ROGERKELVIN
Partners In Your Success

CONQUERING COVID-19

THE SERIES OF TREATMENTS UNDER DEVELOPMENT

CONQUERING COVID-19
THE SERIES OF TREATMENTS UNDER DEVELOPMENT

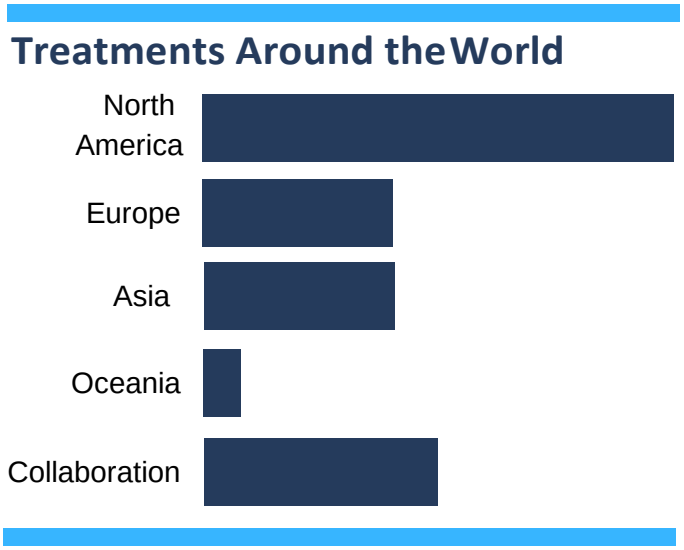
Over 2.5 million people worldwide are infected and over 170,000 have lost their lives to the pandemic caused by Coronavirus. The scientists and medical practitioners around the world are leaving no stones unturned in the discovery of therapies and vaccines for highly infectious Coronavirus disease. As stated by WHO, the infection is caused by a newly discovered coronavirus that enveloped viruses with a positive-sense single-stranded RNA genome and a nucleocapsid of helical symmetry. It has one of the largest genome size among RNA Viruses of 26 to 32 kilobases.

WHO is closely working with biopharmaceutical companies to launch worldwide clinical trials to achieve the purpose; currently it has been identified that 35 major treatment and vaccines are being tested globally that are in various stages of clinical development. This list includes few drugs already existing in the market and others that were supposed to be developed for the treatment of other diseases but have shown potential in treating COVID-19 cases. Currently there are 335,815 ongoing research studies across 50 states in USA and in 210 countries worldwide as cited in the US Clinicaltrials.gov website.

This list extensively categorises treatments, therapies and vaccines in various stages and highlights their potential to fight the pandemic. It includes available drugs that are under trial and have shown positive results in treating COVID-19 patients as well as potential novel therapies and vaccines under development:

Potential Treatments/Vaccines Under Trials

This is an exhaustive list of Treatments/ Combination Therapy and vaccines in various stages of Clinical Trials. It includes Preclinical Stage, Phase I, Phase II, Phase III and Human Trials, consists of the sponsors across the globe for various indications.



