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A novel bat coronavirus reveals natural insertions at the S1/S2 2 cleavage site of the Spike protein and a possible recombinant 3 origin of HCoV-19 4 Hong Zhou^{1,8}, Xing Chen^{2,8}, Tao Hu^{1,8}, Juan Li^{1,8}, Hao Song³, Yanran Liu¹, Peihan Wang^{1 5}, Di Liu⁴, Jing Yang⁵, Edward C. Holmes⁶, Alice C. Hughes^{2,*}, Yuhai Bi^{5,*}, Weifeng Shi^{1,7,*}

The Proximal Origin of SARS-CoV-2 Kristian G. Andersen^{1,2*}, Andrew Rambaut³, W. Ian Lipkin⁴, Edward C. Holmes⁵ & Robert F. Garry^{6,7}

And sequences leading to the reporting of genomic epidemiology at <https://nextstrain.org/ncov>

Polybasic cleavage site for SARS CoV with novel spike protein and ACE2 RBD

US9834595 [Redacted]	Amino acid sequences directed against envelope proteins of a virus and polypeptides comprising the same for the treatment of viral diseases	Ablynx N.V.	5-Jun-08 29-Oct-15 5-Dec-17
US9193780 [Redacted]	Amino acid sequences directed against envelope proteins of a virus and polypeptides comprising the same for the treatment of viral diseases	Ablynx N.V.	5-Jun-08 5-Jun-09 24-Nov-15
US20190077847 14-Mar-19	AMINO ACID SEQUENCES DIRECTED AGAINST ENVELOPE PROTEINS OF A VIRUS AND POLYPEPTIDES COMPRISING THE SAME FOR THE TREATMENT OF VIRAL DISEASES	Ablynx N.V.	5-Jun-08 17-Oct-17 14-Mar-19
US20160152693 2-Jun-16	AMINO ACID SEQUENCES DIRECTED AGAINST ENVELOPE PROTEINS OF A VIRUS AND POLYPEPTIDES COMPRISING THE SAME FOR THE TREATMENT OF VIRAL DISEASES	Ablynx N.V.	5-Jun-08 29-Oct-15 2-Jun-16
US10550174 [Redacted]	Amino acid sequences directed against envelope proteins of a virus and polypeptides comprising the same for the treatment of viral diseases	Ablynx N.V.	5-Jun-08 17-Oct-17 4-Feb-20
US10407492 [Redacted]	Amino acid sequences directed against envelope proteins of a virus and polypeptides comprising the same for the treatment of viral diseases	Ablynx N.V.	5-Jun-08 17-Oct-17 10-Sep-19

