A Systematic Review on Various Therapeutic Options for Coronavirus Outbreak

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Abstract

SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) or coronavirus disease that emerged in Wuhan, China’s Hubei province. According to a Wuhan citizen, the virus spread from the Wuhan fish market to humans via a form of waterborne transmission. The WHO proclaimed the SARS-CoV-2 Pandemic a global public health emergency in March of the following year. Rather than influencing the individual animals mostly, the movement of humans and a few days later, the infection spread to other parts of the world by the distribution of specimens to animals and by the movement of humans, causing considerable illness in human populations. An estimated one and a total of nearly sixty-eight million two hundred and fifty-six million people have been impacted, including one and a million thousand five hundred and sixty thousand fatalities in more than two hundred countries around the world. As of the present, there are no medicines or vaccines against the world’s first SARS-CoV-2 virus in clinical trials molecular and cellular studies of CoVs, as well as their care, were reviewed in this latest assessment.

Keywords: SARS-CoV-2, WHO, Global pandemic, Human coronaviruses, Pathogenesis, Treatments

Introduction:

China informed the World Health Organization about clustered cases of pneumonia of unknown cause on December 31, 2019, among the peoples of Wuhan City, Hubei province¹. Firstly, 27 cases of unknown pneumonia were investigated which further increased up to 41 patients on January 11, 2020, with 7 severe cases and one death. Currently, the virus has an outreach to many other countries and also across the mainland of China². On January 7, 2020, a government and national level technical organization named, “Chinese Centre for Disease Control and Prevention” (CCDC) confirmed this infection as coronavirus infection³. On February 11, 2020, the WHO issued a statement saying Chinese researchers have made a “preliminary determination” and confirmed it as a Novel Coronavirus⁴. Later, the WHO declared a new title to this epidemic disease as 2019-new coronavirus disease (2019-nCoV) and now known as COVID-19⁵. As of December 31, 2020, COVID-19 has influenced more than 10.3 million patients in 210 nations and domains around the globe and two universal movements and caused around 1.83 million deaths around the world. In India, as of December 31, 2020, Coronavirus are a group of RNA virus which causes an infection from less serious normal cold to extreme cold or illnesses, for example, Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) condition ⁷. The coronavirus belongs to the family Coronaviridae, subfamily Orthocoronavirinae, and order Nidovirales ⁸. As coronavirus are wrapped infections and have a positive-sense of single-abandoned RNA genome with a nucleocapsid of helical evenness ⁹. The genomic size of coronavirus differs from 26 to 32 kilobase and the hatching time frame for human coronavirus is 2–14 days. As we know that the coronavirus disease is a transferable disease which mainly spread by droplet infections like coughing, sneezing as well as direct contact with various infected surfaces such as tables, desks, doors, etc ¹⁰.

The clinical prevalence of this disease ranges from no symptom (beings asymptomatic) to severe symptoms such as pneumonia and death ¹¹. The symptom of coronavirus is fever, dry cough, fatigue, sputum production, shortness of breath, chills, nasal congestion, conjunctival congestion, diarrhea, covid toes, and blood clotting ¹². So, in this context,
we have looked into the present scenario with potential reflections on the description of Human Coronaviruses (CoVs), pathogenesis, diagnostics, and available treatment options available at the national and worldwide level. This exhaustive survey will aid improvement of general public health that will further give better administration of therapeutic drugs to combat viral disease.

**Description of Human Coronaviruses (CoVs)**

Coronaviruses are the enveloped viruses that have a positive-sense that can infect humans as well as animals. It belongs to the family Coronaviridae, subfamily Orthocoronavirinae, and order Nidovirales. The phylogenetic examination reveals that the human coronaviruses fall into the subgenus Sarbecovirus of variety Betacoronavirus which incorporates coronaviruses (SARS-CoV, Bat SARS-like CoV, and others) that found in people, bats, and other wild creatures. It is classified into four genera such as alpha-coronavirus, beta-coronavirus, delta-coronavirus, and gamma-coronavirus, where alpha and beta are responsible for causing infection in humans and mammals. There are seven strains of human coronaviruses, among them, four-strain are human coronaviruses (Serotype 229E, Serotype OC43, Serotype NL63 and Serotype HUK1) that are prevalent to cause moderate to gentle respiratory tract infections in people. Another two different strains, for example, SARS-CoV and MERS-CoV are zoonotic in origin which comes out as a significant reason for respiratory illness in China and Saudi Arabia in the years 2003 and 2012 respectively. The detailed outline of Human Coronaviruses (CoVs) and their possible zoonotic causes explained in Figure 1.