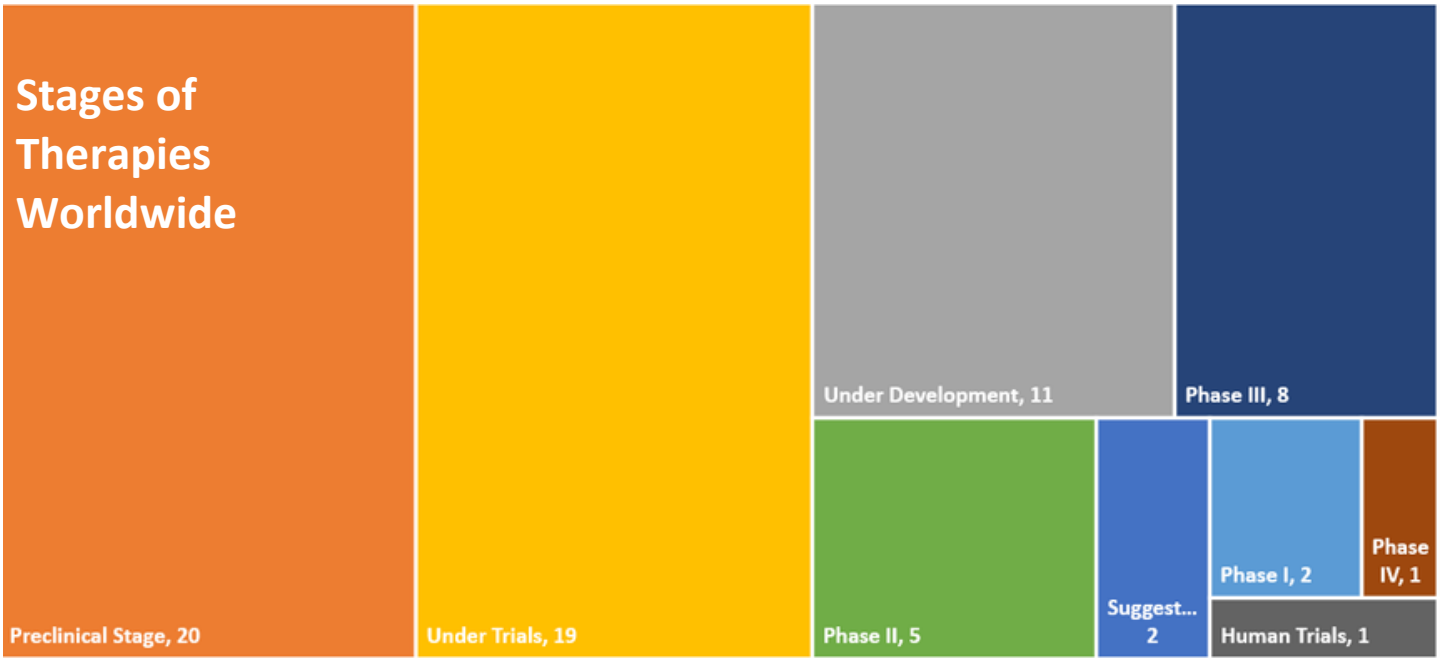
Treatments/Combination Therapies

AbbVie

Kaletra® (also marketed as Aluvia; lopinavir/ritonavir) is marketed by AbbVie for the treatment of HIV-1. The Chinese health commission observed that the patients diagnosed with COVID-19 turned negative after taking Kaletra®. Ascletis Pharma is researching on combination therapies of ASCO9 and Ritonavir.

AIM Immunotech

Ampligen® (rintatolimod) is used for the treatment for Chronic Fatigue Syndrome (CFS) and marketed by AIM Immunotech. They are actively working on seeking approvals under regulations allowing the export of investigational drugs for use in a sudden and immediate national emergency from USFDA and NMPA as a prophylactic/early-onset therapeutic



against COVID-19.

Bayer

Chloroquine phosphate sold under trade name Resochin is an antimalarial and anti-inflammatory drug marketed by Bayer. It was evaluated in 10 hospitals and showed good efficacy. The companies have sped up manufacturing and supply of the drug.

Biocryst

Galidesivir is developed by Biocryst, they are Nucleoside RNA polymerase inhibitor designed to disrupt the viral replication process. It has shown broad- spectrum activity in vitro against more than 20 RNA viruses in coronaviruses and viral disease families that include filoviruses, togaviruses, bunyaviruses, arenaviruses, paramyxoviruses, and flaviviruses.

Chugai Pharmaceuticals and Zhejiang

Hisun Pharmaceuticals Tocilizumab is developed in collaboration between Chugai Pharmaceuticals and Zhejiang Hisun Pharmaceuticals. It is a Humanized monoclonal Antibody (mAb) targeting Interleukin-6. A 94-patient trial assessing has been registered with Chinese authorities for testing and clinical validations.

CytoDyn

They are planning on filling an IND and Phase II clinical trial protocol with FDA. Leronlimab(PRO 140) is Humanized IgG4 monoclonal antibody and also a CCR5 antagonist with potential for multiple therapeutic indications. It has already finished 9 clinical as a combination therapy with HAART for HIV and metastatic triple-negative breast cancer.

Fujifilm Holdings and Hisun Pharma

Favipiravir is marketed under Avigan by Fujifilm Holdings and Favilavir by Hisun and is a broad spectrum anti-viral agent that is designed to selectively and potently inhibit the RNA-dependent RNA polymerase (RdRp) of RNA viruses. Japan has recommended it for the use against Coronavirus after test dosages showed positive results in multiple hospitals. It has also been approved by China's NMPA as an investigational treatment in clinical trials conducted.

