZXC21) that are known to infect humans, including the virus which led to the 2003 SARS-CoV-1 outbreak<sup>6</sup>. The 2019-nCoV is now named as SARS-CoV-2<sup>7</sup>. Further, based on SimPlot analyses, it was demonstrated that SARS-CoV-2 was more closely related to the BatCoV RaTG13 sequence (~96.3% similarity) throughout the genome. The bat-SL-CoVZC45 and bat-SL-CoVZXC21 strains clustered differently from the group formed by SARS-CoV-2 and BatCoV RaTG13 in the region spanning the 3'-end of open reading frame (ORF)1a, the ORF1b and almost half of the spike region<sup>8</sup>.

The receptor-binding domain (RBD) of the spike protein mediates interaction with the host cell receptor<sup>9</sup>, and the angiotensin-converting enzyme 2 (ACE2) has been identified as the receptor for the SARS-CoVs<sup>10</sup>. Specific mutations in the RBD of the SARS-CoV-2 spike glycoprotein were found to have enhanced binding to the ACE2<sup>11</sup>.

The human-to-human transmission of the SARS-CoV-2 created an alert with the increasing number of cases<sup>12</sup>. The WHO report dated February 28, 2020 confirmed 83,652 cases of SARS-CoV-2, with a total of 2,858 deaths from 52 countries<sup>12</sup>. After the first report of SARS-CoV-2 from Wuhan, China, the Government of India reviewed and initiated multisectoral measures for the mitigation of this emerging public health crisis. These include point-of-entry surveillance at 21 international airports, enhanced State-level surveillance programmes and preparedness for handling clinical cases in designated hospitals. Till date, the Integrated Disease Surveillance Programme (IDSP), a national health programme, Government of India, has collected samples from symptomatic travellers in liaison with the State-level Viral Research and Diagnostic Laboratories (VRDLs), Department of Health Research. These VRDLs respond for timely diagnosis during outbreaks.

The suspected samples were collected and transported to the Indian Council of Medical Research-National Institute of Virology (ICMR-NIV), Pune, for the diagnosis of SARS-CoV-2. The specimens of the positive cases were diagnosed with real-time reverse transcription-polymerase chain reaction (RT-PCR)-specific for SARS-CoV-2 using the protocol published by the WHO<sup>13</sup> and characterized by complete genome sequencing and epitope prediction analyses. These sequences were also compared with the available GenBank sequences to monitor the mutations and understand their relation with other known SARS-CoV-2 available in the public database. Here, we report molecular characterization of SARS-CoV-2 sequences from three positive cases.

## Material & Methods

The clinical samples were referred by the hospital authorities through the Kerala State Health Services for diagnostic purposes. Further samples were received from different parts of India for establishing the presence of SARS-CoV-2.

*Detection of SARS-CoV-2 in suspected samples:* Blood and throat swab (TS) specimens were collected from the suspected cases that complied with the case definition of SARS-CoV-2 infection as per the guidelines of the Ministry of Health and Family Welfare<sup>14</sup>. The TS was collected in viral transport medium. These samples were referred to the ICMR-NIV, Pune, India (which is the national reference laboratory for India, also referred as the government's apex laboratory). As

of February 29, 2020, 881 samples of suspected cases referred from different States, with a travel history to Wuhan, China, and other SARS-CoV-2-affected countries, were screened.

The viral RNA was extracted from the TS sample using the Magmax RNA extraction kit (Applied Biosystems, USA) as per the manufacturer's instructions. The extracted RNA was immediately used for testing the presence of SARS-CoV-2 using the real-time RT-PCR protocol published by the WHO<sup>12</sup> for the detection of *RdRp* (1), *RdRp* (2), *E* gene and *N* gene. *RNase P* gene was used as the internal control for the analysis. Confirmatory laboratory tests were performed as per the WHO-recommended test protocols<sup>13</sup>. These samples were also sequenced using the NGS approach to retrieve the complete genome of the virus.

*NGS of SARS-CoV-2 from India - Phylogenetic analysis and molecular characterization:* The total RNA of three positive TS specimens from Kerala, was extracted from 250-300  $\mu$ l of the SARS-CoV-2 real-time RT-PCR positive samples. QIAamp Viral RNA extraction kit (QIAGEN, Hilden, Germany) was used according to the manufacturer's instructions. The extracted RNA was further quantified using a Qubit RNA High-Sensitivity kit (Invitrogen, USA). RNA libraries were prepared as per the earlier-defined protocol and quantified using KAPA Library Quantification Kit (Kapa Biosystems, Roche Diagnostics Corporation, USA) as per the manufacturer's protocol. Further, individual libraries were neutralized and loaded on the Miniseq platform (Illumina, USA). The detailed protocols for the steps undertaken have been published earlier<sup>15,16</sup>. The data generated from the machine were analyzed using CLC genomics workbench version 11.0 (CLC, QIAGEN, Germany). Reference-based mapping was performed to retrieve the sequence of the SARS-CoV-2.

Full-length genome sequences of SARS-CoV-2 were downloaded from the GISAID database<sup>17</sup> (Supplementary Table I (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm5.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm5.pdf))). Multiple sequence alignment was performed using the MEGA software version 7.0<sup>18</sup> with retrieved sequences from two of the three positive cases and the available GISAID sequences. A phylogenetic tree was generated using the neighbour joining method and the Kimura-2-parameter as the nucleotide (nt) substitution model with 1000 bootstrap replications as implemented in

MEGA software<sup>18</sup>. Per cent nucleotide divergence and amino acid (aa) divergence were calculated using the p-distance method<sup>18</sup>. Mutations specific to the Indian SARS-CoV-2 viruses were identified by comparing the coding regions with respect to the SARS-CoV-2, Wuhan, China (Wuhan hu-1).

*Three-dimensional (3D) model of the spike protein and epitope prediction:* The pre-fusion structure of the Indian case 1 SARS-CoV-2 spike (S) glycoprotein was modelled using the Swiss-Model server (<https://swissmodel.expasy.org/interactive>) and the corresponding S protein of Wuhan-Hu-1 (6VSB.PDB) as the template (99.97% identity). Sequential (linear) B-cell epitopes were predicted using BepiPred-2.0 server (<http://www.cbs.dtu.dk/services/BepiPred/>). The ABCpred prediction tool (<http://crdd.osdd.net/raghava/abcpred/>) was also used to identify the B-cell epitopes in the Indian SARS-CoV-2 sequence. The epitope prediction probability of >0.8 was set to increase the specificity of the peptide stretch. The overlapping epitopes predicted by BepiPred-2.0 online server and the ABCpred prediction tool were identified. The antigenicity of the shortlisted peptide sequences was further predicted using the Vaxijen online server (<http://www.ddg-pharmfac.net/vaxijen/VaxiJen/VaxiJen.html>) with a default threshold of 0.4.

Discontinuous epitopes on the modelled structure of the Indian case 1 SARS-CoV-2 spike protein were predicted using the online servers, Ellipro (<http://tools.iedb.org/ellipro/>) and DiscoTope 2.0 (<http://tools.iedb.org/discotope/>), integrated in the Immune Epitope Database. Ellipro predicts epitopes based on the protrusion index (PI), wherein the protein shape is approximated as an ellipsoid (Ref for Ellipro and DiscoTope). An ellipsoid with the PI value of 0.8 indicates that 80 per cent of the residues are within the ellipsoid and 20 per cent are outside. All residues that are outside the 80 per cent ellipsoid will have a score of 0.8. Residues with larger scores are associated with greater solvent accessibility. The PI value was set to a score of 0.8. DiscoTope predicts epitopes using 3D structure and half-sphere exposure as a surface measure in a novel spatial neighbourhood definition method. Default values were set for sensitivity (0.47) and specificity (0.75) for selecting the amino acids forming discontinuous epitopes. A sensitivity of 0.47 means that 47 per cent of the epitope residues are predicted as part of the epitopes, while a specificity of 0.75 means that 25 per cent of the non-epitope residues

are predicted as part of the epitopes. Outputs from both the methods were combined, and the final regions were mapped on the modelled 3D-structure as the most probable conformational epitopes. In addition, we also predicted N-linked glycosylation sites in the S protein using NetNGlyc 1.0 Server (<http://www.cbs.dtu.dk/services/NetNGlyc/>). The spike proteins were also screened for the presence of potential epitopes presented by major histocompatibility complex (MHC) class I molecules to cytotoxic T lymphocytes (CTLs). The online NetCTL1.2 server (<http://www.cbs.dtu.dk/services/NetCTL/>) based on machine learning techniques such as artificial neural network (ANN) and support vector machine (SVM) was used to predict the T-cell epitopes. The prediction was made for all the human leucocyte antigen (HLA) supertypes and the available human alleles. The C terminal cleavage, weight of transport-associated protein (TAP) efficiency and threshold for identification were kept as default. VaxiJen v2.0 tool was used to predict the antigenicity of the predicted epitopes (<http://www.ddg-pharmfac.net/vaxijen/VaxiJen/VaxiJen.html>). The sequences were further screened to be potential epitopes using the CTLPred online server (<http://crdd.osdd.net/raghava/ctlpred/>).

The ability of the predicted linear B-cell and the T-cell epitopes to mount interferon-gamma (IFN- $\gamma$ ) response was assessed using the IFNepitope (<http://crdd.osdd.net/raghava/ifnepitope/index.php>).

## Results

*Detection of SARS-CoV-2 in suspected samples:* Three of the 881 TS/nasal swab (NS) specimens from the suspected cases, tested positive for the SARS-CoV-2 using the real-time RT-PCR specific to *E* gene, *RdRp* (1), *RdRp* (2) and *N* gene. The Ct value of the *E* gene ranged from 19.8 to 34.5 for the TS/NS specimens. Detailed Ct values for the real-time RT-PCRs specific to the above-mentioned genes of the positive specimens are given in Table I. Blood samples were found to be negative for the SARS-CoV-2.

Case 1 travelled from Wuhan, China, reached India on January 23, 2020 and further travelled to the final destination of Kerala on January 24. This individual developed cough on January 25 and further experienced a sore throat and mild fever and was admitted to the General Hospital, Thrissur, Kerala. The second case travelled from Wuhan and had close contact with case 1 during the travel to the final destination in India. Case 2 developed similar symptoms along with fever

and diarrhoea on January 26, and the collected TS specimens were referred to the ICMR-NIV on January 28. The second case was hospitalized on January 30, in a medical college, Alappuzha, Kerala. The clinical sample (TS) was collected on January 31, 2020. Case 3 travelled from China to India, developed a runny nose on January 30 and was admitted to the General Hospital, Kasaragod, Kerala, on January 31, 2020. TS specimens were collected on January 31, 2020.

*NGS of SARS-CoV-2 from India - Phylogenetic analysis and molecular characterization:* NGS analysis from the TS specimens retrieved two complete genome sequences from case 1 and case 3. The complete genomic sequence data for case 2 could not be recovered due to the lower kappa concentration of the sample and hence not included in the study for analysis. The FastQ files were reference mapped with the available Wuhan seafood pneumonia virus (Wuhan Hu-1) complete SARS-CoV-2 genome (accession number: NC 045512.2). The total reads which were mapped and the percentage of the genome recovered for the two cases are summarized in Table I.

Analysis of the complete genome sequences of SARS-CoV-2 from the positive cases in India revealed that the percentage nt and aa differences between case 1 and case 3 were 0.038 and 0.10 per cent, respectively. The sequences of case 1 and case 3 diverged from the Wuhan-Hu1 sequence by 0.017 per cent nt and 0.041 per cent aa respectively. Indian SARS-CoV-2 clustered with the *Sarbecovirus* subgenus of the *Betacoronavirus* genus and was closest to the BatCoV RaTG13 sequence (96.09% nt)<sup>8</sup>. The phylogenetic comparison showed the clustering of the genome sequences of case 1 and case 3 with the existing sequences of the SARS-CoV-2 sequences (Fig. 1). The phylogeny revealed emerging heterogeneity within the SARS-CoV-2 sequences globally. The Indian SARS-CoV-2 viruses were positioned in different clusters.

Indian SARS-CoV-2 sequences showed two changes 408 Arg→Ile and 930 Ala→Val in the spike protein compared to the Wuhan Hu-1 sequence. The mutations were further mapped on the spike protein model of the Indian sequence (Supplementary Fig. 1 (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm6.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm6.pdf))). Deletion of a three-nucleotide stretch, encoding tyrosine residue at position 144, of the spike gene was also observed in the Indian SARS-CoV-2 from case 1 when compared to the other SARS-CoV-2 sequences.

**Table I.** Real-time reverse transcription-polymerase chain reaction (RT-PCR) values for *RdRp* (1), *RdRp* (2), *E* gene and *N* gene, per cent genome coverage recovered and reads mapped for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) positive cases

Positive cases	Ct values for real-time RT-PCR for the confirmation of SARS-CoV-2					Relevant reads	Total reads	Genome length recovered (bp)	Per cent genome coverage
	<i>RdRp</i> (1)	<i>RdRp</i> (2)	<i>E</i> gene	<i>N</i> gene	<i>Rnase P</i> internal control				
Case 1	33.33	27.93	34.5	33.90	Positive	20,096	5,615,846	29,854	99.83
Case 2	24.6	29	19.8	38	Positive	610	8,587,146	16,047	53.66
Case 3	34.17	32.64	28.98	36.35	Positive	11,296	1,405,038	29,851	99.83

As noted in the earlier SARS-CoV-2 sequences, both the Indian sequences possessed the polybasic cleavage site (RRAR) in the spike protein at the junction of S1 and S2, the two subunits of the spike protein<sup>19</sup>.

**Epitope predictions:** Thirty one linear B-cell epitopes were predicted by Bepipred in the Indian SARS-CoV-2, of which three were found to have a length of <6 amino acids and hence not considered. Linear epitopes were also predicted using the ABCpred prediction tool, which predicted 47 epitopes based on the threshold of 0.8. Regions common to both the prediction methods (n=17) were identified manually. The 17 epitopes were screened for their antigenicity using the VaxiJen v2.0 tool (<http://www.ddg-pharmfac.net/vaxijen/VaxiJen/VaxiJen.html>), and nine of these epitopes were shortlisted. These epitopes were further screened for their ability to elicit an IFN- $\gamma$  response, which was predicted using the IFNepitope tool. Finally, five epitopes, four in the S1 domain and one in the S2 domain, were predicted, which could possibly generate an immune response and suppress the IFN- $\gamma$  response (Table II). N-linked glycosylation site prediction revealed that two putative glycosylation sites (with a low value for jury agreement) were present within the epitope stretch 328-344.