![Figure 1: Description of Human Coronaviruses (CoVs)](image)

**Human Coronaviruses (CoVs) Pathogenesis**

The patients of coronaviruses show symptoms similar to SARS-CoV and MERS-CoV infections, for example, myalgia dyspnoea, weakness, ordinary or diminished degree of leukocyte, fever, and non-productive cough. The pathogenesis of SARS-CoV-2 infection is poorly understood but the mechanism of SARS-CoV and MERS-CoV gave a thought regarding the pathogenesis of SARS CoV-2 infection. The pathogenesis of SARS-CoV-2 starts with the entry of viruses into the alveolar epithelial cells which replicates quickly and triggers a strong invulnerable reaction that brings cytokine storm conditions and pulmonary tissue harm. The cytokine storm conditions are commonly called hypercytokinaemia in which the uncontrolled production of pro-inflammatory cytokines responsible for Intense Respiratory Pain Disorder (ARDS) and numerous organ failures. Additionally, the cellular and humoral immunity stimulate antigen presentation which is mediated by virus-specific B cells and T cells, and the number of T-cells, CD4 + T-cells, and CD8 + T-cells are declined in SARS-CoV-2 infected patients. After that T-cells undergo functional depletion, resulting in the least resistant capacity for SARS-CoV-2 infection, acute respiratory distress syndrome, decreased immune system, as well as the secondary infection further, leads to respiratory failure. The pathogenesis of Human Coronaviruses (CoVs) and their fundamentals are explained in Figure 2.
Treatments

The suspected and confirmed cases of coronavirus infection should be treated with effective isolation and protective conditions in designated hospitals. The suspected cases should be treated in an isolated or single room whereas the confirmed cases can be treated in the same ward as well as the critical cases should be admitted to the Intensive Care Unit (ICU) as soon as possible. The common therapy for coronavirus infections is bed rest including supportive therapy like oxygen therapy, maintenance of proper airways, breathing, circulation, ventilation if required (if PO$_2$ < 55%), isolation to prevent its spread, correction of electrolyte imbalance, correct temperature as well as the utilization of broad-spectrum antibiotics to prevent secondary bacterial infections. A number of pre-existing drugs mainly the antiviral drugs are being available and exploited for the treatment of coronavirus infection which has been shown in Fig 3 (a) and 3 (b).
Figure 3(b): Chemical Structure of Drugs used in COVID-19 Treatment
1. Chloroquine and Hydroxychloroquine

It is widely used in malarial infection, autoimmune disorder, chemophylaxis in certain inflammatory conditions like rheumatoid arthritis, lupus, and blood disorder porphyria cutanea tarda respectively 19. Chloroquine has shown its effects against various types of RNA virus i.e., hepatitis A and C, rabies, polio, HIV, influenza type A and B, Zika, Nipah, and Ebola viruses, and also shows some lethal effects against DNA viruses such as hepatitis B and herpes simplex virus 20. The mode of action of chloroquine and its derivatives against SARS-CoV-2 infection has multiple actions in which step by step firstly it inhibits the pre-entry of virus penetration within the cell surface receptors, inhibits the viral enzymes procedures, for example, viral DNA and RNA polymerase processes, blockade of viral entry by inhibiting glycosylation of viral proteins in host receptors, assembly of the virus, transport of new virus particle, lastly the after-virus release 21. The alternate mode of action is by the inhibition of angiotensin-converting enzyme-2 cellular receptor, afterward acidification of the virus at the cell membrane surface, therefore, block viral fusion and also shows some immunomodulatory effects by cytokines inhibition in the host cells 22. In China, Per Gao et al. showed the in vitro activity of chloroquine and its derivatives against SARS-CoV and SARS-CoV-2 infection and the treatment outcomes from 100 patients have shown that chloroquine had better results compared to control medication by restraining the intensification of pneumonia, improving lung imaging discoveries and shortening the ailment course 23.

2. Lopinavir and Ritonavir

It is a Human Immunodeficiency Virus-1 (HIV-1) protease inhibitor known as protease inhibitor which sold under the name Kaletra by AbbVie intended to treat HIV-AIDS that meddles in replication and synthesis of Human Immunodeficiency Virus (HIV), prompting the creation of juvenile, non-irresistible infection particles 24. In 2003, lopinavir/ritonavir shows its activity against SARS-CoV and related to progress in certain patients. The investigation study revealed that lopinavir and ritonavir bind to the endopeptidase C30 of SARS-CoV-2 and hinders the protease enzyme responsible for viral replication and antiviral impact by protein synthesis restraint 25. In the in vitro efficacy study of 47 patients treated with lopinavir/ritonavir combination and the control treatment of pneumonia-related adjuvant medications alone, the combination treatment with lopinavir/ritonavir and adjuvant medications has a progressively obvious remedial impact in bringing down the internal body temperature and re-establishing typical physiological function with no apparent toxic effects 26. Taking into account these conclusions, the beneficial outcome shows that the utilization of lopinavir/ritonavir joined with pneumonia-related adjuvant medications in clinical treatment ought to be promoted. As per WHO, there might be a few advantages of utilizing lopinavir/ritonavir with different medications, for example, interferon-β, oselamivir, or ribavirin 27.