Gilead Sciences

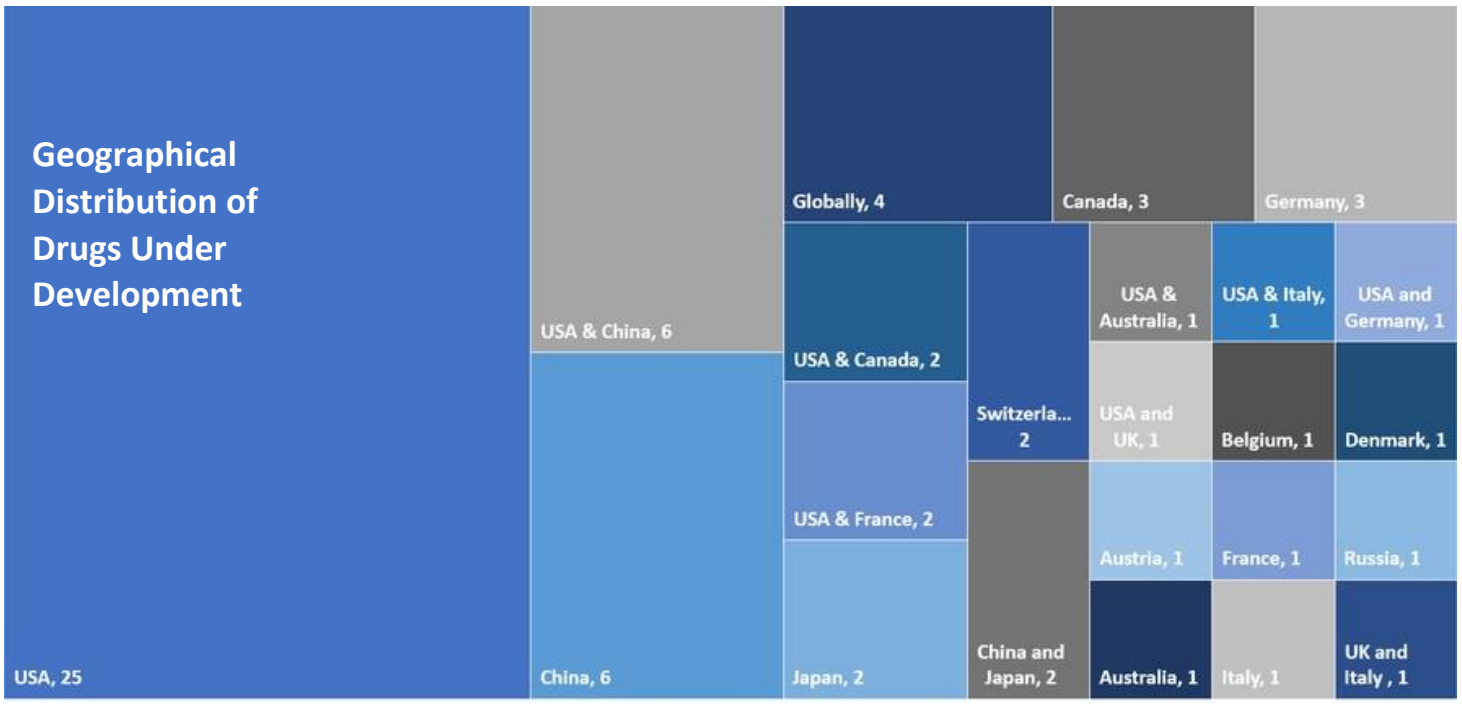
They are currently in Phase III clinical trials for testing of their Nucleotide prodrug Remdesivir (GS-5734), it has shown much positive results in treating patients who were given it as an experimental treatment. Remdesivir works by shutting down viral replication by inhibiting a key viral enzyme, the RNA-dependent RNA polymerase.

Incyte and Shanghai Hengrui

Pharmaceutical Incyte in collaboration with Shanghai Hengrui Pharmaceutical is in process of discovering Humanized monoclonal antibody targeting PD-1 (Camrelizumab); 5-Da polypeptide hormone secreted by the thymus gland (thymosin). Chinese clinical trials assessing the combination treatment have been registered.

Innovation Pharmaceuticals

Brilacidin is their Defensin mimetic in Phase II development in oral mucositis in Head and Neck Cancer patients but recently it was observed to be successful in treating COVID-19 and come out as a potential novel treatment for the same. The company's product is under research and based on it has submitted a preliminary summary on it's potential to BARDA.