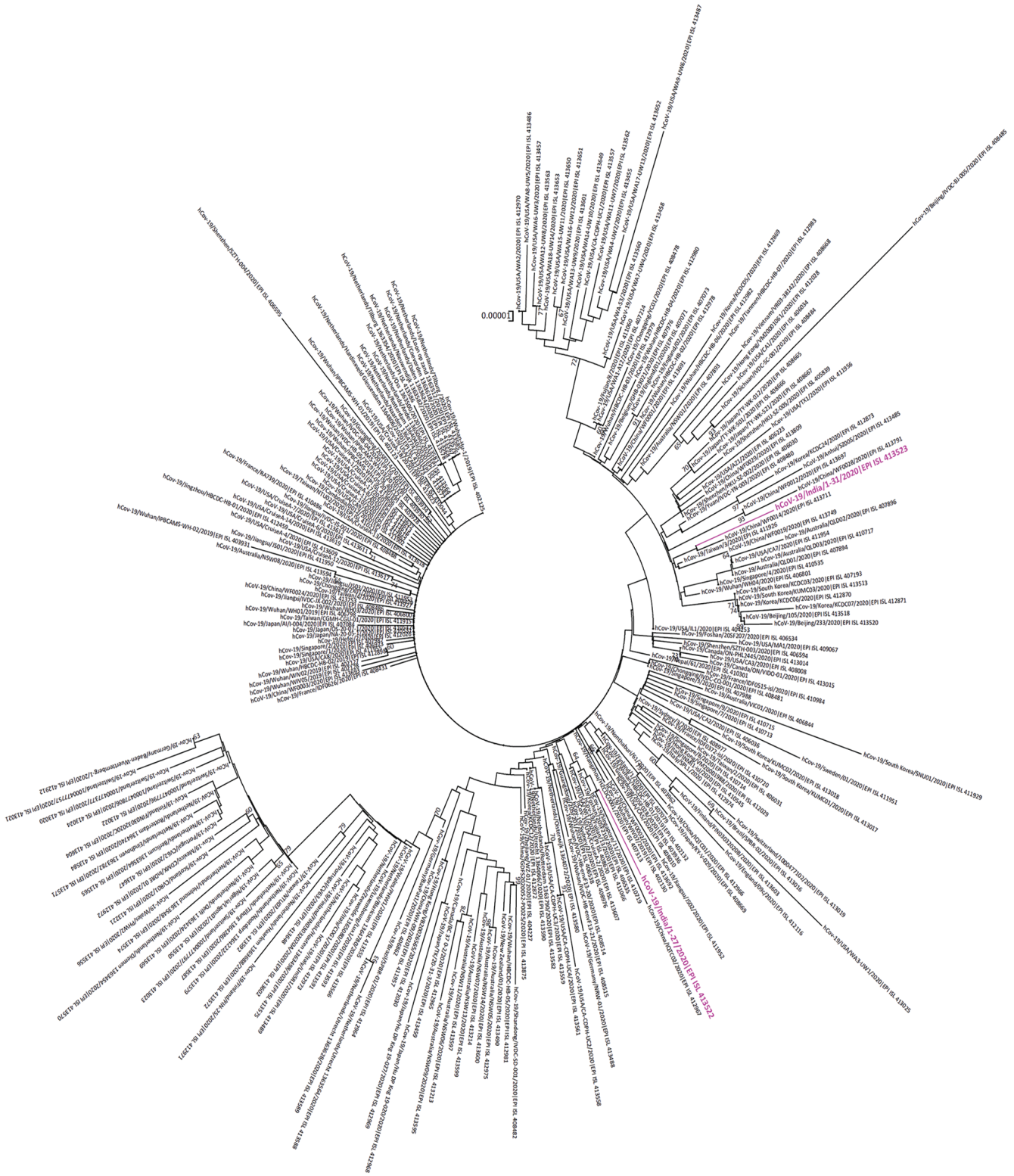
The discontinuous epitopes in the spike protein of the Indian SARS-CoV-2 were further identified using multiple methods, Ellipro and DiscoTope. Conformational epitopes based on these methods were mapped on the pre-fusion structure of the modelled Indian SARS-CoV-2 spike protein. The newly released structure of the SARS-CoV-2 spike protein was used as the template for modelling the Indian spike protein. Ramachandran plot statistics revealed 83.7 per cent of the residues to be in the core region, 14.4 per cent in the additionally allowed region and 0.5 per cent in the disallowed region. Four epitopes

were predicted by Ellipro based on the PI threshold of 0.8 (Supplementary Table II (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm7.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm7.pdf))). The result from the DiscoTope is presented in Supplementary Table III (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm8.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm8.pdf)). The mapped conformational epitopes are depicted in Figure 2. For the purpose of comparison, the IndianSproteinsequencewasalsomodelledusingtheprefusion structure of SARS-CoV-1 (6ACC.PDB; 87.29% identity), and the results for the conformational epitopes predicted are in Supplementary Table IV (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm9.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm9.pdf)) and Supplementary Figure 2 (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm10.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm10.pdf)).

T-cell epitope prediction revealed 105 strong binding epitopes capable of binding to different HLA types using the NetCTL1.2 software based on the threshold of 0.4. Twelve of these were shortlisted, considering a binding efficiency of >0.5 nM and capable of eliciting IFN- $\gamma$  response (Table III).

## Discussion

Till February 29, 2020, three positive cases of SARS-CoV-2 were reported from India from 881 suspected cases tested at ICMR-NIV, Pune. All the three cases had a travel history from Wuhan, China, during January 2020. Although NGS was performed on the specimens for all the three positive cases, the complete genome sequence could be retrieved only from case 1 and case 3. The three cases were recovered after hospitalization and were home quarantined as per the guidelines of the Ministry of Health and Family Welfare, Government of India<sup>14</sup>.



**Fig. 1.** Phylogenetic tree of the complete genomes of severe acute respiratory syndrome coronavirus 2 viruses. Indian viruses are shown in magenta font colour.

**Table II.** Linear B-cell epitopes predicted on the spike protein of the Indian severe acute respiratory syndrome coronavirus 2

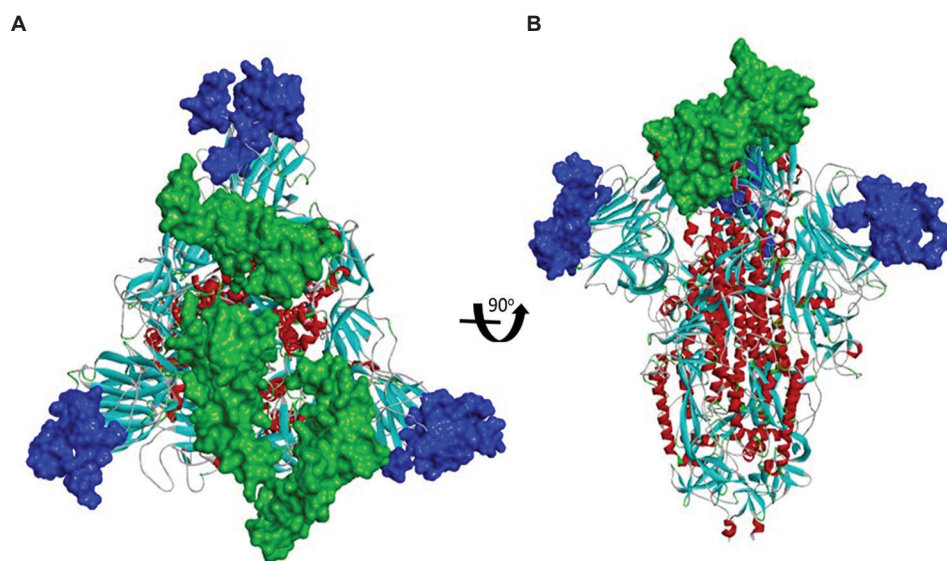
Peptide	Epitope probability	Vaxigen score	Interferon (IFN)- $\gamma$ response <sup>#</sup>
243-HRSYLTPGDSSSGWTA-258	0.92	Antigen (0.602)	Negative (1)
327-FPNITNLCPFGEVFNA-342	0.82	Antigen (0.606)	Negative (-0.132)
404-EVIQIAPGQTGKIADY-419	0.86	Antigen (1.231)	Negative (1)
413-TGKIADYNYKLPDDFT-428	0.84	Antigen (0.9642)	Negative (-0.334)
1204-YEQYIKWPWYIWLGF-1219	0.89	Antigen (0.951)	Negative (1)

Epitopes were predicted using a combination of the Bepipred server and the ABCpred prediction server. The antigenicity was predicted using the VaxiJen v2.0 tool. IFN- $\gamma$  response was predicted using the INFepitope server. <sup>#</sup>Values in bracket show prediction score given by the software

**Table III.** Spike protein peptides capable of binding to major histocompatibility complex (MHC) class I predicted using NetCTL server

Peptide	Vaxijen	Interferon (IFN)- $\gamma$ response	CTLPred Score (ANN/SVM)	MHC restriction
89-GVYFASTEK-97	0.711	Positive (1)	0.58/0.986	HLA-A*1101, HLA-A3, HLA-A*3101, HLA-A68.1, HLA-B*2705
166-FEYVVSQPFL-174	0.632	Positive (0.087)	0.65/0.184	HLA-A2, HLA-A*0201, HLA-A*0205, HLA-A2.1, HLA-B*2702, HLA-B*2705, HLA-B*3701, HLA-B40, HLA-B*4403, HLA-B*5301, HLA-B*5401, HLA-B*51, HLA-B60, HLA-B61, HLA-Cw*0301, H2-Kb, H2-Kk,
256-WTAGAAAYY-264	0.630	Positive (0.576)	0.82/0.544	HLA-A1, HLA-B*2702, HLA-B*3501, HLA-B*4403, HLA-B*5301, HLA-B*5401, HLA-B*51, HLA-B*5801, HLA-B62, HLA-Cw*0702
348-VYAWNRKRI-356	0.500	Positive (0.499)	0.93/0.497	HLA-A24, HLA-B*5101, HLA-B*5102, HLA-B*5103, HLA-B*51, HLA-Cw*0401, H2-Db, H2-Kd, H2-Kk
503-YQPYRVVVL-511	0.596	Positive (0.292)	0.40/0.596	HLA-A*0201, HLA-A*0205, HLA-A24, HLA-B14, HLA-B*2702, HLA-B*2705, HLA-B*3902, HLA-B*5201, HLA-B*5301, HLA-B*5401, HLA-B*51, HLA-B60, HLA-B62, HLA-B7, HLA-B8, HLA-Cw*0401, HLA-Cw*0602, H2-Dd, H2-Kb, H2-Ld
510-VLSFELLHA-518	1.077	Positive (0.268)	0.86/0.276	HLA-A*0201, HLA-A*0205, HLA-A3, HLA-B*5301, HLA-B*51, HLA-B62
825-TLADAGFIK-833	0.578	Positive (0.014)	0.75/0.992	HLA-A1, HLA-A*1101, HLA-A3, HLA-A*3101, HLA-A68.1, HLA-A20, HLA-B*2705
1058-VVFLHVTYV-1066	1.512	Positive (1)	0.77/0.779	HLA-A2, HLA-A*0201, HLA-A*0205, HLA-A68.1, HLA-A2.1, HLA-B14, HLA-B*5101, HLA-B*5102, HLA-B*5103, HLA-B*5201, HLA-B*5301, HLA-B*5401, HLA-B*51
1210-WPWYIWLGF-1218	1.495	Positive (0.221)	0.68/0.0695	HLA-B*2702, HLA-B*2705, HLA-B*3501, HLA-B*3801, HLA-B*5101, HLA-B*5102, HLA-B*5201, HLA-B*5301, HLA-B*5401, HLA-B*51, HLA-B*5801, HLA-B62, HLA-B*0702, HLA-Cw*0401, HLA-Cw*0702, H2-Ld

Threshold of >0.7 nM was used for increased specificity of the prediction. The peptides were reconfirmed using CTLPred server using default parameters. The peptides that were classified as epitopes were further checked for their antigenicity score using the VaxiJen v2.0 tool



**Fig. 2.** Predicted conformational B-cell epitopes mapped on the pre-fusion structure of the modelled Indian severe acute respiratory syndrome coronavirus 2 spike protein using the pre-fusion structure of severe acute respiratory syndrome-coronavirus-2 (6VSB.PDB) (colour key: blue - epitopes 67-261; green - epitopes 341-507 based on the predicted epitopes as shown in Supplementary Table II). (A) Top view (B) Side view.

The low viral copy number of the TS specimen from case 2 could be the possible reason for lesser viral reads being retrieved during the NGS run, leading to a fragmented genome. The recent study from China on serial samples (TSs, sputum, urine and stool) from two patients followed days 3-12 and days 4-15 post onset<sup>20</sup>. *N* gene-specific real-time RT-PCR assay showed that the viral loads in TS and sputum samples peaked at around 5-6 days after symptom onset, ranging from around  $10^4$ - $10^7$  copies per ml during this time<sup>20</sup>. In another study, the virus was detected in the saliva specimens of 11 of the 12 patients, and serial saliva testing showed declines of viral RNA levels<sup>21</sup>.

The two Indian SARS-CoV-2 sequences were found to be non-identical (0.04% nt divergence), and the result of phylogenetic analysis indicated that there were two different introductions into the country. A recent study using 52 published GenBank sequences showed evidence of substantial genetic heterogeneity and estimated the time to the most recent common ancestor to be December 5, 2019 (95% confidence interval: November 6 - December 13, 2019)<sup>22</sup>. Continuous monitoring and analysis of the sequences from the affected countries would be vital to understand the genetic evolution and rates of substitution of the SARS-CoV-2.

The comparison of the amino acid sequences of the non-structural (nsp1-nsp16) and structural polyproteins

was undertaken with reference to the Wuhan-Hu1 strain for molecular characterization. Some human *Betacoronaviruses*, including HCoV-HKU1 (lineage A), have a polybasic cleavage site as well as predicted O-linked glycans near the S1/S2 cleavage site of the spike protein. As published recently, the polybasic cleavage site that has not been previously observed in related lineage B *Betacoronaviruses* and is a unique feature of SARS-CoV-2 was noted in the Indian SARS-CoV-2. The mutation Arg408Ile in the spike protein of one of the Indian sequences is noted to be in the RBD and Ala930Val, is located in the S2 domain. However, both are away from the ACE2 receptor-binding interface<sup>19,23</sup>. Mutations in the spike protein sequences of SARS-CoV-2 observed currently are localized over the S1 and S2 domains and, so far have not been found in the ACE2-binding interface.

From the alignment of the spike protein sequences of SARS CoV-1 and SARS-CoV-2 (Wuhan-Hu1 and India), it can be observed that the three nucleotide-deletion in the case 1 SARS-CoV-2 from India, is located close to the insert 1 region of the SARS CoV-1 (Supplementary Fig. 3 (available from [http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes\\_2020\\_151\\_2\\_200\\_281471\\_sm11.pdf](http://www.ijmr.org.in/articles/2020/151/2/images/IndianJMedRes_2020_151_2_200_281471_sm11.pdf))). Notably, case 1 and case 2 were in close contact while travelling to India, but due to the absence of the complete genome of case 2, the genetic relatedness and source of infection could not be pinpointed.



Among the SARS-CoV structural proteins, the spike protein has been found to elicit neutralizing antibodies<sup>24</sup>. In this study, it was observed that of the five B-cell linear epitopes, which were predicted, four epitopes were present in the S1 domain and one in the S2 domain. Prediction of conformational B-cell epitopes revealed that one of these (residue positions 341-505) in the spike protein incorporates two of the predicted linear epitopes (327-342 and 404-419) having good antigenicity along with a favourable IFN- $\gamma$  response that enables differentiation and proliferation of the B-cells<sup>25</sup>. Notably, an equivalent epitope (347-499) is predicted for the model generated using the SARS-CoV-1 S protein as a template. In both cases, this epitope lies within the RBD<sup>6</sup>. Although the epitope has two putative N-linked glycosylation sites within it at positions 330 and 332, the probability of these sites being actually glycosylated is very low. A major immunodominant epitope has been reported from SARS-CoV between residues 441 and 700<sup>26</sup>. Hence, the predicted B-cell conformational epitope identified in the present study may play an important role in initiating a B-cell response. Among the five linear epitopes predicted in this study, epitopes 327-342 and 1204-1219 are conserved between SARS-CoV-2 and SARS-CoV-1. Epitopes 243-258, 404-419 and 413-428 are found to have variations.

The spike protein of SARS-CoV has also been reported to be immunogenic and elicit high IFN- $\gamma$ -specific T-cell response<sup>26</sup>. The prediction results in this study revealed that nine possible CTL epitopes possessing good antigenicity and inducing IFN- $\gamma$  response were present in the S protein. A recent report<sup>27</sup> also predicted T-cell epitopes in the S protein based on a similar ANN/SVM method and antigenicity score. Although the IFN- $\gamma$  response was not considered by these authors, it was noted that two of the predictions were found to be common. Among the T-cell epitopes predicted in the present study, four epitopes 89-97 and 256-264 in the S1 domain and 825-833 and 1058-1066 in the S2 domain were found to have good CTL prediction scores with a broad HLA allele coverage of A and B supertypes. These HLA supertypes being predominant in the Indian population, the predicted epitopes may be considered suitable for future experiments towards vaccine design.

To conclude, the prompt intervention by the Government of India and the health authorities of the State of Kerala, ensured that the said cases did not become secondary foci of transmission. Further, the timely identification of SARS-CoV-2 in these

suspected cases by the ICMR-NIV, Pune, has helped in the isolation of the patients, containment and enhanced surveillances for the virus and its restricted movement. The availability of the genomic sequences of the identified cases will contribute to the public repositories and help towards the development of diagnostics, vaccines and antivirals. The sequence data would also help in tracking the virus from its origin and evolution with its transmission in time.

*Availability of data:* Sequences are deposited in GISAID database, with accession numbers EPI\_ISL\_413522 and EPI\_ISL\_413523.

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**Conflicts of Interest:** None.