O-linked glycans and SARS CoV Spike Protein Data disclosures

Document number	Title	Assignee name	Priority date File date
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			Issue date
US9644180	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC.	18-Nov-13 12-Jun-15 9-May-17
US8741311	Methods and compositions for immunization against virus	Academia Sinica	27-Mar-09 26-Mar-10 3-Jun-14
US8735416	Antiviral therapies	Technische Universitaet Carolo-Wilhelmina zu Braunschweig	21-Sep-05 23-Apr-12 27-May-14
US7604960	Transient protein expression methods	Crucell Holland B.V.	15-Apr-99 1-Jun-07 20-Oct-09
US20200046826 13-Feb-20	METHODS AND COMPOSITIONS FOR IMMUNIZATION AGAINST VIRUS	Academia Sinica	27-Mar-09 4-Jun-19 13-Feb-20
US20200040042 6-Feb-20	CHIMERIC MOLECULES AND USES THEREOF	Not Available	30-Mar-17 29-Mar-18 6-Feb-20
US20200002674 2-Jan-20	ERYTHROID CELLS COMPRISING PHENYLALANINE HYDROXYLASE	Not Available	18-Nov-13 16-Sep-19 2-Jan-20
US20190376034 12-Dec-19	PLATELETS COMPRISING EXOGENOUS POLYPEPTIDES AND USES THEREOF	Not Available	18-Nov-13 23-Aug-19 12-Dec-19
US20190316091 17-Oct-19	ERYTHROID CELLS COMPRISING ARGINASE	Not Available	18-Nov-13 30-May-19 17-Oct-19
US20190316090 17-Oct-19	ERYTHROID CELLS COMPRISING ARGININE DEIMINASE	RUBIUS THERAPEUTICS, INC.	18-Nov-13 30-May-19 17-Oct-19
US20190316089 17-Oct-19	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 10-May-19 17-Oct-19
US20190309262 10-Oct-19	ERYTHROID CELLS COMPRISING SERINE DEHYDRATASE	Not Available	18-Nov-13 4-Jun-19 10-Oct-19
US20190309261 10-Oct-19	ERYTHROID CELLS COMPRISING LYSINE OXIDASE	Not Available	18-Nov-13 4-Jun-19 10-Oct-19
US20190264177 29-Aug-19	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 10-May-19 29-Aug-19
US20190263934 29-Aug-19	FC VARIANTS WITH ENHANCED BINDING TO FCRN AND PROLONGED HALF-LIFE	Not Available	26-Jan-18 25-Jan-19 29-Aug-19
US20190144827 16-May-19	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	RUBIUS THERAPEUTICS, INC.	18-Nov-13 19-Nov-18 16-May-19
US20180265847 20-Sep-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 29-Mar-18 20-Sep-18
US20180216067 2-Aug-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 29-Mar-18 2-Aug-18
US20180208897 26-Jul-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 19-Mar-18 26-Jul-18

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US20180187154 5-Jul-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 20-Feb-18 5-Jul-18
US20180187153 5-Jul-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 20-Feb-18 5-Jul-18
US20180135012 17-May-18	MEMBRANE-RECEIVER COMPLEX THERAPEUTICS	Not Available	13-May-15 13-May-16 17-May-18
US20180030411 1-Feb-18	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 13-Oct-17 1-Feb-18
US20170369843 28-Dec-17	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 29-Mar-17 28-Dec-17
US20170174783 22-Jun-17	Single-Arm Monovalent Antibody Constructs and Uses Thereof	Not Available	10-May-12 20-Oct-16 22-Jun-17
US20160257932 8-Sep-16	GENETICALLY ENGINEERED ENUCLEATED ERYTHROID CELLS COMPRISING A PHENYLALANINE AMMONIA LYASE RECEIVER POLYPEPTIDE	Not Available	18-Nov-13 17-May-16 8-Sep-16
US20150335728 26-Nov-15	METHODS AND COMPOSITIONS FOR IMMUNIZATION AGAINST VIRUS	Academia Sinica	27-Mar-09 18-Feb-14 26-Nov-15
US20150306212 29-Oct-15	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 12-Jun-15 29-Oct-15
US20150297677 22-Oct-15	COMPOSITIONS AND METHODS FOR INHIBITING VIRAL ENTRY	Children Medical Center Corporation	13-Dec-12 12-Dec-13 22-Oct-15
US20150182588 2-Jul-15	SYNTHETIC MEMBRANE-RECEIVER COMPLEXES	Not Available	18-Nov-13 23-Dec-14 2-Jul-15
US20150125449 7-May-15	Single-Arm Monovalent Antibody Constructs and Uses Thereof	Not Available	10-May-12 8-May-13 7-May-15
US20140113923 24-Apr-14	NOVEL ANTIVIRAL THERAPIES	Not Available	21-Sep-05 23-Apr-12 24-Apr-14
US20100247571 30-Sep-10	METHODS AND COMPOSITIONS FOR IMMUNIZATION AGAINST VIRUS	ACADEMIA SINICA	27-Mar-09 26-Mar-10 30-Sep-10
US20090042793 12-Feb-09	Novel Antiviral Therapies	BALZARINI JAN	21-Sep-05 21-Sep-06 12-Feb-09
US20080113409 15-May-08	Transient protein expression methods	HATEBOER GUUS	15-Apr-99 1-Jun-07 15-May-08
US10557119	Erythroid cells comprising phenylalanine ammonia lyase	RUBIUS THERAPEUTICS, INC.	18-Nov-13 10-May-19 11-Feb-20
US10344263	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC.	18-Nov-13 29-Mar-17 9-Jul-19
US10329531	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC.	18-Nov-13 13-Oct-17 25-Jun-19