Pharmstandard

Arbidol (umifenovir) works as a Membrane fusion inhibitor which was initially developed as a treatment for influenza. For COVID-19 it is currently undergoing multiple clinical trials as a monotherapy and in combination with Kaletra, ASC09, lopinavir, ritonavir, carrimycin, and Bromhexine Hydrochloride.

Apeiron Biologics

APN01 is recombinant human angiotensin-converting enzyme 2 (rhACE2) developed for the treatment of acute lung injury, acute respiratory distress syndrome, and pulmonary arterial hypertension. The company led a pilot clinical trial in china and obtain preliminary data stating the positive impact on the disease. They are currently working with Chinese CRO dMed Pharmaceuticals and in process of conducting a large- scale trial for the testing.

Janssen Pharmaceutical Cos. (Johnson & Johnson) They are working on multiple potential treatment and Vaccine. One such being Prezcobix (darunavir and cobicistat) which is a HIV protease inhibitor and is currently under trial in China. Separately, they are also working in collaboration with BARDA to develop a vaccine. Also, they are screening their library of antiviral molecules to accelerate discovery of potential COVID-19 treatments.

CSL And the University Of Queensland

CSL is providing financial support and technical expertise in development of an unspecified vaccine based on adjuvant technology, MF59® in collaboration with the University of Queensland who will use the adjuvant to test the viral protein it is developing with its molecular clamp technology.

Ascletis Pharma

They are working on combination therapies and in process of testing Ganovo (danoprevir) plus ritonavir; ASC09 and ritonavir; ASC09 and oseltamivir; ritonavir and oseltamivir. The study is based on functioning of HIV protease inhibitors. It is stated that patients treated with Ganovo (danoprevir) plus ritonavir discharged upon full recovery.

China's Tongji Hospital is also testing combinations of ASC09 and Tamiflu (oseltamivir), ritonavir and Tamiflu (oseltamivir), and Tamiflu alone in one trial listed on ClinicalTrials.gov (NCT04261270). Tamiflu is distributed in the U.S. by Genentech, under license from Gilead Sciences.

Nanoviricides

The company has confirmed that they have ligands with potential to bind to SARS-CoV spike protein just as it binds to cognate receptor ACE2. This antiviral therapy based on company's novel nanomedicines platform is a broad-spectrum virus-binding ligand. It relies on copying the human cell-surface receptor to which the virus binds, and making ligands that chemically attach to a nano micelle, to create a nano viricide. When a virus comes in contact with the nano viricide, the nano micelle polymer is designed to fuse with the virus lipid envelope. The company is started testing of candidate against low threat Coronaviruses.

Regeneron Pharmaceuticals

REGN3048 and REGN 3051 is a combination of neutralizing monoclonal antibodies leveraging Regeneron's monoclonal antibody discovery platform called VelocImmune, part of the company's VelociSuite technologies. They have already completed Phase-1 for MERS-CoV and is expected to be used as a potential novel treatment either individually or in combination.

Beijing Staid son Biopharma and Inflarx

They recently got approvals from Chinese authorities for conducting trials of IFX-1, they are Anti-C5a monoclonal antibody in development for COVID-19 as well as hidradenitis suppurativa, a skin disease.

Doherty Institute and Monash University in Australia

Ivermectin is a broad spectrum anti-parasitic agent which has recently shown to have anti-viral activity against a broad range of viruses. It is a potent inhibitor o f the SARS-CoV-2 clinical isolate as shown in tests conducted in Australia. This is under preclinical stage currently and various tests are being conducted to check the functioning.

Fujian Medical University

Fingolimod is a Sphingosine 1-phosphate receptor modulator which was earlier used for treating Multiple Sclerosis. It is currently under phase 2 Clinical Study in China and positive results have been observed so far.

Health Commission of Heilongjiang province Triazavirin is a drug inhibits RNA synthesis, the health commission is currently in the Phase 3 Clinical Study in China. The results have shown recovery in most of the cases.

Ruijin Hospital

Umifenovir (Arbidol) is a membrane Fusion Inhibitor which is currently in the later phases of trials in China.

University of Aarhus

Camostat mesylate (Foypan) is a SARS-CoV-2 Spike protein-initiated membrane fusion inhibitor and is currently under Phase 1 and Phase 2 in various parts of Europe.