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**Supplementary Table I:** Acknowledgement for the list of the sequences downloaded from GISAID database that were used in the study

Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
1	EPI_ ISL_402120	BetaCoV/Wuhan/ IVDC-HB-04/2020	Asia/China/Hubei/ Wuhan	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control and Prevention, China CDC	Wenjie Tan, Xiang Zhao, Wenling Wang, Xuejun Ma, Yongzhong Jiang, Roujian Lu, Ji Wang, Weimin Zhou, Peihua Niu, Peipei Liu, Faxian Zhan, Weifeng Shi, Baoying Huang, Jun Liu, Li Zhao, Yao Meng, Xiaozhou He, Fei Ye, Na Zhu, Yang Li, Jing Chen, Wenbo Xu, George F. Gao, Guizhen Wu
2	EPI_ ISL_402121	BetaCoV/Wuhan/ IVDC-HB-05/2019	Asia/China/Hubei/ Wuhan	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control and Prevention, China CDC	Wenjie Tan, Xuejun Ma, Xiang Zhao, Wenling Wang, Yongzhong Jiang, Roujian Lu, Ji Wang, Peihua Niu, Weimin Zhou, Faxian Zhan, Weifeng Shi, Baoying Huang, Jun Liu, Li Zhao, Yao Meng, Fei Ye, Na Zhu, Xiaozhou He, Peipei Liu, Yang Li, Jing Chen, Wenbo Xu, George F. Gao, Guizhen Wu
3	EPI_ ISL_402123	BetaCoV/Wuhan/ IPBCAMS-WH-01/2019	Asia/China/Hubei/ Wuhan	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Lili Ren, Jianwei Wang, Qi Jin, Zichun Xiang, Zhiqiang Wu, Chao Wu, Yiwei Liu
4	EPI_ ISL_402125	BetaCoV/Wuhan-Hu-1/2019	Asia/China	Unknown	National Institute for Communicable Disease Control and Prevention (ICDC), Chinese Center for Disease Control and Prevention (China CDC)	Zhang, Y.-Z., Wu, F., Chen, Y.-M., Pei, Y.-Y., Xu, L., Wang, W., Zhao, S., Yu, B., Hu, Y., Tao, Z.-W., Song, Z.-G., Tian, J.-H., Zhang, Y.-L., Liu, Y., Zheng, J.-J., Dai, F.-H., Wang, Q.-M., She, J.-L. and Zhu, T.-Y.
5	EPI_ ISL_402127	BetaCoV/Wuhan/ WIV02/2019	Asia/China/Hubei/ Wuhan	Wuhan Jinyintan Hospital	Wuhan Institute of Virology, Chinese Academy of Sciences	Peng Zhou, Xing-Lou Yang, Ding-Yu Zhang, Lei Zhang, Yan Zhu, Hao-Rui Si, Zhengli Shi

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
6	EPI_ ISL_402128	BetaCoV/Wuhan/ WIV05/2019	Asia/China/Hubei/ Wuhan	Wuhan Jinyintan Hospital	Wuhan Institute of Virology, Chinese Academy of Sciences	Peng Zhou, Xing-Lou Yang, Ding-Yu Zhang, Lei Zhang, Yan Zhu, Hao-Rui Si, Zhengli Shi
7	EPI_ ISL_402130	BetaCoV/Wuhan/ WIV07/2019	Asia/China/Hubei/ Wuhan	Wuhan Jinyintan Hospital	Wuhan Institute of Virology, Chinese Academy of Sciences	Peng Zhou, Xing-Lou Yang, Ding-Yu Zhang, Lei Zhang, Yan Zhu, Hao-Rui Si, Zhengli Shi
8	EPI_ ISL_402132	BetaCoV/Wuhan/ HBCDC-HB-01/2019	Asia/China/Hubei/ Wuhan	Wuhan Jinyintan Hospital	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
9	EPI_ ISL_403928	BetaCoV/Wuhan/ IPBCAMS-WH-05/2020	Asia/China/Hubei/ Wuhan	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Lili Ren, Jianwei Wang, Qi Jin, Zichun Xiang, Zhiqiang Wu, Chao Wu, Yiwei Liu
10	EPI_ ISL_403930	BetaCoV/Wuhan/ IPBCAMS-WH-03/2019	Asia/China/Hubei/ Wuhan	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Lili Ren, Jianwei Wang, Qi Jin, Zichun Xiang, Zhiqiang Wu, Chao Wu, Yiwei Liu
11	EPI_ ISL_403931	BetaCoV/Wuhan/ IPBCAMS-WH-02/2019	Asia/China/Hubei/ Wuhan	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College	Lili Ren, Jianwei Wang, Qi Jin, Zichun Xiang, Zhiqiang Wu, Chao Wu, Yiwei Liu
12	EPI_ ISL_403934	BetaCoV/ Guangdong/20SF014/2020	Asia/China/ Guandong/Shenzhen	Guangdong Provincial Center for Diseases Control and Prevention; Guangdong Provincial Public Health	Department of Microbiology, Guangdong Provincial Center for Diseases Control and Prevention	Min Kang, Jie Wu, Jing Lu, Tao Liu, Baisheng Li, Shujiang Mei, Feng Ruan, Lifeng Lin, Changwen Ke, Haojie Zhong, Yingtao Zhang, Lirong Zou, Xuguang Chen, Qi Zhu, Jianpeng Xiao, Jianxiang Geng, Zhe Liu, Jianxiang Hu, Weilin Zeng, Xing Li, Yuhuang Liao, Xiujian Tang, Songjian Xiao, Ying Wang, Yingchao Song, Xue Zhuang, Lijun Liang, Guanhao He, Huihong Deng, Tie Song, Jianfeng He, Wenjun Ma

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
13	EPI_ ISL_403936	BetaCoV/ Guangdong/20SF028/2020	Asia/China/ Guangdong/Zhuhai	Guangdong Provincial Center for Diseases Control and Prevention; Guangdong Provincial Public Health	Department of Microbiology, Guangdong Provincial Center for Diseases Control and Prevention	Min Kang, Jie Wu, Jing Lu, Tao Liu, Baisheng Li, Shujiang Mei, Feng Ruan, Lifeng Lin, Changwen Ke, Haojie Zhong, Yingtao Zhang, Lirong Zou, Xuguang Chen, Qi Zhu, Jianpeng Xiao, Jianxiang Geng, Zhe Liu, Jianxiang Hu, Weilin Zeng, Xing Li, Yuhuang Liao, Xiujian Tang, Songjian Xiao, Ying Wang, Yingchao Song, Xue Zhuang, Lijun Liang, Guanhao He, Huihong Deng, Tie Song, Jianfeng He, Wenjun Ma
14	EPI_ ISL_403962	BetaCoV/ Nonthaburi/61/2020	Asia/Thailand/ Nonthaburi	Bamrasnaradura Hospital	1. Department of Medical Sciences, Ministry of Public Health, Thailand 2. Thai Red Cross Emerging Infectious Diseases - Health Science Centre 3. Department of Disease Control, Ministry of Public Health, Thailand	Pilailuk, Okada; Siripaporn, Phuygun; Thanutsapa, Thanadachakul; Supaporn, Wacharapluesadee; Sittiporn, Parmen; Warawan, Wongboot; Sunthareeya, Waicharoen; Rome, Buathong; Malinee, Chittaganpitch; Nanthawan, Mekha
15	EPI_ ISL_404227	BetaCoV/Zhejiang/ WZ-01/2020	Asia/China/Zhejiang	Zhejiang Provincial Center for Disease Control and Prevention	Department of Microbiology, Zhejiang Provincial Center for Disease Control and Prevention	Yin Chen, Yanjun Zhang, Haiyan Mao, Junhang Pan, Xiuyu Lou, Yiyu Lu, Juying Yan, Hanping Zhu, Jian Gao, Yan Feng, Yi Sun, Hao Yan, Zhen Li, Yisheng Sun, Liming Gong, Qiong Ge, Wen Shi, Xinying Wang, Wenwu Yao, Zhangnv Yang, Fang Xu, Chen Chen, Enfu Chen, Zhen Wang, Zhiping Chen, Jianmin Jiang, Chonggao Hu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
16	EPI_ ISL_404253	BetaCoV/USA/IL1/2020	North America/USA/ Illinois/Chicago	IL Department of Public Health Chicago Laboratory	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Krista Queen, Clinton R. Paden, Jing Zhang, Yan Li, Anna Uehara, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
17	EPI_ ISL_405839	BetaCoV/Shenzhen/ HKU-SZ-005/2020	Asia/China/ Guangdong/ Shenzhen	The University of Hong Kong - Shenzhen Hospital	Li Ka Shing Faculty of Medicine, The University of Hong Kong	Chan, J.F.-W., Yuan, S., Kok, K.H., To, K.K.-W., Chu, H., Yang, J., Xing, F., Liu, J., Yip, C.C.-Y., Poon, R.W.-S., Tsai, H.W., Lo, S.K.-F., Chan, K.H., Poon, V.K.-M., Chan, W.M., Ip, J.D., Cai, J.P., Cheng, V.C.-C., Chen, H., Hui, C.K.-M. and Yuen, K.Y.
18	EPI_ ISL_406030	BetaCoV/Shenzhen/ HKU-SZ-002/2020	Asia/China/ Guangdong/ Shenzhen	The University of Hong Kong - Shenzhen Hospital	Li Ka Shing Faculty of Medicine, The University of Hong Kong	Chan, J.F.-W., Yuan, S., Kok, K.H., To, K.K.-W., Chu, H., Yang, J., Xing, F., Liu, J., Yip, C.C.-Y., Poon, R.W.-S., Tsai, H.W., Lo, S.K.-F., Chan, K.H., Poon, V.K.-M., Chan, W.M., Ip, J.D., Cai, J.P., Cheng, V.C.-C., Chen, H., Hui, C.K.-M. and Yuen, K.Y.
19	EPI_ ISL_406031	BetaCoV/Taiwan/2/2020	Asia/Taiwan/ Kaohsiung	Centers for Disease Control, R.O.C. (Taiwan)	Centers for Disease Control, R.O.C. (Taiwan)	Ji-Rong Yang, Yu-Chi Lin, Jung-Jung Mu, Ming-Tsan Liu, Shu-Ying Li
20	EPI_ ISL_406034	BetaCoV/USA/CA1/2020	North America/ USA/California/Los Angeles	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Krista Queen, Ying Tao, Yan Li, Clinton R. Paden, Jing Zhang, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
21	EPI_ ISL_406036	BetaCoV/USA/CA2/2020	North America/USA/ California/Orange County	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Krista Queen, Ying Tao, Yan Li, Clinton R. Paden, Jing Zhang, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
22	EPI_ ISL_406223	BetaCoV/USA/AZ1/2020	North America/USA/ Arizona/Phoenix	Arizona Department of Health Services	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Disease Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Yan Li, Jing Zhang, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
23	EPI_ ISL_406534	BetaCoV/ Foshan/20SF207/2020	Asia/China/ Guangdong/Foshan	Guangdong Provincial Center for Diseases Control and Prevention; Guangdong Provincial Public Health	Guangdong Provincial Center for Diseases Control and Prevention	Min Kang, Jie Wu, Jing Lu, Tao Liu, Baisheng Li, Shujiang Mei, Feng Ruan, Lifeng Lin, Changwen Ke, Haojie Zhong, Yingtao Zhang, Lirong Zou, Xuguang Chen, Qi Zhu, Jianpeng Xiao, Jianxiang Geng, Zhe Liu, Jianxiong Hu, Weilin Zeng, Xing Li, Yuhuang Liao, Xiujuan Tang, Songjian Xiao, Ying Wang, Yingchao Song, Xue Zhuang, Lijun Liang, Guanhao He, Huihong Deng, Tie Song, Jianfeng He, Wenjun Ma

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
24	EPI_ ISL_406535	BetaCoV/ Foshan/20SF210/2020	Asia/China/ Guangdong/Foshan	Guangdong Provincial Center for Diseases Control and Prevention; Guangdong Provincial Public Health	Guangdong Provincial Center for Diseases Control and Prevention	Min Kang, Jie Wu, Jing Lu, Tao Liu, Baisheng Li, Shujiang Mei, Feng Ruan, Lifeng Lin, Changwen Ke, Haojie Zhong, Yingtao Zhang, Lirong Zou, Xuguang Chen, Qi Zhu, Jianpeng Xiao, Jianxiang Geng, Zhe Liu, Jianxiang Hu, Weilin Zeng, Xing Li, Yuhuang Liao, Xiujuan Tang, Songjian Xiao, Ying Wang, Yingchao Song, Xue Zhuang, Lijun Liang, Guanhao He, Huihong Deng, Tie Song, Jianfeng He, Wenjun Ma
25	EPI_ ISL_406538	BetaCoV/ Guangdong/20SF201/2020	Asia/China/ Guangdong	Guangdong Provincial Center for Diseases Control and Prevention; Guangdong Provincial Institute of Public Health	Guangdong Provincial Center for Diseases Control and Prevention	Min Kang, Jie Wu, Jing Lu, Tao Liu, Baisheng Li, Shujiang Mei, Feng Ruan, Lifeng Lin, Changwen Ke, Haojie Zhong, Yingtao Zhang, Lirong Zou, Xuguang Chen, Qi Zhu, Jianpeng Xiao, Jianxiang Geng, Zhe Liu, Jianxiang Hu, Weilin Zeng, Xing Li, Yuhuang Liao, Xiujuan Tang, Songjian Xiao, Ying Wang, Yingchao Song, Xue Zhuang, Lijun Liang, Guanhao He, Huihong Deng, Tie Song, Jianfeng He, Wenjun Ma
26	EPI_ ISL_406594	BetaCoV/Shenzhen/ SZTH-003/2020	Asia/China/ Guandong/Shenzhen	Shenzhen Key Laboratory of Pathogen and Immunity, National Clinical Research Center for Infectious Disease, Shenzhen Third People's Hospital	Shenzhen Key Laboratory of Pathogen and Immunity, National Clinical Research Center for Infectious Disease, Shenzhen Third People's Hospital	Yang Yang, Chenguang Shen, Li Xing, Zhixiang Xu, Haixia Zheng, Yingxia Liu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
27	EPI_ ISL_406595	BetaCoV/Shenzhen/ SZTH-004/2020	Asia/China/ Guandong/Shenzhen	Shenzhen Key Laboratory of Pathogen and Immunity, National Clinical Research Center for Infectious Disease, Shenzhen Third People's Hospital	Shenzhen Key Laboratory of Pathogen and Immunity, National Clinical Research Center for Infectious Disease, Shenzhen Third People's Hospital	Yang Yang, Chenguang Shen, Li Xing, Zhixiang Xu, Haixia Zheng, Yingxia Liu
28	EPI_ ISL_406798	BetaCov/Wuhan/ WH01/2019	Asia/China/Hubei/ Wuhan	General Hospital of Central Theater Command of People's Liberation Army of China	BGI & Institute of Microbiology, Chinese Academy of Sciences & Shandong First Medical University & Shandong Academy of Medical Sciences & General Hospital of Central Theater Command of People's Liberation Army of China	Weijun Chen, Yuhai Bi, Weifeng Shi and Zhenhong Hu
29	EPI_ ISL_406800	BetaCov/Wuhan/ WH03/2020	Asia/China/Hubei/ Wuhan	General Hospital of Central Theater Command of People's Liberation Army of China	BGI & Institute of Microbiology, Chinese Academy of Sciences & Shandong First Medical University & Shandong Academy of Medical Sciences & General Hospital of Central Theater Command of People's Liberation Army of China	Weijun Chen, Yuhai Bi, Weifeng Shi and Zhenhong Hu
30	EPI_ ISL_406801	BetaCov/Wuhan/ WH04/2020	Asia/China/Hubei/ Wuhan	General Hospital of Central Theater Command of People's Liberation Army of China	BGI & Institute of Microbiology, Chinese Academy of Sciences & Shandong First Medical University & Shandong Academy of Medical Sciences & General Hospital of Central Theater Command of People's Liberation Army of China	Weijun Chen, Yuhai Bi, Weifeng Shi and Zhenhong Hu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
31	EPI_ ISL_406844	BetaCoV/Australia/ VIC01/2020	Oceania/Australia/ Victoria/Clayton	Monash Medical Centre	Collaboration between the University of Melbourne at The Peter Doherty Institute for Infection and Immunity, and the Victorian Infectious Disease Reference Laboratory	Caly, L., Seemann, T., Schultz, M., Druce, J. and Taiaroa, G
32	EPI_ ISL_406862	BetaCoV/Germany/ BavPat1/2020	Europe/Germany/ Bavaria/Munich	Charité Universitätsmedizin Berlin, Institute of Virology; Institut für Mikrobiologie der Bundeswehr, Munich	Charité Universitätsmedizin Berlin, Institute of Virology	Victor M Corman, Julia Schneider, Talitha Veith, Barbara Mühlemann, Markus Antwerpen, Christian Drosten, Roman Wölfel
33	EPI_ ISL_406973	BetaCoV/Singapore/1/2020	Asia/Singapore	Singapore General Hospital	National Public Health Laboratory	Mak, TM; Octavia S; Chavatte JM; Zhou, ZY; Cui, L; Lin, RTP
34	EPI_ ISL_407071	BetaCoV/England/01/2020	Europe/United Kingdom/England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Monica Galiano, Shahjahan Miah, Richard Myers, Angie Lackenby, Omolola Akinbami, Tiina Talts, Leena Bhaw, Kirstin Edwards, Jonathan Hubb, Joanna Ellis, Maria Zambon
35	EPI_ ISL_407073	BetaCoV/England/02/2020	Europe/United Kingdom/England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Monica Galiano, Shahjahan Miah, Richard Myers, Angie Lackenby, Omolola Akinbami, Tiina Talts, Leena Bhaw, Kirstin Edwards, Jonathan Hubb, Joanna Ellis, Maria Zambon.
36	EPI_ ISL_407079	BetaCoV/Finland/1/2020	Europe/Finland/ Lapland	Lapland Central Hospital	Department of Virology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland	Teemu Smura, Suvi Kuivanen, Hannimari Kallio-Kokko, Olli Vapalahti
37	EPI_ ISL_407084	BetaCoV/Japan/AI/ I-004/2020	Asia/Japan/Aichi	Department of Virology III, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Shinji Watanabe, Makoto Takeda, Makoto Kuroda