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US10307475	Methods and compositions for immunization against virus	Academia Sinica	27-Mar-09 18-Feb-14 4-Jun-19
US10301594	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC	18-Nov-13 19-Nov-18 28-May-19
US10301593	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC.	18-Nov-13 19-Mar-18 28-May-19
US10253296	Synthetic membrane-receiver complexes	RUBIUS THERAPEUTICS, INC.	18-Nov-13 28-Nov-17 9-Apr-19

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SARS-CoV research specifically on ACE2 binding

Document number	Title	Assignee name	Priority date File date Issue date
US9415087	Compositions and methods for treating coronavirus infection	Ludwig-Maximilians-Universitaet Muenchen	11-Mar-14 8-May-15 16-Aug-16
US8541003	Vectors expressing SARS immunogens, compositions containing such vectors or expression products thereof, methods and assays for making and using	Protein Sciences Corporation	20-Jun-03 21-Jun-04 24-Sep-13
US7750123	Antibodies against SARS-CoV and methods of use thereof	Dana Farber Cancer Institute, Inc.	25-Nov-03 24-Nov-04 6-Jul-10
US7728110	Antibodies to SARS coronavirus	Amgen, Inc.	19-May-06 21-May-07 1-Jun-10
US7696330	Binding molecules against SARS-coronavirus and uses thereof	Crucell Holland B.V.	22-Jul-03 20-Jan-06 13-Apr-10
US7687475	RNA interference in respiratory epithelial cells	University of Iowa Research Foundation	9-Jul-04 16-Oct-07 30-Mar-10
US7629443	Neutralizing monoclonal antibodies against severe acute respiratory syndrome-associated coronavirus	New York Blood Center, Inc.	2-Jun-04 8-Feb-06 8-Dec-09
US7604960	Transient protein expression methods	Crucell Holland B.V.	15-Apr-99 1-Jun-07 20-Oct-09
US7491489	Synthetic peptide targeting critical sites on the SARS-associated coronavirus spike protein responsible for viral infection and method of use thereof	The University of Hong Kong	22-Nov-04 28-Oct-05 17-Feb-09
US7320857	Characterization of the earliest stages of the severe acute respiratory syndrome (SARS) virus and uses thereof	Chinese National Human Genome Center at Shanghai	9-Jul-04 9-Jul-04 22-Jan-08
US7297786	RNA interference in respiratory epithelial cells	University of Iowa Research Foundation	9-Jul-04 11-Jul-05 20-Nov-07