Regeneron Pharmaceuticals and Sanofi

Kevzara (sarilumab) is Anti - IL-6, Monoclonal antibody, used for treating Rheumatoid arthritis, Regeneron and Sanofi are collaboratively conducting trials for the same in USA and France and have recently moved to Phase 2 and 3 in USA and France respectively.

University of Tokyo

Nafamostat mesylate (Fusan) which is use as a SARS-CoV-2 Spike protein-initiated membrane fusion inhibitor and used for treating Acute pancreatitis has recently successful completed its preclinical studies in Japan.

Therapeutic Modalities and Class of Drugs under Development

Immunosuppressants	25
mRNA/DNA Based	17
Antibiotics/Antiviral	10
Monoclonal/ Polyclonal antibodies	09
Stem Cells/Plant Cells	02
Others	06

Incyte Corporation and Tongji Hospital Ruxolitinib

(Jakafi, Jakavi) is an Inhibitor of Janus-associated kinases (JAK1 and JAK2) and used for treating Myelofibrosis. Currently clinical Studies are being conducted in China where Ruxolitinib is combined with stem cell therapy.

Roche

Actemra (tocilizumab) is an anti-IL-6R, Monoclonal antibody, used for treating Rheumatoid arthritis. This has been approved in China for a potential COVID-19 treatment whereas currently 5 other trials are going on in various parts of Europe and China for full results on various strains.

Wenzhou Medical University

Thalidomide is an anti-cancerous drug using for treating multiple myeloma, graft-versus-host disease, and several skins condition. The Wenzhou Medical University recently conducted the safety and efficacy testing in China.

Medical Institutions Worldwide

Various institutions globally are conducting trials for many available drugs such as Chloroquine (Endosomal acidification fusion inhibitor, Anti-malarial Drug), Azithromycin (Antibiotic), Baricitinib (JAK/NAK inhibitor used for Rheumatic Disease), Hydroxychloroquine (Plaquenil-Endosomal acidification fusion inhibitor, used as Anti-malarial Rheumatoid arthritis treatment) which have shown promising results in various stages on clinical trials and currently >10 trials are being conducted globally to assess these drugs.

Vaccines

Inovio Pharmaceuticals and Beijing

Advaccine Biotechnology INO-4800 is a vaccine which is under phase 1 trial in China in parallel to USA for a potential treatment.

Moderna

The company has shipped its first batch of mRNA-1273, a Novel lipid nanoparticle (LNP)-encapsulated mRNA vaccine against the COVID-19 encoding for a prefusion stabilized form of the Spike (S) protein to NIH for Phase I studies to evaluate safety and reactogenicity of a 2-dose vaccination schedule which is to be given at a duration of 28 daysvacross 3 dosages.

Glaxosmithkline And Clover

Biopharmaceuticals COVID-19 S-Trimer is a Protein-based coronavirus vaccine developed in collaboration with GSK and Clover Pharma, where the latter will be using GSk's adjuvant System for evaluation and testing required for preclinical studies and once done has capabilities to scale up at a large quantity.

Pfizer And Biontech

They have collaborated to develop mRNA-based vaccine BNT162 aiming at accelerating development and is expected to start testing by April 2020.

University of Oxford and Advent Srl

Oxford university in collaboration with Advent SRL has recently launch Human Trials for their very promising vaccine ChAdOx1 nCoV-19. The ChAdOx1 viral vector will act as a potential vector for vaccines against another human coronavirus, MERS. It consists of an attenuated adenovirus capable of producing the spike (S) protein of SARS-CoV-2, allowing for the formation of endogenous antibodies against these proteins and, consequently, against SARS-CoV-2.3

Cansino Biologics Inc.

Ad5-nCoV is a Recombinant Novel Coronavirus Disease Vaccine (Adenovirus Type 5 Vector) Which genetic engineered vaccine with the replication-defective adenovirus type 5 as the vector to express SARS-CoV-2 spike protein, which intends to be used to prevent the disease caused by the novel coronavirus infection. The Phase I is expected to end in December and the Phase II studies to evaluate the safety and efficacy will start soon.

Altimmune

AdCOVID is a single-dose, intranasal vaccine candidate designed to protect against COVID-19. It has recently been shown that it can activate the immune system showing potential stimulation of mucosal and cellular immune responses in addition to a strong serum antibody response.