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
38	EPI_ ISL_407193	BetaCoV/South Korea/ KCDC03/2020	Asia/South Korea/ Gyeonggi-do	Korea Centers for Disease Control & Prevention (KCDC) Center for Laboratory Control of Infectious Diseases Division of Viral Diseases	Korea Centers for Disease Control & Prevention (KCDC) Center for Laboratory Control of Infectious Diseases Division of Viral Diseases	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, SangHee Woo, Hye-Joon Jo, Sehee Park, Heui Man Kim, Myung Guk Han
39	EPI_ ISL_407214	BetaCoV/USA/ WA1-A12/2020	North America/USA/ Washington	WA State Department of Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Krista Queen, Azaibi Tamin, Jennifer Harcourt, Ying Tao, Clinton R. Paden, Jing Zhang, Yan Li, Anna Uehara, Xiaoyan Lu, Shifaq Kamili, Rashi Gautam, Haibin Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Natalie Thornburg, Suxiang Tong
40	EPI_ ISL_407313	BetaCoV/Hangzhou/ HZCDC0001/2020	Asia/China/Zhejiang/ Hangzhou	Hangzhou Center for Disease Control and Prevention	Hangzhou Center for Disease Control and Prevention	Jun Li, Haoqiu Wang, Hua Yu, Lingfeng Mao, Xinfen Yu, Zhou Sun, Qingxin Kong, Xin Qian, Shuchang Chen, Xuchu Wang
41	EPI_ ISL_407893	BetaCoV/Australia/ NSW01/2020	Oceania/Australia/ New South Wales/ Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Eden J-S, Carter I, Rahman H, Holmes EC, Rockett R, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group
42	EPI_ ISL_407894	BetaCoV/Australia/ QLD01/2020	Oceania/Australia/ Queensland/Gold Coast	Pathology Queensland	Public Health Virology Laboratory	Ben Huang, Alyssa Pyke, Amanda De Jong, Andrew Van Den Hurk, Carmel Taylor, David Warrilow, Doris Genge, Elisabeth Gamez, Glen Hewitson, Ian Maxwell Mackay, Inga Sultana, Jamie McMahon, Jean Barcelon, Judy Northill, Mitchell Finger, Natalie Simpson, Neelima Nair, Peter Burtonclay, Peter Moore, Sarah Wheatley, Sean Moody, Sonja Hall-Mendelin, Timothy Gardam, and Frederick Moore.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
43	EPI_ ISL_407896	BetaCoV/Australia/ QLD02/2020	Oceania/Australia/ Queensland/Gold Coast	Pathology Queensland	Public Health Virology Laboratory	Ben Huang, Alyssa Pyke, Amanda De Jong, Andrew Van Den Hurk, Carmel Taylor, David Warrilow, Doris Genge, Elisabeth Gamez, Glen Hewitson, Ian Maxwell Mackay, Inga Sultana, Jamie McMahon, Jean Barcelon, Judy Northill, Mitchell Finger, Natalie Simpson, Neelima Nair, Peter Burtonclay, Peter Moore, Sarah Wheatley, Sean Moody, Sonja Hall-Mendelin, Timothy Gardam, and Frederick Moore.
44	EPI_ ISL_407976	BetaCoV/Belgium/ GHB-03021/2020	Europe/Belgium/ Leuven	KU Leuven, Clinical and Epidemiological Virology	KU Leuven, Clinical and Epidemiological Virology	Bert Vanmechelen, Elke Wollants, Annabel Rector, Els Keyaerts, Lies Laenen, Marc Van Ranst, and Piet Maes
45	EPI_ ISL_407987	BetaCoV/Singapore/2/2020	Asia/Singapore	Singapore General Hospital	Programme in Emerging Infectious Diseases, Duke-NUS Medical School	Danielle E Anderson, Martin Linster, Yan Zhuang, Jayanthi Jayakumar, Kian Sing Chan, Lynette LE Oon, Jenny GH Low, Yvonne CF Su, Linfa Wang, Gavin JD Smith
46	EPI_ ISL_407988	BetaCoV/Singapore/3/2020	Asia/Singapore	National Centre for Infectious Diseases	Programme in Emerging Infectious Diseases, Duke-NUS Medical School	Danielle E Anderson, Martin Linster, Yan Zhuang, Jayanthi Jayakumar, David CB Lye, Yee Sin Leo, Barnaby E Young, Yvonne CF Su, Linfa Wang, Gavin JD Smith
47	EPI_ ISL_408008	BetaCoV/USA/CA3/2020	North America/USA/ California	California Department of Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Disease Control and Prevention	Krista Queen, Jing Zhang, Yan Li, Ying Tao, Anna Uehara, Clinton Paden, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
48	EPI_ ISL_408010	BetaCoV/USA/CA5/2020	North America/USA/ California	California Department of Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Krista Queen, Jing Zhang, Yan Li, Anna Uehara, Clinton Paden, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakhivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
49	EPI_ ISL_408431	BetaCov/France/ IDF0626/2020	Europe/France/ Ile-de-France/Paris	Sorbonne Université, Inserm et Assistance Publique-Hôpitaux de Paris (Pitié Salpêtrière)	National Reference Center for Viruses of Respiratory Infections, Institut Pasteur, Paris	Mélanie Albert, Marion Barbet, Sylvie Behillil, Méline Bizard, Angela Brisebarre, Flora Donati, Vincent Enouf, Maud Vanpeene, Sylvie van der Werf, Sonia Burrel, Anne-Geneviève Marcelin, Vincent Calvez, David Boutolleau, Elise Klément, Valérie Pourcher, Eric Caumes.
50	EPI_ ISL_408478	BetaCoV/Chongqing/ YC01/2020	Asia/China/ Chongqing/ Yongchuan	Yongchuan District Center for Disease Control and Prevention	Chongqing Municipal Center for Disease Control and Prevention	Ye Sheng, Tang Yun, Ling Hua, Yu zhen, Chen Shuang, Tan ZhangPing, Su Kun, Li Qing, Tang Wenge, Rong Rong
51	EPI_ ISL_408479	BetaCoV/Chongqing/ ZX01/2020	Asia/China/ Chongqing/ Zhongxian	Zhongxian Center for Disease Control and Prevention	Chongqing Municipal Center for Disease Control and Prevention	Ye Sheng, Tang Yun, Ling Hua, Zhang Hong, Yu zhen, Chen Shuang, Tan ZhangPing, Su Kun, Li Qin, Tang Wenge, Rong Rong
52	EPI_ ISL_408480	BetaCoV/Yunnan/ IVDC-YN-003/2020	Asia/China/Yunnan/ Kunming	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Xiaoqing Fu, Xiang Zhao, Wenling Wang, Peihua Niu, Roujian Lu, Yanhong Sun, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
53	EPI_ ISL_408481	BetaCoV/Chongqing/ IVDC-CQ-001/2020	Asia/China/ Chongqing	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Hengqin Wang, Xiang Zhao, Wenling Wang, Peihua Niu, Roujian Lu, Sheng Ye, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
54	EPI_ ISL_408482	BetaCoV/Shandong/ IVDC-SD-001/2020	Asia/China/ Shandong/Qingdao	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Zhaoguo Wang, Xiang Zhao, Wenling Wang, Peihua Niu, Roujian Lu, Ti Liu, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
55	EPI_ ISL_408484	BetaCoV/Sichuan/ IVDC-SC-001/2020	Asia/China/Sichuan/ Chengdu	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Jianan Xu, Wenling Wang, Peihua Niu, Roujian Lu, Huiping Yang, Xiang Zhao, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
56	EPI_ ISL_408485	BetaCoV/Beijing/ IVDC-BJ-005/2020	Asia/China/Beijing	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Quanyi Wang, Wenling Wang, Peihua Niu, Roujian Lu, Yang Pan, Xiang Zhao, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
57	EPI_ ISL_408486	BetaCoV/Jiangxi/ IVDC-JX-002/2020	Asia/China/Jiangxi/ Pingxiang	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Yong Shi, Wenling Wang, Peihua Niu, Roujian Lu, Jianxiang Li, Xiang Zhao, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
58	EPI_ ISL_408488	BetaCoV/Jiangsu/ IVDC-JS-001/2020	Asia/China/Jiangsu/ Huaian	National Institute for Viral Disease Control and Prevention, China CDC	National Institute for Viral Disease Control & Prevention, CCDC	Wenjie Tan, Shenjiao Wang, Wenling Wang, Peihua Niu, Roujian Lu, Kangchen Zhao, Xiang Zhao, Baoying Huang, Li Zhao, Fei Ye, Wenbo Xu, George F. Gao, Guizhen Wu
59	EPI_ ISL_408514	BetaCoV/Wuhan/ IVDC-HB-envF13-20/2020	Asia/China/Hubei/ Wuhan	Institute of Viral Disease Control and Prevention, China CDC	Institute of Viral Disease Control and Prevention, China CDC	William J. Liu, Peipei Liu, Xiang Zhao, Peihua Niu, Yingze Zhao, Wenwen Lei, Ziqian Xu, Shumei Zou, Wei Zhen, Beiwei Ye, Mengjie Yang, Weifeng Shi, Roujian Lu, Wenjie Tan, Zhixiao Chen, Yuchao Wu, Juan Song, Weimin Zhou, Dayan Wang, Jun Han, Wenbo Xu, George F. Gao, Guizhen Wu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
60	EPI_ ISL_408515	BetaCoV/Wuhan/ IVDC-HB-envF13-21/2020	Asia/China/Hubei/ Wuhan	Institute of Viral Disease Control and Prevention, China CDC	Institute of Viral Disease Control and Prevention, China CDC	William J. Liu, Peipei Liu, Xiang Zhao, Peihua Niu, Yingze Zhao, Wenwen Lei, Ziqian Xu, Shumei Zou, Wei Zhen, Beiwei Ye, Mengjie Yang, Weifeng Shi, Roujian Lu, Wenjie Tan, Zhixiao Chen, Yuchao Wu, Juan Song, Weimin Zhou, Dayan Wang, Jun Han, Wenbo Xu, George F. Gao, Guizhen Wu
61	EPI_ ISL_408665	BetaCoV/Japan/ TY-WK-012/2020	Asia/Japan/Tokyo	Dept. of Virology III, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Makoto Takeda, Makoto Kuroda
62	EPI_ ISL_408666	BetaCoV/Japan/ TY-WK-501/2020	Asia/Japan/Tokyo	Dept. of Virology III, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Makoto Takeda, Makoto Kuroda
63	EPI_ ISL_408667	BetaCoV/Japan/ TY-WK-521/2020	Asia/Japan/Tokyo	Dept. of Virology III, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Makoto Takeda, Makoto Kuroda
64	EPI_ ISL_408668	BetaCoV/Vietnam/ VR03-38142/2020	Asia/Vietnam/Thanh Hoa	National Influenza Center - National Institute of Hygiene and Epidemiology (NIHE)	National Influenza Center - National Institute of Hygiene and Epidemiology (NIHE)	Ung Thi Hong Trang, Hoang Vu Mai Phuong, Nguyen Le Khanh Hang, Nguyen Vu Son, Le Thi Thanh, Vuong Duc Cuong, Nguyen Phuong Anh, Pham Thi Hien, Tran Thu Huong, Le Thi Quynh Mai,
65	EPI_ ISL_408669	BetaCoV/Japan/ KY-V-029/2020	Asia/Japan/Kyoto	Dept. of Virology III, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Makoto Takeda, Makoto Kuroda
66	EPI_ ISL_408670	BetaCoV/USA/WI1/2020	North America/USA/ Wisconsin	Wisconsin Department of Health Services	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Jing Zhang, Anna Uehara, Krista Queen, Yan Li, Ying Tao, Clinton R. Paden, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
67	EPI_ ISL_408976	BetaCoV/Sydney/2/2020	Oceania/Australia/ New South Wales/ Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Rockett R, Sadsad R, Eden J-S, Carter I, Rahman H, Holmes EC, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
68	EPI_ ISL_408977	BetaCoV/Sydney/3/2020	Oceania/Australia/ New South Wales/ Sydney	Serology, Virology and OTDS Laboratories (SAViD), NSW Health Pathology Randwick	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Centre for Infectious Diseases and Microbiology Laboratory Services; Westmead Hospital; University of Sydney	Eden J-S, Carter I, Rahman H, Rawlinson W, Holmes EC, Rockett R, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
69	EPI_ ISL_409067	BetaCoV/USA/MA1/2020	North America/USA/ Massachusetts	Massachusetts Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Clinton R. Paden, Jing Zhang, Krista Queen, Yan Li, Ying Tao, Anna Uehara, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakhivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
70	EPI_ ISL_410044	BetaCoV/USA/CA6/2020	North America/USA/ California	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Jing Zhang, Krista Queen, Yan Li, Ying Tao, Anna Uehara, Clinton R. Paden, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakhivel, Brett L. Whitaker, Shifaq Kamili, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
71	EPI_ ISL_410218	BetaCov/Taiwan/ NTU02/2020	Asia/Taiwan/Taipei	Department of Laboratory Medicine, National Taiwan University Hospital	Microbial Genomics Core Lab, National Taiwan University Centers of Genomic and Precision Medicine	Shiou-Hwei Yeh, You-Yu Lin, Ya-Yun Lai, Chiao-Ling Li, Shan-Chwen Chang, Pei-Jer Chen, Sui-Yuan Chang

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
72	EPI_ ISL_410301	BetaCoV/Nepal/61/2020	Asia/Nepal/ Kathmandu	National Influenza Centre, National Public Health Laboratory, Kathmandu, Nepal	The University of Hong Kong	Ranjit Sah , Runa Jha, Daniel Chu, Haogao Gu, Malik Peiris, Anup Bastola, Alfonso J. Rodriguez-Morales, Bibek Kumar Lal, Basu Dev Pandey, Leo Poon
73	EPI_ ISL_410486	BetaCoV/France/ RA739/2020	Europe/France/ Rhone-Alpes/ Contamines	CNR Virus des Infections Respiratoires - France SUD	CNR Virus des Infections Respiratoires - France SUD	Bal, Antonin; Destras, Gregory; Gaymard, Alexandre; Bouscambert-Duchamp, Maude; Cheynet, Valérie; Brenzel-Pesce, Karen; Morfin-Sherpa, Florence; Valette, Martine; Josset, Laurence; Lina, Bruno.
74	EPI_ ISL_410531	BetaCoV/Japan/ NA-20-05-1/2020	Asia/Japan/Nara	Dept. of Pathology, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Harutaka Katano, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Motoi Suzuki, Hideki Hasegawa, Takaji Wakita, Makoto Takeda, Tadaki Suzuki, Makoto Kuroda
75	EPI_ ISL_410532	BetaCoV/Japan/ OS-20-07-1/2020	Asia/Japan/Osaka	Dept. of Pathology, National Institute of Infectious Diseases	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Harutaka Katano, Shutoku Matsuyama, Naganori Nao, Kazuya Shirato, Motoi Suzuki, Hideki Hasegawa, Takaji Wakita, Makoto Takeda, Tadaki Suzuki, Makoto Kuroda
76	EPI_ ISL_410535	BetaCoV/Singapore/4/2020	Asia/Singapore	National Centre for Infectious Diseases	Programme in Emerging Infectious Diseases, Duke-NUS Medical School	Danielle E Anderson, Martin Linster, Yan Zhuang, Jayanthi Jayakumar, David CB Lye, Yee Sin Leo, Barnaby E Young, Yvonne CF Su, Gavin JD Smith
77	EPI_ ISL_410545	BetaCoV/Italy/ INMI1-isl/2020	Europe/Italy/Rome	INMI Lazzaro Spallanzani IRCCS	Laboratory of Virology, INMI Lazzaro Spallanzani IRCCS	Maria R. Capobianchi, Cesare E. M. Gruber, Martina Rueca, Barbara Bartolini, Francesco Messina, Emanuela Giombini, Francesca Colavita, Concetta Castilletti, Eleonora Lalle, Fabrizio Carletti, Emanuele Nicastrì, Giuseppe Ippolito.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
78	EPI_ ISL_410713	BetaCoV/Singapore/7/2020	Asia/Singapore	National Public Health Laboratory, National Centre for Infectious Diseases	National Public Health Laboratory, National Centre for Infectious Diseases	Octavia S, Mak TM, Cui L, Lin RTP
79	EPI_ ISL_410714	BetaCoV/Singapore/8/2020	Asia/Singapore	National Public Health Laboratory, National Centre for Infectious Diseases	National Public Health Laboratory, National Centre for Infectious Diseases	Octavia S, Mak TM, Cui L, Lin RTP
80	EPI_ ISL_410715	BetaCoV/Singapore/9/2020	Asia/Singapore	National Public Health Laboratory, National Centre for Infectious Diseases	National Public Health Laboratory, National Centre for Infectious Diseases	Octavia S, Mak TM, Cui L, Lin RTP
81	EPI_ ISL_410717	BetaCoV/Australia/ QLD03/2020	Oceania/Australia/ Queensland/Gold Coast	Pathology Queensland	Public Health Virology Laboratory	Ben Huang, Alyssa Pyke, Amanda De Jong, Andrew Van Den Hurk, Carmel Taylor, David Warrilow, Doris Genge, Elisabeth Gamez, Glen Hewitson, Ian Maxwell Mackay, Inga Sultana, Jamie McMahon, Jean Barcelon, Judy Northill, Mitchell Finger, Natalie Simpson, Neelima Nair, Peter Burtonclay, Peter Moore, Sarah Wheatley, Sean Moody, Sonja Hall-Mendelin, Timothy Gardam, and Frederick Moore.
82	EPI_ ISL_410719	BetaCoV/Singapore/11/2020	Asia/Singapore	National Public Health Laboratory	National Public Health Laboratory	Octavia S, Mak TM, Cui L, Lin RTP
83	EPI_ ISL_410720	BetaCoV/France/ IDF0372-isl/2020	Europe/France/ Ile-de-France/Paris	Department of Infectious and Tropical Diseases, Bichat Claude Bernard Hospital, Paris	National Reference Center for Viruses of Respiratory Infections, Institut Pasteur, Paris	Mélanie Albert, Marion Barbet, Sylvie Behillil, Méline Bizard, Angela Brisebarre, Flora Donati, Vincent Enouf, Maud Vanpeene, Sylvie van der Werf, Yazdan Yazdanpanah, Xavier Lescure.
84	EPI_ ISL_410984	BetaCoV/France/ IDF0515-isl/2020	Europe/France/ Ile-de-France/Paris	Department of Infectious and Tropical Diseases, Bichat Claude Bernard Hospital, Paris	National Reference Center for Viruses of Respiratory Infections, Institut Pasteur, Paris	Mélanie Albert, Marion Barbet, Sylvie Behillil, Méline Bizard, Angela Brisebarre, Flora Donati, Vincent Enouf, Maud Vanpeene, Sylvie van der Werf, Yazdan Yazdanpanah, Xavier Lescure