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US7151163 12-Mar-20	Antiviral agents for the treatment, control and prevention of infections by coronaviruses	Sequoia Pharmaceuticals, Inc.	28-Apr-03 28-Apr-04 19-Dec-06
US20200079781 12-Mar-20	Substituted 2,4 diamino-quinoline as new medicament for fibrosis, autophagy and cathepsins B (CTSB), L (CTSL) and D (CTSD) related diseases	Not Available	5-Sep-18 1-Aug-19 12-Mar-20
US20200061185 27-Feb-20	PREFUSION CORONAVIRUS SPIKE PROTEINS AND THEIR USE	The Scripps Research Institute	25-Oct-16 25-Oct-17 27-Feb-20
US20200009244 9-Jan-20	NANOPARTICLE VACCINES WITH NOVEL STRUCTURAL COMPONENTS	Not Available	13-Jun-18 13-Jun-19 9-Jan-20
US20190328865 31-Oct-19	IMMUNOGENIC COMPOSITION FOR MERS CORONAVIRUS INFECTION	Not Available	28-Jul-14 17-Nov-17 31-Oct-19
US20190256579 22-Aug-19	MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS IMMUNOGENS, ANTIBODIES, AND THEIR USE	The U.S.A., as represented by the Secretary, Department of Health and Human Services	24-Feb-15 3-May-19 22-Aug-19
US20190194299 27-Jun-19	MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS NEUTRALIZING ANTIBODIES AND METHODS OF USE THEREOF	Not Available	25-Apr-14 19-Nov-18 27-Jun-19
US20190192691 27-Jun-19	REGULATED BIOCIRCUIT SYSTEMS	Not Available	11-Apr-16 11-Apr-17 27-Jun-19
US20180334480 22-Nov-18	CORONAVIRUSES EPITOPE-BASED VACCINES	RAMOT AT TEL-AVIV UNIVERSITY LTD.	17-Sep-15 15-Sep-16 22-Nov-18
US20180332885 22-Nov-18	REDUCED RISK TOBACCO PRODUCTS AND METHODS OF MAKING SAME	Not Available	11-May-05 25-May-18 22-Nov-18
US20180244756 30-Aug-18	MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS IMMUNOGENS, ANTIBODIES, AND THEIR USE	The United States of America, as Represented by the Secretary, Dept. of Health and Human Services	24-Feb-15 24-Feb-16 30-Aug-18
US20180230447 16-Aug-18	ACTIVE LOW MOLECULAR WEIGHT VARIANTS OF ANGIOTENSIN CONVERTING ENZYME 2 (ACE2)	Northwestern University	24-Jan-17 24-Jan-18 16-Aug-18
US20180177860 28-Jun-18	VACCINE CONTAINING VIRUS INACTIVATED BY GREEN TEA EXTRACT, AND PREPARATION METHOD THEREFOR	Not Available	11-Jun-15 7-Jun-16 28-Jun-18
US20170158752 8-Jun-17	MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS NEUTRALIZING ANTIBODIES AND METHODS OF USE THEREOF	Not Available	25-Apr-14 27-Apr-15 8-Jun-17
US20170055566 2-Mar-17	REDUCED RISK TOBACCO PRODUCTS AND METHODS OF MAKING SAME	Not Available	11-May-05 22-Aug-16 2-Mar-17
US20160376321 29-Dec-16	A NOVEL SARS IMMUNOGENIC COMPOSITION	BAYLOR COLLEGE OF MEDICINE	26-Nov-13 21-Nov-14 29-Dec-16
US20160082074 24-Mar-16	COMPOSITIONS AND METHODS FOR TREATING CORONAVIRUS INFECTION	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	11-Mar-14 8-May-15 24-Mar-16
US20150297677 22-Oct-15	COMPOSITIONS AND METHODS FOR INHIBITING VIRAL ENTRY	Children Medical Center Corporation	13-Dec-12 12-Dec-13 22-Oct-15
US20150275183 1-Oct-15	Human Betacoronavirus Lineage C and Identification of N-Terminal Dipeptidyl Peptidase As Its Virus Receptor	Not Available	23-Sep-12 23-Sep-13 1-Oct-15