Medical Institutions Worldwide

The BCG vaccine used to protect against Tuberculosis is been tested by multiple institutions in nearly 6 countries where it has showed promising results and have reached the Phase III trials.

Potential Treatments/ Vaccines Under Development and Suggested

This list contains the Treatments/Combination Therapies and Vaccines which are under developmental stages along with the ones suggested recently and yet to go for development.

Treatments/Combination Therapies

Biocryst

Galidesivir is under Advanced Developmental Stage, they are Nucleoside RNA polymerase inhibitor designed to disrupt the viral replication process. It has shown broad-spectrum activity in vitro against more than 20 RNA viruses in coronaviruses and viral disease families that include filoviruses, togaviruses, bunyaviruses, arenaviruses, paramyxoviruses, and flaviviruses.

Immunoprecise Antibodies

They are in process of developing vaccines and coronavirus-neutralizing antibodies which is currently establishing as a prophylactic using ImmunoPrecise's proprietary discovery platforms (including B Cell Select™ and DeepDisplay™) and ImmunoPrecise subsidiary Talem Therapeutics' access to the transgenic animal platform OmniAb® for direct generation of human antibodies.

Novavax

A Vaccines is under animal testing and plans to advance to Phase 1 by May and is designed to apply company's proprietary recombinant protein nanoparticle technology platform to generate antigens derived from the coronavirus spike (S) protein. It will utilise saponin-based Matrix-M™ adjuvant with COVID-19 vaccine candidates to enhance immune responses.

Q Biomed and Mannin Research

They have collaborated in development of adjunct treatment for vascular leakage and endothelial dysfunction seen in COVID-19 which is designed to target the activation of the Angiopoietin-Tie2 signaling pathway and currently have submitted grant applications to NIH for approvals.

Vir Biotechnology And Wuxi Biologics

They have collaborated announced the development and manufacturing of human monoclonal antibodies that would be isolated from SARS infection survivors.

AbCellera and Eli Lilly

They are collaboratively developing a COVID 19 antibody therapy which is currently under developmental stages and will be tested in USA and Canada.

Sanofi

They are working on developing a treatment based on recombinant DNA technology.

Gilead Sciences

They are working on preparing a combination therapy Truvada (emtricitabine + tenofovir) which is a nucleoside reverse-transcriptase inhibitor for the prevention and treatment of HIV infection and an antiviral medicine that is used to treat HIV related symptom of Chronic Hepatitis B respectively.

Takeda Pharmaceuticals

They are in the process of developing a therapy TAK- 888 based on deriving plasma from recovered COVID- 19 patients which would be a Polyclonal hyperimmune globulin (H-IG), (Plasma-derived antibodies) and would be used for treating the patients.

Vaccines

Curevac

They are collaborating with CEPI to develop an mRNA-based vaccine, they are in process of starting the clinical testing within a few months.

Generex Biotechnology

They are in process of developing a Ii-Key peptide vaccine using immune system activation technology platform in contract with the China Technology Exchange, Beijing Zhonghua Investment Fund Management Co. Ltd., Biology Institute of Shandong Academy of Sciences, and Sinotek-Advocates International Industry Development (Shenzhen) Co. Ltd.

Ibio And Beijing Cc-Pharming

A Plant-derived vaccine is to be manufactured using iBio's FastPharming System™

Linearx (Applied DNA Sciences) And Takis Biotech They are working collaboratively on PCR-produced linear DNA designed vaccine to induce antibodies that can neutralize SARS-CoV-2. The companies have highlighted on various advantages of their technology which included their ability to scale up production, absence of antibiotics and their resistant genes, DNA purity, Simple design, Absence of contamination and effectiveness of vaccine without inserting into patient's genome.

Tonix Pharmaceuticals Holding
They are in process of developing TNX-1800 which is live modified horsepox virus vaccine for percutaneous administration and has shown as a potential vaccine for COVID-19. This is under research currently.

Vaxart
They are in process of developing a vaccine based on proprietary VAAST™ Platform which would be an oral recombinant vaccine administered by tablet. They are currently enrolling candidates based on COVID-19 genome and will further evaluate them under preclinical trials to understand their ability to generate mucosal and systemic immune responses.

Arcturus Therapeutics
They are in Preclinical Development of a Coronavirus vaccine (self-replicating RNA) vaccine.