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
85	EPI_ ISL_411060	BetaCoV/Fujian/8/2020	Asia/China/Fujian	Fujian Center for Disease Control and Prevention	Fujian Center for Disease Control and Prevention	Chen Wei, Zhang Yanhua, He Wenxiang, Weng Yuwei
86	EPI_ ISL_411066	BetaCoV/Fujian/13/2020	Asia/China/Fujian	Fujian Center for Disease Control and Prevention	Fujian Center for Disease Control and Prevention	Chen Wei, Zhang Yanhua, He Wenxiang, Weng Yuwei
87	EPI_ ISL_411902	BetaCoV/ Cambodia/0012/2020	Asia/Cambodia/ Sihanoukville	Virology Unit, Institut Pasteur du Cambodge.	Virology Unit, Institut Pasteur du Cambodge (Sequencing done by: Jennifer A Bohl at Malaria and Vector Research Laboratory, National Institute of Allergy and Infectious Diseases and Vida Ahyong from Chan-Zuckerberg Biohub)	Erik A Karlsson, Jennifer A Bohl, Vida Ahyong, Veasna Duong, Philippe Dussart, Jessica E Manning, Jessica E Manning.
88	EPI_ ISL_411915	BetaCoV/Taiwan/ CGMH-CGU-01/2020	Asia/Taiwan/ Taoyuan	Laboratory Medicine	Department of Laboratory Medicine, Lin-Kou Chang Gung Memorial Hospital, Taoyuan, Taiwan.	Kuo-Chien Tsao, Yu-Nong Gong, Shu-Li Yang, Yi-Chun Li, Chung-Guei Huang, Yhu-Chering Huang, Shin-Ru Shih
89	EPI_ ISL_411926	BetaCoV/Taiwan/3/2020	Asia/Taiwan/Taipei	Taiwan Centers for Disease Control	Taiwan Centers for Disease Control	Ji-Rong Yang, Yu-Chi-Lin, Jung-Jung Mu, Ming-Tsan-Liu
90	EPI_ ISL_411927	BetaCoV/Taiwan/4/2020	Asia/Taiwan/Taipei	Taiwan Centers for Disease Control	Taiwan Centers for Disease Control	Ji-Rong Yang, Yu-Chi-Lin, Jung-Jung Mu, Ming-Tsan-Liu
91	EPI_ ISL_411929	BetaCoV/South Korea/ SNU01/2020	Asia/South Korea	Unknown	Department of Clinical Diagnostics	Park, W.B., Kwon, N.-J., Choi, S.-J., Kang, C.K., Choe, P.G., Kim, J.Y., Yun, J., Lee, G.-W., Seong, M.-W., Kim, N., Seo, J.-S. and Oh, M.-D.
92	EPI_ ISL_411950	BetaCoV/Jiangsu/JS01/2020	Asia/China/Jiangsu	NHC Key laboratory of Enteric Pathogenic Microbiology, Institute of Pathogenic Microbiology	Jiangsu Provincial Center for Disease Control & Prevention	Lunbiao Cui, Kangchen Zhao, Xiaojuan Zhu, Yiyue Ge, Tao Wu, Bin Wu, Yin Chen, Fengcai Zhu, Baoli Zhu, Ming Wu
93	EPI_ ISL_411951	BetaCoV/Sweden/01/2020	Europe/Sweden	Unknown	Unit for Laboratory Development and Technology Transfer, Public Health Agency of Sweden	Bengner, M., Palmerus, M., Lindsjo, O., Lind Karlberg, M., Monteil, V., Appelberg, S., Brave, A., Muradrasoli, S. and Tegmark-Wisell, K.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
94	EPI_ ISL_411952	BetaCoV/Jiangsu/JS02/2020	Asia/China/Jiangsu	NHC Key laboratory of Enteric Pathogenic Microbiology, Institute of Pathogenic Microbiology	Jiangsu Provincial Center for Disease Control & Prevention	Kangchen Zhao, Xiaojuan Zhu, Lunbiao Cui, Tao Wu, Yiyue Ge, Bin Wu, Yin Chen, Fengcai Zhu, Baoli Zhu, Ming Wu
95	EPI_ ISL_411953	BetaCoV/Jiangsu/JS03/2020	Asia/China/Jiangsu	NHC Key laboratory of Enteric Pathogenic Microbiology, Institute of Pathogenic Microbiology	Jiangsu Provincial Center for Disease Control & Prevention	Kangchen Zhao, Xiaojuan Zhu, Lunbiao Cui, Tao Wu, Yiyue Ge, Bin Wu, Yin Chen, Fengcai Zhu, Baoli Zhu, Ming Wu
96	EPI_ ISL_411954	BetaCoV/USA/CA7/2020	North America/USA/California	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Ying Tao, Clinton R. Paden, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
97	EPI_ ISL_411955	BetaCoV/USA/CA8/2020	North America/USA/California	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Ying Tao, Clinton R. Paden, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
98	EPI_ ISL_411956	BetaCoV/USA/TX1/2020	North America/USA/Texas	Texas Department of State Health Services	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Ying Tao, Clinton R. Paden, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
99	EPI_ ISL_411957	BetaCoV/China/ WH-09/2020	Asia/China	Unknown	Key Laboratory of Human Diseases, Comparative Medicine, Institute of Laboratory Animal Science	Linlin, B., Lili, R., Shuran, G., Jiangning, L., Feifei, Q., Qi, L., Fengdi, L., Jing, X., Wei, D., Pin, Y., Yanfeng, X., Yajin, Q., Hong, G., Qiang, W., Mingya, L., Guanpeng, W., Shunyi, W., Zhiqi, S., Li, G., Lan, C., Conghui, W., Ying, W., Xinming, W., Yan, X., Qi, J. and Chuan, Q.
100	EPI_ ISL_412026	BetaCoV/Hefei/2/2020	Asia/China/Anhui/ Hefei	Second Hospital of Anhui Medical University	Second Hospital of Anhui Medical University	Changtai Wang, Zhongping Liua, Zixiang Chen, Xin Huang, Mengyuan Xua, Tengfei He, Mengji Lu, Zhenhua Zhang
101	EPI_ ISL_412028	BetaCoV/Hong Kong/ VM20001061/2020	Asia/Hong Kong	Hong Kong Department of Health	School of Public Health, The University of Hong Kong	Dominic N.C. Tsang, Daniel K.W. Chu, Leo L.M. Poon, Malik Peiris
102	EPI_ ISL_412029	BetaCoV/Hong Kong/ VM20001988/2020	Asia/Hong Kong	Hong Kong Department of Health	The University of Hong Kong	Dominic N.C. Tsang, Daniel K.W. Chu, Leo L.M. Poon, Malik Peiris
103	EPI_ ISL_412030	BetaCoV/Hong Kong/ VB20026565/2020	Asia/Hong Kong	Hong Kong Department of Health	School of Public Health, The University of Hong Kong	Dominic N.C. Tsang, Daniel K.W. Chu, Leo L.M. Poon, Malik Peiris
104	EPI_ ISL_412116	BetaCoV/England/09c/2020	Europe/United Kingdom/England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Respiratory Virus Unit, Microbiology Services Colindale, Public Health England	Monica Galiano, Shahjahan Miah, Angie Lackenby, Omolola Akinbami, Tiina Talts, Leena Bhaw, Richard Myers, Steven Platt, Kirstin Edwards, Jonathan Hubb, Joanna Ellis, Maria Zambon
105	EPI_ ISL_412459	BetaCoV/Jingzhou/ HBCDC-HB-01/2020	Asia/China/Hubei/ Jingzhou	Jingzhou Center for Disease Control and Prevention	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Maoyi Chen, Jie Hu, Chunlin Mao, Yongzhong Jiang.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
106	EPI_ ISL_412862	BetaCoV/USA/CA9/2020	North America/USA/ California/Solano	California Department of Public Health	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Disease Control and Prevention	Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Ying Tao, Clinton R. Paden, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
107	EPI_ ISL_412869	BetaCoV/Korea/ KCDC05/2020	Asia/South Korea/ Seoul	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, Sang Hee Woo, Hye-Jun Jo, Sehee Park, Heui Man Kim, Myung Guk Han
108	EPI_ ISL_412870	BetaCoV/Korea/ KCDC06/2020	Asia/South Korea/ Seoul	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, Sang Hee Woo, Hye-Jun Jo, Sehee Park, Heui Man Kim, Myung Guk Han
109	EPI_ ISL_412871	BetaCoV/Korea/ KCDC07/2020	Asia/South Korea/ Seoul	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, Sang Hee Woo, Hye-Jun Jo, Sehee Park, Heui Man Kim, Myung Guk Han
110	EPI_ ISL_412872	BetaCoV/Korea/ KCDC12/2020	Asia/South Korea/ Gyeonggi-do	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, Sang Hee Woo, Hye-Jun Jo, Sehee Park, Heui Man Kim, Myung Guk Han
111	EPI_ ISL_412873	BetaCoV/Korea/ KCDC24/2020	Asia/South Korea/ Chungcheongnam-do	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Division of Viral Diseases, Center for Laboratory Control of Infectious Diseases, Korea Centers for Diseases Control and Prevention	Jeong-Min Kim, Yoon-Seok Chung, Namjoo Lee, Mi-Seon Kim, Sang Hee Woo, Hye-Jun Jo, Sehee Park, Heui Man Kim, Myung Guk Han

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
112	EPI_ ISL_412898	BetaCoV/Wuhan/ HBCDC-HB-02/2019	Asia/China/Hubei/ Wuhan	Wuhan Jinyintan Hospital	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
113	EPI_ ISL_412912	BetaCoV/Germany/Baden- Wuerttemberg-1/2020	Europe/Germany/ Baden- Wuerttemberg	State Health Office Baden- Wuerttemberg	Charité Universitätsmedizin Berlin, Institute of Virology	Victor M Comman, Julia Schneider, Barbara Mühlemann, Talitha Veith, Jörn Beheim-Schwarzbach, Terry Jones, Rainer Oehme, Silke Fischer, Christian Drosten
114	EPI_ ISL_412964	BetaCoV/Brazil/ SPBR-01/2020	South America/ Brazil/Sao Paulo/Sao Paulo	Hospital Israelita Albert Einstein	Instituto Adolfo Lutz Interdisciplinary Procedures Center Strategic Laboratory	Jaqueline Goes de Jesus, Claudio Tavares Sacchi, Daniela Bernardes Borges da Silva, Ingra Morales Claro, Flávia Cristina da Silva Sales, Claudia Regina Gonçalves, Joshua Quick, Maria do Carmo, Sampaio Tavares Timenetsky, Nicholas James Loman, Andrew Rambaut, Ester Cerqueira Sabino, Nuno Rodrigues Faria
115	EPI_ ISL_412965	BetaCoV/Canada/ BC_37_0-2/2020	North America/ Canada/British Columbia	BCCDC Public Health Laboratory	BCCDC Public Health Laboratory	Harrigan, Prystajecy, Krajden, Lee, Kamelian, Lapointe, Choi, Hoang, Sekirov, Levett, Tyson, Loman, Quick, Li, Gilmour
116	EPI_ ISL_412966	BetaCoV/China/ IQTC01/2020	Asia/China/ Guangdong/ Guangzhou	Unknown	Technology Centre, Guangzhou Customs	Shi, Y., Sun, J., Zheng, K., Huang, J. and Zhao, J.
117	EPI_ ISL_412967	BetaCoV/China/ IQTC02/2020	Asia/China/ Guangzhou	Unknown	Technology Centre, Guangzhou Customs	Shi, Y., Zheng, K., Sun, J., Huang, J., Zhu, A., Zhuang, Z., Dai, J., Chen, Z., Sun, F., Zhang, Z., Li, X. and Wang, Y.
118	EPI_ ISL_412968	BetaCoV/Japan/Hu_DP_ Kng_19-020/2020	Asia/Japan	Unknown	Takayuki Hishiki Kanagawa Prefectural Institute of Public Health, Department of Microbiology	Hishiki, T., Suzuki, R., Sakuragi, J., Usui, K., Tanaka, Y., Kawai, J., Kogo, Y., Matsuki, Y., An, T., Hayashizaki, Y. and Takasaki, T.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
119	EPI_ ISL_412969	BetaCoV/Japan/Hu_DP_ Kng_19-027/2020	Asia/Japan	Unknown	Takayuki Hishiki Kanagawa Prefectural Institute of Public Health, Department of Microbiology	Hishiki, T., Suzuki, R., Sakuragi, J., Usui, K., Tanaka, Y., Kawai, J., Kogo, Y., Matsuki, Y., An, T., Hayashizaki, Y. and Takasaki, T.
120	EPI_ ISL_412970	BetaCoV/USA/WA2/2020	North America/ USA/Washington/ Snohomish County	Washington State Department of Health	Seattle Flu Study	Helen Chu, Michael Boeckh, Janet Englund, Michael Famulare, Barry Lutz, Deborah Nickerson, Mark Rieder, Lea Starita, Matthew Thompson, Jay Shendure, and Trevor Bedford
121	EPI_ ISL_412971	BetaCoV/Finland/ FIN-25/2020	Europe/Finland/ Helsinki	HUS Diagnostiikkakeskus, Hallinto	Department of Virology Faculty of Medicine, Medicum University of Helsinki	Teemu Smura, Suvi Kuivanen, Hannimari Kallio-Kokko, Olli Vapalahti
122	EPI_ ISL_412972	BetaCoV/Mexico/CDMX/ InDRE_01/2020	North America/ Mexico/Mexico City	Instituto Nacional de Enfermedades Respiratorias	Instituto de Diagnostico y Referencia Epidemiologicos (INDRE)	Ramirez-Gonzalez Ernesto, Garces-Ayala Fabiola, Araiza-Rodriguez Adnan, Mendieta-Condado Edgar, Rodriguez-Maldonado Abril, Wong-Arambula Claudia, Vazquez-Perez Joel, Martinez Arturo, Boukadida Celia, Munoz-Medina Esteban, Sanchez Alejandro, Isa Pavel, Taboada Blanca, Lopez Susana, Arias Carlos, Barrera-Badillo Gisela, Hernandez-Rivas Lucia, Lopez-Martinez Irma
123	EPI_ ISL_412973	BetaCoV/Italy/CDG1/2020	Europe/Italy/ Lombardy	Department of Infectious Diseases, Istituto Superiore di Sanità, Roma , Italy	Virology Laboratory, Scientific Department, Army Medical Center	Paola Stefanelli, Stefano Fiore, Antonella Marchi, Eleonora Benedetti, Concetta Fabiani, Giovanni Faggioni, Antonella Fortunato, Riccardo De Santis, Silvia Fillo, Anna Anselmo, Andrea Ciammaruconi, Stefano Palomba, Florigio Lista