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US20150150878 4-Jun-15	Methods For Inhibiting Viruses By Targeting Cathepsin-L Cleavage Sites In The Viruses' Glycoproteins	Not Available	4-Apr-12 4-Apr-13 4-Jun-15
US20140174460 26-Jun-14	REDUCED RISK TOBACCO PRODUCTS AND METHODS OF MAKING SAME	VECTOR TOBACCO INC.	11-May-05 10-Dec-13 26-Jun-14
US20130216566 22-Aug-13	Vectors expressing SARS immunogens, compositions containing such vectors or expression products thereof, methods and assays for making and using	ADAMS DANIEL	20-Jun-03 21-Jun-04 22-Aug-13
US20130196903 1-Aug-13	Multimeric Inhibitors of Viral Fusion and Uses Thereof	JV BIO SRL	11-Aug-10 11-Aug-11 1-Aug-13
US20100204286 12-Aug-10	METHOD FOR REDUCING GASTROINTESTINAL ADVERSE EFFECTS OF CYTOTOXIC AGENTS	BYRNES JOHN J	12-Feb-09 11-Feb-10 12-Aug-10
US20100172917 8-Jul-10	Binding molecules against SARS-coronavirus and uses thereof	Crucell Holland B.V.	22-Jul-03 16-Nov-09 8-Jul-10
US20100150923 17-Jun-10	FUSION PROTEINS OF RECOMBINANT SARS CORONAVIRUS STRUCTURAL PROTEINS, THEIR PRODUCTION AND USES	Chinese Academy of Medical Sciences, Institute of Basic Medical Sciences	20-Jun-05 13-Jun-06 17-Jun-10
US20100092470 15-Apr-10	ANTIBODIES, ANALOGS AND USES THEREOF	ICB International, Inc.	22-Sep-08 21-Sep-09 15-Apr-10
US20100047767 25-Feb-10	PATHOGEN BINDING	ITI SCOTLAND LIMITED	5-Feb-07 4-Feb-08 25-Feb-10
US20100035848 11-Feb-10	THERAPY FOR DISORDERS OF THE PROXIMAL DIGESTIVE TRACT	BARNES THOMAS MICHAEL	10-Mar-08 10-Mar-09 11-Feb-10
US20090304683 10-Dec-09	Soluble Fragments of The Sars-Cov Spike Glycoprotein	DIMITROV DIMITER S	19-Jan-07 19-Jan-07 10-Dec-09
US20090186014 23-Jul-09	METHOD FOR TREATMENT OF PANCREATITIS	Ore Pharmaceuticals Inc.	10-Oct-07 9-Oct-08 23-Jul-09
US20090130691 21-May-09	SCREENING PROTEINASE MODULATORS USING A CHIMERIC PROTEIN AND SKI-I PROPROTEIN CONVERTASE SUBSTRATES AND INHIBITORS	Institut de Recherches Cliniques de Montreal	16-Sep-05 14-Sep-06 21-May-09
US20090099259 16-Apr-09	Method for regulating gene expression	ANTHONY JOSHUA	28-Feb-06 28-Feb-07 16-Apr-09
US20090098530 16-Apr-09	Cell Line For Producing Coronaviruses	CRUCCELL HOLLAND B.V.	22-Jul-05 21-Jul-06 16-Apr-09
US20090083865 26-Mar-09	Transgenic Mouse Lines Expressing Human Ace2 and Uses Thereof	CHAN TEH-SHENG	11-Jan-06 11-Jan-07 26-Mar-09
US20080248043 9-Oct-08	Antibodies to SARS coronavirus	Amgen Inc.	19-May-06 21-May-07 9-Oct-08
US20080234345 25-Sep-08	METHOD FOR REDUCING OR ALLEVIATING INFLAMMATION IN THE DIGESTIVE TRACT	Gene Logic Inc.	8-Sep-06 7-Sep-07 25-Sep-08
US20080159962 3-Jul-08	Use of Inhibitors of the Renin-Angiotensin System for the Treatment of Lung Injuries	IMBA-INSTITUTE FUR MOLEKULARE BIOTECHNOLOGIE GMBH	19-May-05 19-May-06 3-Jul-08