Distributed Bio
They are under Preclinical Developmental phase where they are developing a vaccine using Anti-SARS antibodies.

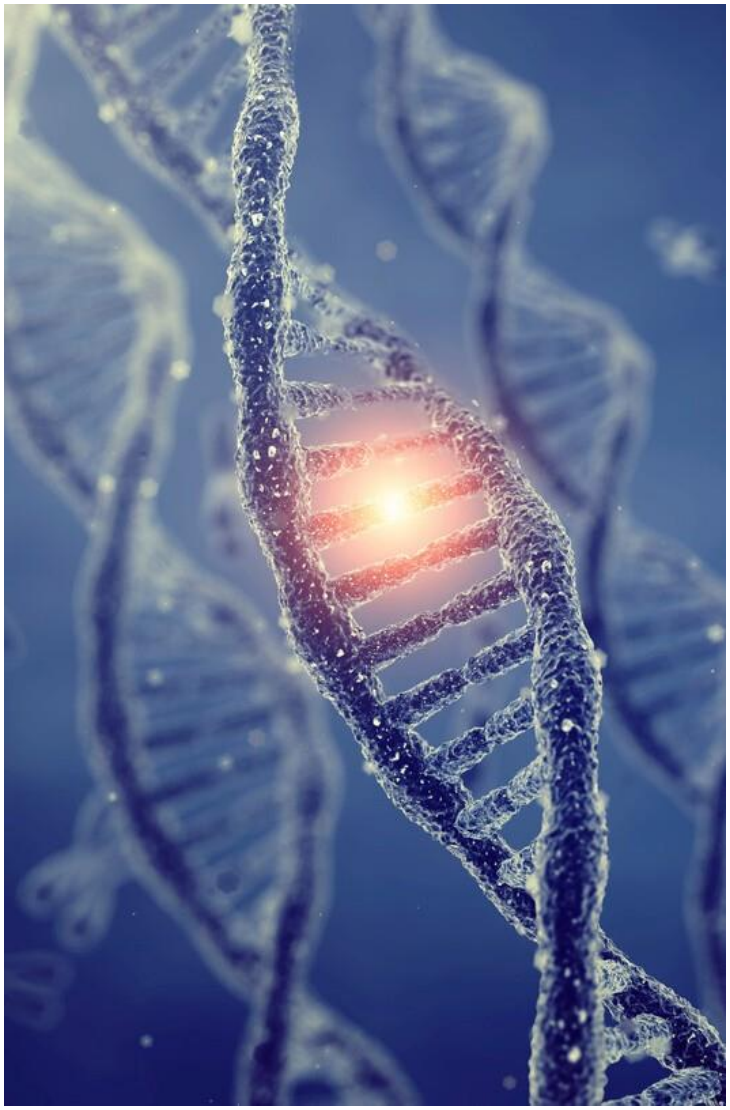
Dynavax Technologies Corp and Clover Pharma They are actively working in developing a Vaccine adjuvant CpG 1018 (adjuvant to S-Trimer vaccine) which is used in Hepatitis B vaccines.

Emergent BioSolutions and J&J
They are collaborating on developing an Anti-SARS antibodies vaccine.

Geovax
They are in process of developing a coronavirus vaccine using their GV-MVA-VLPTM vaccine platform and expertise to design and construct vaccine candidates using genetic sequences from the virus responsible for the ongoing COVID-19 outbreak originating in Wuhan, China.

HaloVax (Hoth Therapeutics + Voltron Therapeutics) They have selected the peptides required to complete the structure of HaloVax for development and progression into pre-clinical animal testing of the HaloVax Self-Assembling Vaccine (SAV). This vaccine is designed to protect patients at risk of coronavirus (COVID-19) infection. Initiation of the first animal study for the vaccine candidates is expected to begin during May of 2020.

Heat Biologics Inc. and University of Miami
Heat Biologics' COVID-19 vaccine program focuses on engineering multiple protein regions of the virus into their gp96 platform with potential of generating long- term immune responses and may confer immunity to different coronaviruses. They are currently in the development testing phase.