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
124	EPI_ ISL_412974	BetaCoV/Italy/SPL1/2020	Europe/Italy/Rome	Department of Infectious Diseases, Istituto Superiore di Sanità, Rome, Italy	Virology Laboratory, Scientific Department, Army Medical Center	Paola Stefanelli, Stefano Fiore, Antonella Marchi, Eleonora Benedetti, Concetta Fabiani, Giovanni Faggioni, Antonella Fortunato, Silvia Fillo, Riccardo De Santis, Andrea Ciammaruconi, Giancarlo Petralito, Filippo Molinari, Florigio Lista
125	EPI_ ISL_412975	BetaCoV/Australia/ NSW05/2020	Oceania/Australia/ New South Wales/ Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Eden J-S, Carter I, Rahman H, Holmes EC, Rockett R, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group
126	EPI_ ISL_412978	BetaCoV/Wuhan/ HBCDC-HB-02/2020	Asia/China/Hubei/ Wuhan	The Central Hospital Of Wuhan	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
127	EPI_ ISL_412979	BetaCoV/Wuhan/ HBCDC-HB-03/2020	Asia/China/Hubei/ Wuhan	Union Hospital of Tongji Medical College, Huazhong University of Science and Technology	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
128	EPI_ ISL_412980	BetaCoV/Wuhan/ HBCDC-HB-04/2020	Asia/China/Hubei/ Wuhan	Union Hospital of Tongji Medical College, Huazhong University of Science and Technology	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
129	EPI_ ISL_412981	BetaCoV/Wuhan/ HBCDC-HB-05/2020	Asia/China/Hubei/ Wuhan	CR&WISCO GENERAL HOSPITAL	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.
130	EPI_ ISL_412982	BetaCoV/Wuhan/ HBCDC-HB-06/2020	Asia/China/Hubei/ Wuhan	Wuhan Lung Hospital	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, Yongzhong Jiang.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
131	EPI_ ISL_412983	BetaCoV/Tianmen/ HBCDC-HB-07/2020	Asia/China/Hubei/ Tianmen	Tianmen Center for Disease Control and Prevention	Hubei Provincial Center for Disease Control and Prevention	Bin Fang, Xiang Li, Xiao Yu, Linlin Liu, Bo Yang, Faxian Zhan, Guojun Ye, Xixiang Huo, Junqiang Xu, Bo Yu, Kun Cai, Jing Li, YiFa Zhu, Yangyang Tao, Xierong Li, Yongzhong Jiang.
132	EPI_ ISL_413014	BetaCoV/Canada/ ON-PHL2445/2020	North America/ Canada/Ontario	Public Health Ontario Laboratory	Ontario Agency for Health Protection and Promotion (OAHPP)	Alireza Eshaghi, Samir N Patel, Jonathan B Gubbay, Vanessa G Allen, Christine Frantz, Aimin Li, Sandeep Nagra
133	EPI_ ISL_413015	BetaCoV/Canada/ON/ VIDO-01/2020	North America/ Canada/Ontario	Public Health Ontario Laboratory	National Microbiology Laboratory	Shari Tyson, Anna Majer, Erika Landry, Morag Graham, Grace Seo, Philip Mabon, Natalie Knox, Adrian Zetner, Samira Mubareka, Rob Kozak, Darryl Falzarano, Gerdt Volker, Jonathan Gubbay, Nathalie Bastien, Yan Li, Timothy F. Booth
134	EPI_ ISL_413016	BetaCov/Brazil/ SPBR-02/2020	South America/ Brazil/Sao Paulo/Sao Paulo	Hospital Israelita Albert Einstein	Instituto Adolfo Lutz, Interdisciplinary Procedures Center, Strategic Laboratory	Jaqueline Goes de Jesus, Claudio Tavares Sacchi, Fabiana Cristina Pereira dos Santos, Ingra Morales Claro, Flávia Cristina da Silva Sales, Claudia Regina Gonçalves, Joshua Quick, Maria do Carmo Sampaio Tavares Timenetsky, Nicholas James Loman, Andrew Rambaut, Ester Cerqueira Sabino, Nuno Rodrigues Faria
135	EPI_ ISL_413017	BetaCoV/South Korea/ KUMC01/2020	Asia/South Korea	Department of Microbiology, Institute for Viral Diseases, College of Medicine, Korea University	Department of Microbiology, Institute for Viral Diseases, College of Medicine, Korea University	Changmin Kang, Joon-Yong Bae, Jungmin Lee, Heedo Park, Juyoung Cho, Jeonghun Kim, Gee eun Lee, Cui Chunguang, Kyeong-ryeol Shin, Dong Min Kim, Jin Il Kim, Man-Seong Park

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
136	EPI_ ISL_413018	BetaCoV/South Korea/ KUMC02/2020	Asia/South Korea	Department of Microbiology, Institute for Viral Diseases, College of Medicine, Korea University	Department of Microbiology, Institute for Viral Diseases, College of Medicine, Korea University	Changmin Kang, Joon-Yong Bae, Jungmin Lee, Heedo Park, Juyoung Cho, Jeonghun Kim, Gee eun Lee, Cui Chunguang, Kyeong-ryeol Shin, Dong Min Kim, Jin Il Kim, Man-Seong Park
137	EPI_ ISL_413019	BetaCoV/Switzerland/ 1000477102/2020	Europe/Switzerland/ Zurich	Department of Internal Medicine, Triemli Hospital	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Gerhard Eich, Alexandra Trkola
138	EPI_ ISL_413020	BetaCoV/Switzerland/ 1000477377/2020	Europe/Switzerland/ Zurich	Department of Internal Medicine, Triemli Hospital	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Gerhard Eich, Alexandra Trkola
139	EPI_ ISL_413021	BetaCoV/Switzerland/ 1000477757/2020	Europe/Switzerland/ Zurich	Klinik Hirslanden Zurich	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Gabriela Ziltener, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Christian Ruedf, Alexandra Trkola
140	EPI_ ISL_413022	BetaCoV/Switzerland/ 1000477796/2020	Europe/Switzerland/ Zurich	Division of Infectious Diseases, University Hospital Zurich	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Gabriela Ziltener, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Roberto Speck, Alexandra Trkola
141	EPI_ ISL_413023	BetaCoV/Switzerland/ 1000477797/2020	Europe/Switzerland/ Zurich	Division of Infectious Diseases, University Hospital Zurich	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Gabriela Ziltener, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Roberto Speck, Alexandra Trkola

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
142	EPI_ ISL_413024	BetaCoV/Switzerland/ 1000477806/2020	Europe/Switzerland/ Zurich	Division of Infectious Diseases, University Hospital Zurich	Institute of Medical Virology, University of Zurich	Stefan Schmutz, Maryam Zaheri, Verena Kufner, Gabriela Ziltener, Patrick Redli, Fiona Steiner, Jon Huder, Riccarda Capaul, Andrea Zbinden, Jürg Böni, Michael Huber, Roberto Speck, Alexandra Trkola
143	EPI_ ISL_413025	BetaCoV/USA/ WA3-UW1/2020	North America/USA/ Washington	Harborview Medical Center	UW Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger
144	EPI_ ISL_413213	BetaCoV/Australia/ NSW06/2020	Oceania/Australia/ New South Wales/ Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Eden J-S, Carter I, Rahman H, Holmes EC, Rockett R, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
145	EPI_ ISL_413214	BetaCoV/Australia/ NSW07/2020	Oceania/Australia/ New South Wales/ Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Eden J-S, Carter I, Rahman H, Holmes EC, Rockett R, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
146	EPI_ ISL_413221	BetaCoV/Scotland/ CVR01/2020	Europe/United Kingdom/Scotland	West of Scotland Specialist Virology Centre, NHSGGC	MRC-University of Glasgow Centre for Virus Research	Emma Thomson, Antonia Ho; James Shephard, Shirin Ashraf; Kathy Smollett, Daniel Mair, Stephen Carmichael, Ana da Silva Filipe; Richard Orton, Josh Singer, Scott Arkison, David L Robertson; Andrew Rambaut; Alasdair MacLean, Rory Gunson.
147	EPI_ ISL_413455	BetaCoV/USA/ WA4-UW2/2020	North America/USA/ Washington	Washington State Public Health Lab	University of Washington Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger
148	EPI_ ISL_413457	BetaCoV/USA/ WA6-UW3/2020	North America/USA/ Washington	Washington State Public Health Lab	UW Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger
149	EPI_ ISL_413458	hCoV-19/USA/ WA7-UW4/2020	North America/USA/ Washington	Washington State Public Health Lab	UW Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
150	EPI_ ISL_413459	hCoV-19/Japan/ TK/20-31-3/2020	Asia/Japan/Tokyo	Department of Pathology, Toshima Hospital	Pathogen Genomics Center, National Institute of Infectious Diseases	Tsuyoshi Sekizuka, Kentaro Itokawa, Takuya Adachi, Masahiro Sano, Jun Yamazaki, Ippei Miyamoto, Haruka Nishioka, Ja-Mun Chong, Noriko Nakajima, Yuko Sato, Minoru Tobiume, Harutaka Katano, Tadaki Suzuki, Makoto Kuroda
151	EPI_ ISL_413485	hCoV-19/Anhui/ SZ005/2020	Asia/China/Anhui/ Suzhou	Department of microbiology laboratory, Anhui Provincial Center for Disease Control and Prevention	Department of microbiology laboratory, Anhui Provincial Center for Disease Control and Prevention	Weiwei Li, Jun He, Yong Sun, Junling Yu, Qingqing Chen, Yuan Yuan, Yonglin Shi, Zhuhui Zhang, Yinglu Ge, Weidong Li, Bin Su, Zhirong Liu
152	EPI_ ISL_413486	hCoV-19/USA/ WA8-UW5/2020	North America/USA/ Washington	Valley Medical Center	University of Washington Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger
153	EPI_ ISL_413487	hCoV-19/USA/ WA9-UW6/2020	North America/USA/ Washington	Harborview Medical Center	University of Washington Virology Lab	Pavitra Roychoudhury, Arun Nalla, Hong Xie, Keith Jerome, Alexander Greninger
154	EPI_ ISL_413488	hCoV-19/Germany/ NRW-01/2020	Europe/Germany/ North Rhine Westphalia/ Heinsberg District	Center of Medical Microbiology, Virology, and Hospital Hygiene	Center of Medical Microbiology, Virology, and Hospital Hygiene	Adams Ortwin, Andree Marcel, Dilthey Alexander, Hauka Sandra, Houwaart Torsten, Kohns Vasconcelos Malte, Pfeffer Klaus, Senff Tina, StreLOW Daniel, Timm Jörg, Walker Andreas, Wienemann Tobias
155	EPI_ ISL_413489	hCoV-19/Italy/UniSR1/2020	Europe/Italy/ Lombardy/Milan	Laboratorio di Microbiologia e Virologia, Università Vita-Salute San Raffaele, Milano	Laboratorio di Microbiologia e Virologia, Università Vita-Salute San Raffaele, Milano	R.A Diotti, E. Criscuolo, M. Castelli, V. Caputo, R. Ferrarese, M. Sampaolo, E. Boeri, I. Negri, V. Amato, G. Lo Raso, C. Di Resta, R. Burioni, M. Clementi, N. Mancini & N. Clementi
156	EPI_ ISL_413490	hCoV-19/New Zealand/01/2020	Oceania/New Zealand/Auckland	Auckland Hospital	Institute of Environmental Science and Research (ESR)	Matt Storey, Xiaoyun Ren, Gary McAuliffe, Sally Roberts, Matthew Blakiston, Erasmus Smit, Lauren Jelly, Joep de Ligt

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
157	EPI_ ISL_413513	hCoV-19/South Korea/ KUMC03/2020	Asia/South Korea	Division of Infectious Diseases, Department of Internal Medicine, Korea University College of Medicine	Department of Microbiology, Institute for Viral Diseases, College of Medicine, Korea University	Changmin Kang, Joon-Yong Bae, Jungmin Lee, Jin Gu Yoon, Heedo Park, Juyoung Cho, Jeonghun Kim, Gee Eun Lee, Cui Chunguang, Kyeong-ryeol Shin, Ji Yun Noh, Joon Young Song, Hee Jin Cheong, Woo Joo Kim, Jin Il Kim, Man-Seong Park
158	EPI_ ISL_413518	hCoV-19/Beijing/105/2020	Asia/China/Beijing	Unknown	Infectious Disease Control Center	Li, J., Li, L., Li, Z., Qiu, S., Song, H., Li, P. and Li, P.
159	EPI_ ISL_413520	hCoV-19/Beijing/233/2020	Asia/China/Beijing	Unknown	Infectious Disease Control Center	Li, J., Li, L., Li, Z., Qiu, S., Song, H., Li, P. and Li, P.
160	EPI_ ISL_413522	hCoV-19/India/1-27/2020	Asia/India/Kerala	Indian Council of Medical Research - National Institute of Virology	National Influenza Center, Indian Council of Medical Research - National Institute of Virology	Potdar V, Yadav PD, Choudhary ML, Shete-Aich A
161	EPI_ ISL_413523	hCoV-19/India/1-31/2020	Asia/India/Kerala	Indian Council of Medical Research-National Institute of Virology	National Influenza Center, Indian Council of Medical Research-National Institute of Virology	Potdar V, Yadav PD, Choudhary ML, Shete-Aich A
162	EPI_ ISL_413550	hCoV-19/Nigeria/ Lagos01/2020	Africa/Nigeria/Lagos	Centre for Human and Zoonotic Virology (CHAZVY), College of Medicine University of Lagos/Lagos University Teaching Hospital (LUTH), part of the Laboratory Network of the Nigeria Centre for Disease Control (NCDC)	African Centre of Excellence for Genomics of Infectious Diseases (ACEGID), Redeemer's University, Ede, Osun State, Nigeria	Oluniyi P.E., Ajogbasile F.V., Kayode A., Oguzie J., Folarin O.A., Ihekweazu C. Happi C.T.
163	EPI_ ISL_413555	hCoV-19/Wales/ PHW1/2020	Europe/United Kingdom/Wales	Wales Specialist Virology Centre	Public Health Wales Microbiology Cardiff	Catherine Moore, Cen Sabu, Joanne Watkins, Sally Corden, Tom Connor
164	EPI_ ISL_413556	hCoV-19/Wales/ PHW2/2020	Europe/United Kingdom/Wales	Wales Specialist Virology Centre	Public Health Wales Microbiology Cardiff	Catherine Moore, Tim Jones, Joanne Watkins, Sally Corden, Tom Connor
165	EPI_ ISL_413557	hCoV-19/USA/ CA-CDPH-UC1/2020	North America/USA/ California/Sonoma County	California Department of Public Health	Chiu Laboratory, UCSF-Abbott Viral Diagnostics and Discovery Center, University of California, San Francisco	Xianding Deng, Scot Federman, Guixia Yu, Chao-Yang Pan, Hugo Guevara, Alicia Sotomayor-Gonzalez, Allan Gopez, Elaine Hsu, Wei Gu, Steve Miller, Debra A. Wadford, and Charles Y. Chiu