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US20080113409 15-May-08	Transient protein expression methods	HATEBOER GUUS	15-Apr-99 1-Jun-07 15-May-08
US20080107650 8-May-08	METHOD FOR TREATING INFLAMMATORY DISEASES OF THE DIGESTIVE TRACT	Gene Logic Inc.	8-Sep-06 7-Sep-07 8-May-08
US20080044437 21-Feb-08	Encapsidation System for Production of Recombinant Virus-Like Particles	CHEN QUN	2-Sep-04 1-Sep-05 21-Feb-08
US20070298498 27-Dec-07	Adenoviral Amplicon and Producer Cells for the Production of Replication-Defective Adenoviral Vectors, Methods of Preparation and Use Thereof	CATALUCCI DANIELE	2-Nov-04 27-Oct-05 27-Dec-07
US20070238681 11-Oct-07	MODULATION OF ACE2 EXPRESSION	BENNETT C F	7-Nov-06 7-Dec-06 11-Oct-07
US20070203073 30-Aug-07	SARS and Ebola inhibitors and use thereof, and methods for their discovery	BATES PAUL	22-Jun-05 21-Jun-06 30-Aug-07
US20070185044 9-Aug-07	Modulation of ace2 expression	BENNETT C F	8-Mar-05 8-Mar-05 9-Aug-07
US20070185027 9-Aug-07	ANTIVIRAL AGENTS FOR THE TREATMENT, CONTROL AND PREVENTION OF INFECTIONS BY CORONAVIRUSES	SEQUOIA PHARMACEUTICALS, INC.	28-Apr-03 9-Nov-06 9-Aug-07
US20070003577 4-Jan-07	Purified trimeric S protein as vaccine against severe acute respiratory syndrome virus infections	SUBBARAO KANTA	28-Jun-05 27-Jun-06 4-Jan-07
US20060258577 16-Nov-06	ANTIVIRAL AGENTS FOR THE TREATMENT, CONTROL AND PREVENTION OF INFECTIONS BY CORONAVIRUSES	ERICKSON JOHN W	28-Apr-03 28-Apr-04 16-Nov-06
US20060257852 16-Nov-06	Severe acute respiratory syndrome coronavirus	Chiron Corporation	10-Apr-03 9-Apr-04 16-Nov-06
US20060240551 26-Oct-06	Neutralizing monoclonal antibodies against severe acute respiratory syndrome-associated coronavirus	HE YUXIAN	2-Jun-04 8-Feb-06 26-Oct-06
US20060240515 26-Oct-06	Soluble fragments of the SARS-CoV spike glycoprotein	DIMITROV DIMITER S	21-Jul-03 19-Jan-06 26-Oct-06
US20060199176 7-Sep-06	Coronavirus S peptides	CHONG PELE C S	15-Jul-04 14-Jul-05 7-Sep-06
US20060121580 8-Jun-06	Binding molecules against SARS-coronavirus and uses thereof	CRUCCELL	22-Jul-03 20-Jan-06 8-Jun-06
US20060110758 25-May-06	Synthetic peptide targeting critical sites on the SARS-associated coronavirus spike protein responsible for viral infection and method of use thereof	UNIV HONG KONG	22-Nov-04 28-Oct-05 25-May-06
US20060093616 4-May-06	Process for vaccinating eucaryotic hosts and for protecting against SARS-CoV infection	ALTMAYER RALF	29-Sep-04 28-Sep-05 4-May-06
US20050249739 10-Nov-05	Antibodies against SARS-CoV and methods of use thereof	MARASCO WAYNE	25-Nov-03 24-Nov-04 10-Nov-05
US20050203038 15-Sep-05	Modulation of ACE2 expression		10-Mar-04 10-Mar-04 15-Sep-05

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US20050113298 <small>26-May-05</small>	Receptor binding peptides derived from the SARS S protein		15-Sep-03 13-Sep-04 26-May-05
US20050112554 <small>26-May-05</small>	Characterization of the earliest stages of the severe acute respiratory syndrome (SARS) virus and uses thereof	HENG XU RUI	9-Jul-04 9-Jul-04 26-May-05
US10443049 	Active low molecular weight variants of angiotensin converting enzyme 2 (ACE2)	Northwestern University	24-Jan-17 24-Jan-18 15-Oct-19
US10301377 	Middle east respiratory syndrome coronavirus immunogens, antibodies, and their use	The United States of America, as Represented by the Secretary, Department of Health and Human Services	24-Feb-15 24-Feb-16 28-May-19
US10131704 	Middle east respiratory syndrome coronavirus neutralizing antibodies and methods of use thereof	DANA-FARBER CANCER INSTITUTE, INC.	25-Apr-14 27-Apr-15 20-Nov-18

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