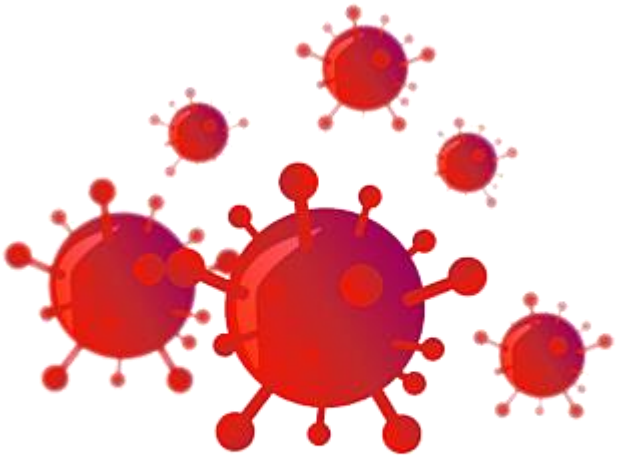
Translate Bio Inc in collaboration with Sanofi Pasteur They have collaborated on developing a novel mRNA vaccine for COVID-19. This list contains the Treatments/Combination Therapies and Vaccines which are under developmental stages along with the ones suggested recently and yet to go for development.

Vir Biotechnology and GSK
They are collaboratively working on developing VIR-7831, VIR-7832 where they use Vir's CRISPR screening and machine learning approach to identify cellular targets whose inhibition can prevent viral infection.

Alnylam and Vir Biotechnology
They have collaborated to develop and commercialize RNAi therapeutics for the viral infection against COVID-19, which is currently in early developmental phase.

Ridgeback Biotherapeutics and Emory University USFDA has recently approved their IND application for EIDD-2801 which functions on mechanism of preventing the replication of SARS-CoV-2, the virus that causes COVID-19, and has shown potent activity against SARS- CoV and MERS-CoV in animal models of infection.

Translate Bio Inc in collaboration with Sanofi Pasteur They have collaborated on developing a novel mRNA vaccine for COVID-19. This list contains the Treatments/Combination Therapies and Vaccines which are under developmental stages along with the ones suggested recently and yet to go for development.



Vir Biotechnology and GSK

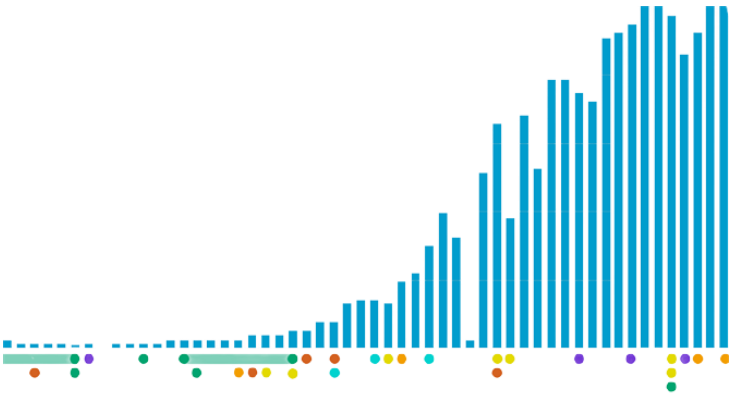
They are collaboratively working on developing VIR-7831, VIR-7832 where they use Vir's CRISPR screening and machine learning approach to identify cellular targets whose inhibition can prevent viral infection.

Alnylam and Vir Biotechnology

They have collaborated to develop and commercialize RNAi therapeutics for the viral infection against COVID-19, which is currently in early developmental phase.

Ridgeback Biotherapeutics and Emory University USFDA has recently approved their IND application for EIDD-2801 which functions on mechanism of preventing the replication of SARS-CoV-2, the virus that causes COVID-19, and has shown potent activity against SARS- CoV and MERS-CoV in animal models of infection.

Suggested Treatments/Combination Therapies



Bold Therapeutics

They have partnered with University of Ottawa to explore the potential utility of BOLD-100, which is currently under development as an anti-cancer drug, as a novel antiviral agent which works as a stress-induced Inhibit in upregulation of GRP78. They have recently suggested it and yet to undergo the process of testing.

Roche (Genentech)

Researchers suggested that Activas which is a tissue plasminogen activator and used as Stroke drug could be a potential COVID-19 treatment.

CONCLUSION

Drug manufacturer performing rigorous trials, testing and studies during an outbreak is surely a challenge but it's certainly the only way to reduce the risk and finding the appropriate treatment. In such times the scientists are meticulously working in achieving the desired treatment for treating the 7 Billion population. We hope they find get something soon and till then we do out bits by following the norms of social distancing.