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
166	EPI_ ISL_413558	hCoV-19/USA/ CA-CDPH-UC2/2020	North America/USA/ California/Solano County	California Department of Public Health	Chiu Laboratory, UCSF-Abbott Viral Diagnostics and Discovery Center, University of California, San Francisco	Xianding Deng, Scot Federman, Guixia Yu, Chao-Yang Pan, Hugo Guevara, Alicia Sotomayor-Gonzalez, Allan Gopez, Wei Gu, Steve Miller, Debra A. Wadford, and Charles Y. Chiu
167	EPI_ ISL_413559	hCoV-19/USA/ CA-CDPH-UC3/2020	North America/USA/ California/Solano County	California Department of Public Health	Chiu Laboratory, UCSF-Abbott Viral Diagnostics and Discovery Center, University of California, San Francisco	Xianding Deng, Scot Federman, Guixia Yu, Chao-Yang Pan, Hugo Guevara, Alicia Sotomayor-Gonzalez, Allan Gopez, Wei Gu, Steve Miller, Debra A. Wadford, and Charles Y. Chiu
168	EPI_ ISL_413560	hCoV-19/USA/WA-S3/2020	North America/USA/ Washington	Seattle Flu Study	Seattle Flu Study	Chu et al
169	EPI_ ISL_413561	hCoV-19/USA/ CA-CDPH-UC4/2020	North America/USA/ California/Solano County	California Department of Public Health	Chiu Laboratory, UCSF-Abbott Viral Diagnostics and Discovery Center, University of California, San Francisco	Xianding Deng, Scot Federman, Guixia Yu, Chao-Yang Pan, Hugo Guevara, Alicia Sotomayor-Gonzalez, Allan Gopez, Wei Gu, Steve Miller, Debra A. Wadford, and Charles Y. Chiu
170	EPI_ ISL_413562	hCoV-19/USA/ WA11-UW7/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
171	EPI_ ISL_413563	hCoV-19/USA/ WA12-UW8/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
172	EPI_ ISL_413564	hCoV-19/Netherlands/ Andel_1365066/2020	Europe/Netherlands/ Andel	MHC West-Brabant	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kamga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
173	EPI_ ISL_413565	hCoV-19/Netherlands/ Berlicum_1363564/2020	Europe/Netherlands/ Berlicum	Foundation Pamm	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
174	EPI_ ISL_413566	hCoV-19/Netherlands/ Blaricum_1364780/2020	Europe/Netherlands/ Blaricum	MHC Gooi & Vechtstreek	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
175	EPI_ ISL_413567	hCoV-19/Netherlands/ Coevorden_1363618/2020	Europe/Netherlands/ Coevorden	Unknown	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
176	EPI_ ISL_413568	hCoV-19/Netherlands/ Dalen_1363624/2020	Europe/Netherlands/ Dalen	MHC Drente	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
177	EPI_ ISL_413569	hCoV-19/Netherlands/ Delft_1363424/2020	Europe/Netherlands/ Delft	RIVM	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
178	EPI_ ISL_413570	hCoV-19/Netherlands/ Diemen_1363454/2020	Europe/Netherlands/ Diemen	RIVM	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
179	EPI_ ISL_413571	hCoV-19/Netherlands/ Eindhoven_1363782/2020	Europe/Netherlands/ Eindhoven	MHC Brabant Zuidoost	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
180	EPI_ ISL_413572	hCoV-19/Netherlands/ Haarlem_1363688/2020	Europe/Netherlands/ Haarlem	MHC Kennemerland	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
181	EPI_ ISL_413573	hCoV-19/Netherlands/ Hardinxveld_ Giessendam_1364806/2020	Europe/Netherlands/ Hardinxveld Giessendam	Dienst Gezondheid & Jeugd Zuid-Holland Zuid	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
182	EPI_ ISL_413574	hCoV-19/Netherlands/ Helmond_1363548/2020	Europe/Netherlands/ Helmond	MHC West-Brabant	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
183	EPI_ ISL_413575	hCoV-19/Netherlands/ Houten_1363498/2020	Europe/Netherlands/ Houten	RIVM	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
184	EPI_ ISL_413576	hCoV-19/Netherlands/ Loon_op_ zand_1363512/2020	Europe/Netherlands/ Loon op zand	RIVM	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
185	EPI_ ISL_413577	hCoV-19/Netherlands/ Naarden_1364774/2020	Europe/Netherlands/ Naarden	MHC Gooi & Vechtstreek	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
186	EPI_ ISL_413578	hCoV-19/Netherlands/ Nieuwendijk_1363582/2020	Europe/Netherlands/ Nieuwendijk	ErasmusMC	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
187	EPI_ ISL_413579	hCoV-19/Netherlands/ Nootdorp_1364222/2020	Europe/Netherlands/ Nootdorp	MHC Haaglanden	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
188	EPI_ ISL_413580	hCoV-19/Netherlands/ Oisterwijk_1364072/2020	Europe/Netherlands/ Oisterwijk	MHC Hart voor Brabant	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
189	EPI_ ISL_413581	hCoV-19/Netherlands/ Oss_1363500/2020	Europe/Netherlands/ Oss	RIVM	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
190	EPI_ ISL_413582	hCoV-19/Netherlands/ Rotterdam_1363790/2020	Europe/Netherlands/ Rotterdam	ErasmusMC	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
191	EPI_ ISL_413583	hCoV-19/Netherlands/ Rotterdam_1364040/2020	Europe/Netherlands/ Rotterdam	MHC Rotterdam-Rijnmond	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
192	EPI_ ISL_413584	hCoV-19/Netherlands/ Rotterdam_1364740/2020	Europe/Netherlands/ Rotterdam	Unknown	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
193	EPI_ ISL_413585	hCoV-19/Netherlands/ Tilburg_/2020	Europe/Netherlands/ Tilburg	Unknown	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kamga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
194	EPI_ ISL_413586	hCoV-19/Netherlands/ Tilburg_1363354/2020	Europe/Netherlands/ Tilburg	Foundation Elisabeth-Tweesteden Ziekenhuis	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kamga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
195	EPI_ ISL_413587	hCoV-19/Netherlands/ Tilburg_1364286/2020	Europe/Netherlands/ Tilburg	Foundation Elisabeth-Tweesteden Ziekenhuis	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
196	EPI_ ISL_413588	hCoV-19/Netherlands/ Utrecht_1363564/2020	Europe/Netherlands/ Utrecht	MHC Utrecht	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
197	EPI_ ISL_413589	hCoV-19/Netherlands/ Utrecht_1363628/2020	Europe/Netherlands/ Utrecht	MHC Utrecht	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kamga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
198	EPI_ ISL_413590	hCoV-19/Netherlands/ Utrecht_1364066/2020	Europe/Netherlands/ Utrecht	MHC Utrecht	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kamga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
199	EPI_ ISL_413591	hCoV-19/Netherlands/ Zeewolde_1365080/2020	Europe/Netherlands/ Zeewolde	MHC Flevoland	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, Corien Swaan, Manon Haverkate, Madelief Mollers, Mart Stein, Sandra Kengne Kanga Mobou, Jeroen van Kampen, Jolanda Voermans, Aura Timen, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
200	EPI_ ISL_413592	hCoV-19/Taiwan/ NTU03/2020	Asia/Taiwan/Taipei	Department of Laboratory Medicine, National Taiwan University Hospital	Microbial Genomics Core Lab, National Taiwan University Centers of Genomic and Precision Medicine	Shiou-Hwei Yeh, You-Yu Lin, Ya-Yun Lai, Chiao-Ling Li, Shan-Chwen Chang, Pei-Jer Chen, Sui-Yuan Chang
201	EPI_ ISL_413593	hCoV-19/Luxembourg/ Lu×1/2020	Europe/Luxembourg	Laboratoire National de Santé	Erasmus Medical Center	David Nieuwenhuijse, Bas Oude Munnink, Reina Sikkema, Claudia Schapendonk, Irina Chestakova, Anne van der Linden, Mark Pronk, Pascal Lexmond, T. Abdelrahman, G. Fournier, J. Mossong, T. Nguyen, Jeroen van Kampen, Jolanda Voermans, Corine GeurtsvanKessel, Annemiek van der Eijk, Richard Molenkamp, Marion Koopmans, on behalf of the Dutch national COVID-19 response team.
202	EPI_ ISL_413594	hCoV-19/Australia/ NSW08/2020	Oceania/Australia/ NSW/Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Rockett R, Eden J-S, Lam C, Gray K, Timms, V, Gall, M, Alicia, A, Carter I, Rahman H, Holmes EC, , O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
203	EPI_ ISL_413595	hCoV-19/Australia/ NSW09/2020	Oceania/Australia/ NSW/Sydney	Centre for Infectious Diseases and Microbiology Laboratory Services	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Rockett R, Eden J-S, Lam C, Gray K, Timms, V, Gall, M, Carter I, Rahman H, Holmes EC, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
204	EPI_ ISL_413597	hCoV-19/Australia/ NSW11/2020	Oceania/Australia/ NSW/Sydney	Centre for Infectious Diseases and Microbiology- Public Health	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Lam C, Eden J-S, Rockett R, Gray K, Timms, V, Gall, M, Carter I, Rahman H, Holmes EC, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
205	EPI_ ISL_413599	hCoV-19/Australia/ NSW13/2020	Oceania/Australia/ NSW/Sydney	Centre for Infectious Diseases and Microbiology - Public Health	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Timms, V, Eden J-S, Lam C, Gray K, Rockett R, Gall, M, Carter I, Rahman H, Holmes EC, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
206	EPI_ ISL_413600	hCoV-19/Australia/ NSW14/2020	Oceania/Australia/ NSW/Sydney	Centre for Infectious Diseases and Microbiology - Public Health	NSW Health Pathology - Institute of Clinical Pathology and Medical Research; Westmead Hospital; University of Sydney	Gall, M, Eden J-S, Lam C, Gray K, Timms, V, Rockett R, Carter I, Rahman H, Holmes EC, O'Sullivan MV, Sintchenko V, Chen SC, Maddocks S, Kok J and Dwyer DE for the 2019-nCoV Study Group*
207	EPI_ ISL_413601	hCoV-19/USA/ WA13-UW9/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
208	EPI_ ISL_413602	hCoV-19/Finland/ FIN03032020A/2020	Europe/Finland/ Helsinki	Department of Virology and Immunology, University of Helsinki and Helsinki University Hospital, Huslab Finland	Department of Virology, Faculty of Medicine, University of Helsinki, Helsinki, Finland	Teemu Smura, Hannimari Kallio-Kokko, Olli Vapalahti
209	EPI_ ISL_413603	hCoV-19/Finland/ FIN03032020B/2020	Europe/Finland/ Helsinki	Department of Virology and Immunology, University of Helsinki and Helsinki University Hospital, Huslab Finland	Department of Virology, Faculty of Medicine, University of Helsinki, Helsinki, Finland	Teemu Smura, Hannimari Kallio-Kokko, Olli Vapalahti

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
210	EPI_ ISL_413604	hCoV-19/Finland/ FIN03032020C/2020	Europe/Finland/ Helsinki	Department of Virology and Immunology, University of Helsinki and Helsinki University Hospital, Huslab Finland	Department of Virology, Faculty of Medicine, University of Helsinki, Helsinki, Finland	Teemu Smura, Hannimari Kallio-Kokko, Olli Vapalahti
211	EPI_ ISL_413606	hCoV-19/USA/ CruiseA-1/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Ying Tao, Clinton R. Paden, Krista Queen, Jing Zhang, Yan Li, Mary S. Keckler, Alison S Laufer Halpin, Haibin Wang, Jasmine Padilla, Justin Lee, Christopher A. Elkins, Susan I. Gerber, Suxiang Tong
212	EPI_ ISL_413607	hCoV-19/USA/ CruiseA-2/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Ying Tao, Clinton R. Paden, Krista Queen, Jing Zhang, Yan Li, Mary S. Keckler, Alison S Laufer Halpin, Haibin Wang, Jasmine Padilla, Justin Lee, Christopher A. Elkins, Susan I. Gerber, Suxiang Tong
213	EPI_ ISL_413609	hCoV-19/USA/ CruiseA-4/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Ying Tao, Clinton R. Paden, Krista Queen, Jing Zhang, Yan Li, Mary S. Keckler, Alison S Laufer Halpin, Haibin Wang, Jasmine Padilla, Justin Lee, Christopher A. Elkins, Susan I. Gerber, Suxiang Tong
214	EPI_ ISL_413611	hCoV-19/USA/ CruiseA-6/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Anna Uehara, Ying Tao, Clinton R. Paden, Krista Queen, Jing Zhang, Yan Li, Mary S. Keckler, Alison S Laufer Halpin, Haibin Wang, Jasmine Padilla, Justin Lee, Christopher A. Elkins, Susan I. Gerber, Suxiang Tong
215	EPI_ ISL_413612	hCoV-19/USA/ CruiseA-7/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
216	EPI_ ISL_413613	hCoV-19/USA/ CruiseA-8/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
217	EPI_ ISL_413615	hCoV-19/USA/ CruiseA-10/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
218	EPI_ ISL_413616	hCoV-19/USA/ CruiseA-11/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
219	EPI_ ISL_413617	hCoV-19/USA/ CruiseA-12/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Ying Tao, Clinton R. Paden, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
220	EPI_ ISL_413618	hCoV-19/USA/ CruiseA-13/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Clinton R. Paden, Ying Tao, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
221	EPI_ ISL_413619	hCoV-19/USA/ CruiseA-14/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Clinton R. Paden, Ying Tao, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
222	EPI_ ISL_413622	hCoV-19/USA/ CruiseA-17/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Clinton R. Paden, Ying Tao, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong
223	EPI_ ISL_413623	hCoV-19/USA/ CruiseA-18/2020	North America/USA	Unknown	Pathogen Discovery, Respiratory Viruses Branch, Division of Viral Diseases, Centers for Diseases Control and Prevention	Clinton R. Paden, Ying Tao, Krista Queen, Anna Uehara, Jing Zhang, Yan Li, Haibin Wang, Shifaq Kamili, Xiaoyan Lu, Brian Lynch, Senthil Kumar K. Sakthivel, Brett L. Whitaker, Lijuan Wang, Janna' R. Murray, Jasmine Padilla, Justin Lee, Susan I. Gerber, Stephen Lindstrom, Suxiang Tong

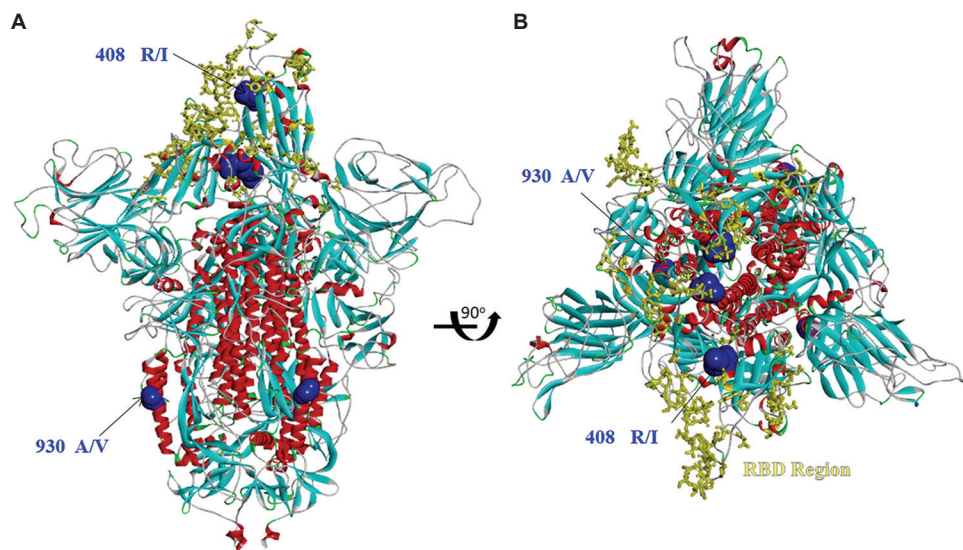
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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
224	EPI_ ISL_413647	hCoV-19/Portugal/ CV62/2020	Europe/Portugal	Centro Hospital do Porto, E.P.E. - H. Geral de Santo Antonio	Instituto Nacional de Saude (INSA)	Raquel Guiomar, Inês Costa, Pedro Pechirra, Joana Mendonça, Luís Vieira, Helena Ramos, Joana Isidro, Vitor Borges, João Paulo Gomes
225	EPI_ ISL_413648	hCoV-19/Portugal/ CV63/2020	Europe/Portugal	Centro Hospitalar e Universitário de Sao Joao, Porto	Instituto Nacional de Saude (INSA)	Raquel Guiomar, Inês Costa, Pedro Pechirra, Joana Mendonça, Luís Vieira, João Tiago Guimarães, Joana Isidro, Vitor Borges, João Paulo Gomes
226	EPI_ ISL_413649	hCoV-19/USA/ WA14-UW10/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
227	EPI_ ISL_413650	hCoV-19/USA/ WA15-UW11/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
228	EPI_ ISL_413651	hCoV-19/USA/ WA16-UW12/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
229	EPI_ ISL_413652	hCoV-19/USA/ WA17-UW13/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
230	EPI_ ISL_413653	hCoV-19/USA/ WA18-UW14/2020	North America/USA/ Washington	UW Virology Lab	UW Virology Lab	Pavitra Roychoudhury, Hong Xie, Keith Jerome, Alexander Greninger
231	EPI_ ISL_413691	hCoV-19/China/ WF0001/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
232	EPI_ ISL_413692	hCoV-19/China/ WF0002/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen, Mengmeng Tian
233	EPI_ ISL_413693	hCoV-19/China/ WF0003/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
234	EPI_ ISL_413697	hCoV-19/China/ WF0012/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
235	EPI_ ISL_413711	hCoV-19/China/ WF0014/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
236	EPI_ ISL_413749	hCoV-19/China/ WF0019/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
237	EPI_ ISL_413753	hCoV-19/China/ WF0024/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen

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Sr No	Accession ID	Virus name	Location	Originating lab	Submitting lab	Authors
238	EPI_ ISL_413791	hCoV-19/China/ WF0028/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
239	EPI_ ISL_413809	hCoV-19/China/ WF0029/2020	Asia/China	Weifang Center for Disease Control and Prevention	Weifang Center for Disease Control and Prevention	Qing Nie, Wei Chen, Dehui Liu, Yingying Chen
240	EPI_ ISL_413875	hCoV-19/China/ GDFS2020052-P0025/2020	Asia/China/ Guangdong	Guangdong Provincial Institution of Public Health, Guangdong Provincial Center for Disease Control and Prevention	Guangdong Provincial Institution of Public Health	Jing Lu, Louis du Plessis, Liu Zhe, Jiufeng Sun, Sarah François, Huifang Lin, Moritz Kraemer, Jingju Peng, Qianlin Xiong, Runyu Yuan, Lilian Zeng, Pingping Zhou, Chuming Liang, Tao Liu, Wei Li, Juan Su, Huanying Zheng, Kang Min, Song Tie, Bo Peng, Shisong Fang, Wenzhe Su, Kuibiao Li, Ruilin Sun, Ru bai, Xi Tang, Minfeng Liang, Nuno Faria, Josh Quick, Andrew Rambaut, Verity Hill, Wenjun Ma, Nick Loman, Oliver Pybus, Changwen Ke

\*We acknowledge the authors, originating and submitting laboratories of the sequence from GISAID's EpiCoV™ database on which this research is partially based. ESR, Environmental Science and Research; ICDC, National Institute for Communicable Disease Control and Prevention; MHC, major histocompatibility complex; INSA, Instituto Nacional de Saude; CDC, Centers for Disease Control and Prevention; KCDC, Korea Centers for Disease Control and Prevention; OAHPP, Ontario Agency for Health Protection and Promotion



**Supplementary Fig. 1.** Receptor-binding domain and mutations within the 'S' protein of the Indian severe acute respiratory syndrome coronavirus 2 mapped on the respective modelled structure (A) Side view (B) Top view.

**Supplementary Table II.** Conformational B-cell epitopes predicted by Ellipro based on the chains A, B and C of the Indian severe acute respiratory syndrome coronavirus 2 spike protein modelled structure (template used: 6VSB.PDB). Ellipro protrusion Index threshold set to 0.8 cut-off

	Chain A	Ellipro Score
1	D1137, P1138, L1139, Q1140, P1141, E1142, L1143, D1144	0.984
2	Y705, S706, N707, N708, S709, T1074, T1075, A1076, P1077, A1078, I1079, C1080, H1081, D1082, G1083, K1084, A1085, H1086, F1087, P1088, R1089, E1090, G1091, F1093, V1094, S1095, N1096, G1097, T1098, H1099, W1100, F1101, V1102, Y1108, E1109, P1110, Q1111, I1112, I1113, T1114, T1115, D1116, N1117, T1118, F1119, V1120, S1121, G1122, N1123,	0.906
3	N341, A342, T343, R344, F345, A346, S347, V348, Y349, A350, W351, N352, S397, F398, V399, I400, R401, E404, Q412, T413, G414, K415, I416, A417, D418, Y419, N420, Y421, K422, L423, S436, N437, N438, L439, D440, S441, K442, V443, G444, G445, N446, Y447, N448, Y449, L450, Y451, R452, L453, F454, R455, K456, S457, N458, L459, K460, P461, F462, E463, R464, D465, I466, S467, T468, E469, I470, Y471, Q472, A473, G474, S475, T476, P477, C478, N479, G480, V481, G483, F484, N485, C486, Y487, F488, P489, L490, Q491, S492, Y493, G494, F495, Q496, P497, T498, N499, G500, V501, G502, Y503, Q504, P505, R507	0.887
4	I68, H69, V70, S71, G72, T73, N74, G75, T76, K77, R78, S98, I100, C136, D138, F140, G142, Y143, H144, K145, N146, N147, K148, S149, W150, M151, E152, S153, E154, F155, R156, N183, F184, A241, L242, H243, R244, S245, Y246, L247, T248, P249, G250, D251, S252, S253, S254, G255, W256, T257, A258, G259, A260	0.876
Chain B		
1	A704, Y705, S706, N707, N708, S709, F1073, T1074, T1075, A1076, P1077, A1078, I1079, C1080, H1081, D1082, G1083, K1084, A1085, H1086, F1087, P1088, R1089, E1090, G1091, V1092, F1093, V1094, S1095, N1096, G1097, T1098, H1099, W1100, F1101, V1102, T1103, Q1104, R1105, F1107, Y1108, E1109, P1110, Q1111, I1112, I1113, T1114, T1115, D1116, N1117, T1118, F1119, V1120, S1121, G1122, N1123, C1124, D1125, V1126, V1127, I1128, G1129, I1130, V1131, N1132, N1133, T1134, V1135, Y1136, D1137, P1138, L1139, Q1140, P1141, E1142, L1143, D1144	0.902
2	N341, A342, T343, F345, A346, S347, V348, Y349, A350, W351, V399, R401, G402, T413, G414, K415, D418, Y419, N420, Y421, K422, S436, N437, N438, L439, D440, S441, K442, V443, G444, G445, N446, Y447, N448, Y449, L450, Y451, R452, L453, F454, R455, K456, S457, N458, L459, K460, P461, E463, R464, D465, I466, S467, T468, E469, I470, Y471, Q472, A473, G474, S475, T476, P477, C478, N479, G480, V481, E482, G483, F484, N485, C486, Y487, F488, P489, L490, Q491, S492, Y493, G494, F495, Q496, P497, T498, N499, G500, V501, G502, Y503, Q504, P505	0.886
3	A67, I68, H69, V70, S71, G72, T73, N74, G75, T76, K77, R78, E96, K97, S98, N99, I100, R102, N122, A123, T124, N125, C136, N137, D138, P139, F140, L141, G142, Y143, H144, K145, N146, N147, K148, S149, W150, M151, E152, S153, E154, F155, L239, L240, A241, L242, H243, R244, S245, Y246, L247, T248, P249, G250, D251, S252, S253, S254, G255, W256, T257, A258, G259, A260, A261	0.869
Chain C		
1	D1137, P1138, L1139, Q1140, P1141, E1142, L1143, D1144	0.984
2	Y705, S706, N707, N708, S709, T1074, T1075, A1076, P1077, A1078, I1079, C1080, H1081, D1082, G1083, K1084, A1085, H1086, F1087, P1088, R1089, E1090, G1091, F1093, V1094, S1095, N1096, G1097, T1098, H1099, W1100, F1101, V1102, Y1108, E1109, P1110, Q1111, I1112, I1113, T1114, T1115, D1116, N1117, T1118, F1119, V1120, S1121, G1122, N1123, C1124, D1125, V1126, V1127, I1128, G1129, I1130, V1131, N1132, N1133, T1134, V1135, Y1136	0.906
3	N341, A342, T343, R344, F345, A346, S347, V348, Y349, A350, W351, N352, S397, F398, V399, I400, R401, E404, Q412, T413, G414, K415, I416, A417, D418, Y419, N420, Y421, K422, L423, S436, N437, N438, L439, D440, S441, K442, V443, G444, G445, N446, Y447, N448, Y449, L450, Y451, R452, L453, F454, R455, K456, S457, N458, L459, K460, P461, F462, E463, R464, D465, I466, S467, T468, E469, I470, Y471, Q472, A473, G474, S475, T476, P477, C478, N479, G480, V481, G483, F484, N485, C486, Y487, F488, P489, L490, Q491, S492, Y493, G494, F495, Q496, P497, T498, N499, G500, V501, G502, Y503, Q504, P505, R507	0.887

Contd...

Chain C

4	I68, H69, V70, S71, G72, T73, N74, G75, T76, K77, R78, S98, I100, C136, D138, F140, G142, Y143, H144, K145, N146, N147, K148, S149, W150, M151, E152, S153, E154, F155, R156, N183, F184, A241, L242, H243, R244, S245, Y246, L247, T248, P249, G250, D251, S252, S253, S254, G255, W256, T257, A258, G259, A260	0.876
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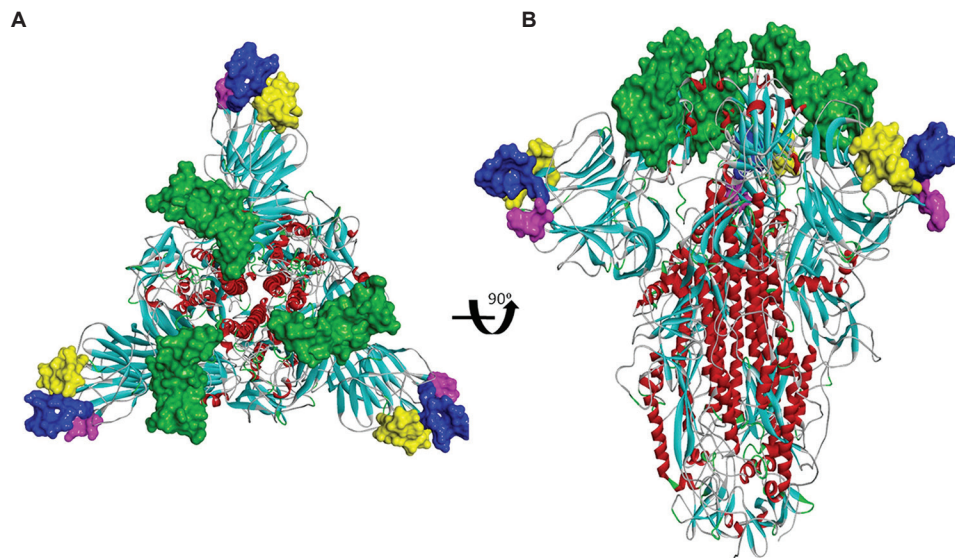
**Supplementary Table III:** Conformational B-cell epitopes predicted by the Discotope server based on the chain A, B and C of India severe acute respiratory syndrome coronavirus 2 spike protein modelled structure (template used 6VSB.PDB). Discotope threshold set to -3.7 cut-off

CHAIN A	71S, 72G, 73T, 74N, 75G, 76T, 148K, 149S, 150W, 151M, 152E, 178E, 179G, 180K, 181Q, 209N, 245S, 247L, 248T, 250G, 252S, 253S, 440D, 441S, 442K, 443V, 444G, 445G, 446N, 447Y, 448N, 452R, 453L, 454F, 455R, 456K, 458N, 460K, 461P, 465D, 468T, 470I, 482E, 487Y, 488F, 489P, 490L, 491Q, 492S, 493Y, 494G, 495F, 496Q, 497P, 498T, 499N, 500G, 501V, 502G, 554N, 556K, 558L, 559P, 560F, 568A, 677N, 678S, 679P, 680R, 681R, 682A, 683R, 701N, 702S, 703V, 791P, 792I, 807P, 808S, 810P, 912N, 915Y, 916E, 1069Q, 1097G, 1099H, 1116D, 1137D, 1138P, 1139L, 1140Q, 1141P, 1142E, 1143L, 1144D
CHAIN B	70V, 73T, 74N, 75G, 76T, 147N, 148K, 149S, 150W, 151M, 176D, 177L, 178E, 179G, 180K, 181Q, 182G, 183N, 212R, 244R, 245S, 246Y, 247L, 248T, 249P, 250G, 251D, 252S, 253S, 254S, 255G, 256W, 438N, 441S, 442K, 443V, 444G, 445G, 446N, 447Y, 454F, 456K, 457S, 458N, 460K, 467S, 476T, 492S, 494G, 495F, 496Q, 497P, 498T, 499N, 500G, 501V, 502G, 503Y, 554N, 556K, 558L, 559P, 676T, 677N, 678S, 679P, 680R, 701N, 702S, 703V, 714T, 791P, 792I, 807P, 808S, 810P, 912N, 915Y, 916E, 1069Q, 1109E, 1112I, 1116D, 1137D, 1138P, 1139L, 1140Q, 1141P, 1142E, 1143L, 1144D
CHAIN C	72G, 73T, 74N, 75G, 97K, 98S, 143Y, 144H, 145K, 146N, 147N, 148K, 149S, 150W, 151M, 152E, 153S, 180K, 181Q, 182G, 183N, 184F, 209N, 252S, 253S, 441S, 442K, 443V, 444G, 445G, 446N, 447Y, 454F, 456K, 457S, 458N, 460K, 480G, 492S, 494G, 496Q, 497P, 498T, 499N, 500G, 501V, 502G, 503Y, 554N, 556K, 558L, 559P, 676T, 678S, 679P, 680R, 681R, 682A, 683R, 684S, 685V, 701N, 702S, 714T, 791P, 792I, 807P, 808S, 912N, 915Y, 916E, 1069Q, 1072N, 1098T, 1112I, 1116D, 1138P, 1139L, 1140Q, 1141P, 1142E, 1143L, 1144D

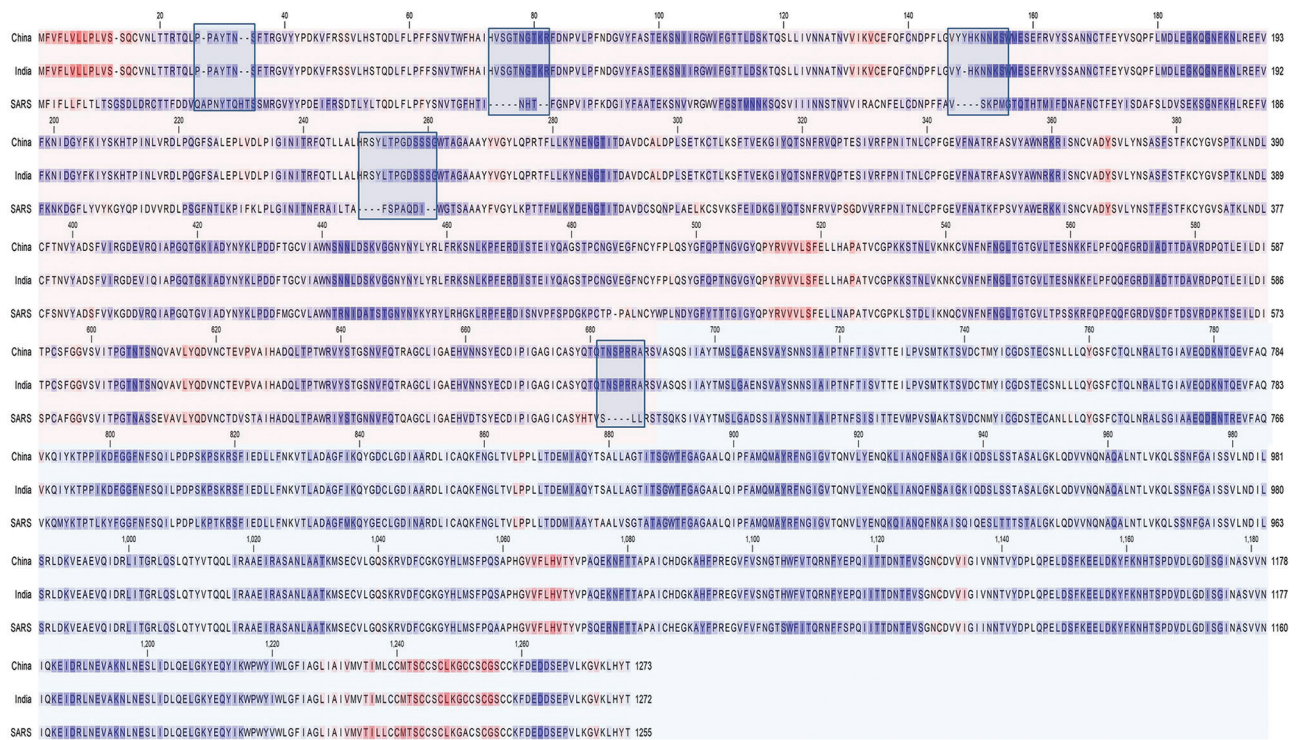
**Supplementary Table IV.** Conformational B-cell epitopes predicted using the modelled structure of the spike protein (template used: 6ACC. PDB; 87.29% identity). (A) Ellipro server (using a protrusion Index threshold of 0.9) (B) DiscoTope server

A. Ellipro epitope prediction		
Epitope number	Epitope residues	Epitope score
1	244-RSYLTPGDSSSGW-256	0.95
2	347S, 349Y, 419Y, 441-SKVGGNYNLYRLFR-455, 457S, 465-DISTEIYQAGSTPCNGVEGFNCYFPLQSYGFQPTN -499	0.943
3	1074 TTAPAICHDGKAHFPR 1089, 1094-VSNGTHWFV-1102, 1110- PQIITTDNTFVSGNCDVVIGIVNNTV-1135	0.934
4	144-HKNNKSWMESE-154	0.912
5	72-GTNGTK-77	0.907
B. DiscoTope epitope prediction		
G72, T73, N74, G75, K145, N146, N147, K148, S149, L174, E178, K180, Q181, G182, 183, V211, S245, Y246, L247, T248, P249, G250, D251, S252, S253, K415, N438, S441, K442, V443, G444, G445, N446, Y447, N448, K456, S457, N458, K460, A473, G474, S475, S492, G494, Q496, P497, T498, N499, G500, V501, Y503, N554, K556, L558, P559, I567, Q675, T676, N677, S678, P679, R680, R681, A682, R683, S702, V703, A704, Y705, T714, P791, P807, S808, K809, P810, E916, Q1069, E1070		





**Supplementary Fig. 2.** Conformational B-cell epitopes predicted on the S protein of the Indian severe acute respiratory syndrome coronavirus (SARS-CoV-2) using the pre-fusion structure of SARS-CoV-1 (6ACC.PDB; 87.29%) (colour key: blue - epitope 1; green - epitope 2; yellow - epitope 4; pink - epitope 5 as indicated in Supplementary Table III) (A) Top view (B) Side view.



**Supplementary Fig. 3.** Alignment of Wuhan severe acute respiratory syndrome coronavirus 2, Indian severe acute respiratory syndrome (SARS-CoV-2) and SARS-CoV-1 (accession number: NC\_004718) spike protein using CLC Genomics workbench. Boxes represent the different insertions in the spike protein region of Indian SARS-CoV-2 (deletions in SARS-CoV-1. S1 domain is highlighted in light red colour and the S2 domain in blue colour.