3. Darunavir/ Cobicistat

It is another class of Human Immunodeficiency Virus-1 (HIV-1) protease inhibitor but its mode of action is similar to lopinavir and ritonavir 28. In February 2020, the in vitro study by Chinese researchers Dong et al. showed that darunavir significantly inhibits SARS-CoV-2 replication and its inhibition efficacy was more than that in the untreated group by 280-fold 29. It is currently being evaluated in a clinical trial under the name NCT04252274.

4. Ribavirin

Ribavirin a nucleoside derivative with broad-spectrum antiviral activity used to treat a few viral infections like Hepatitis C, Respiratory Syncytial Virus (RSV), and Viral Haemorrhagic Fever (VHF) 30. The replication of RNA and DNA infections is forestalled by inhibiting Inosine Monophosphate Dehydrogenase (IMD), which requires the synthesis of Guanosine Triphosphate (GTP) 31. In the year 2003, Ribavirin was broadly used to treat SARS-CoV infected patients and utilized clinically in combination with corticosteroids or interferon in Hong Kong. Wang et al. studied the in vitro activity of ribavirin against SARS-CoV-2 infection and found that an EC50 of 109.5 μM, which was 100 times more potent and less potent than Remdesivir 32. The ribavirin shows the unfortunate antagonistic impact of diminishing hemoglobin in respiratory pain patients at high dose exceeds potential clinical advantage and, in this way, ribavirin was not considered as a suitable medication for additional research by World Health Organization 33.

5. Favipiravir

It is an RNA-subordinate RNA polymerase inhibitor with a wide range of antiviral action recently known as T-705 which is a prodrug of purine nucleotide Favipiravir Ribofuranosyl-5’-Triphosphate that changes into phosphoribosylated active form which restrains the RNA polymerase by ending viral replication and shows in vitro action against Influenza A, B, and C, Ebola virus, and against RNA infections 34. Recently, researchers have found in vitro efficacy of Favipiravir in Chinese patients against SARS-CoV-2 infection at a higher dosing range contrasted with Ebola infection despite comparable high EC50 values 35. In March 2020, China endorsed Favipiravir for the treatment of SARS-CoV-2 disease and as of now being under Clinical Trial NCT04273763 for patients with SARS-CoV-2 infection and currently available in Japan for the treatment of Influenza flu 36. However, it is not available in the United States for clinical use because of the absence of FDA approval.

6. Remdesivir

It is a prodrug of Remdesivir-triphosphate (RDV-TP) of an adenosine analog known as GS-5734 that undergoes metabolism to an active C-adenosine nucleoside triphosphate form that inhibits RNA-dependent RNA polymerases competes with adenosine-triphosphate for consolidation into viral RNA chains at position 1 of RDV-TP eventually ends RNA synthesis at position 1+3 and blocks viral RNA synthesis 37. It shows a wide array of antiviral activity against RNA viruses including Filoviridae, Paramyxoviridae, Pneumoviridae, and Orthocoronaviridae (SARS-CoV and MERS-CoV) 38. Recently, the Washington Department of Health administered Remdesivir intravenously and found that Remdesivir shows potential activity in SARS-CoV-2 infection, at that point in vitro study of Remdesivir and Chloroquine exhibited to inhibit SARS-CoV-2 infection and shows benefits in the treatment of SARS-CoV-2 pneumonia 39. Clinical trials are ongoing to evaluate the safety and efficacy of Remdesivir in SARS-CoV-2 patients with mild, moderate, or severe infection (NCT04292899, NCT04292730, NCT04257656, NCT04252664, NCT04280705) 40. On 1 May 2020, U.S. Food and Drug Administration (FDA) approved Remdesivir in the treatment of SARS-CoV-2 hospitalized patients and is now approved by USFDA for the treatment of SARS-CoV-2 infection.

7. Arbidol (Umifenovir)

It is also an antiviral drug against influenza flu generally utilized in Russia and China. The in vitro investigation of
Arbidol and Arbidol mesylate indicated a strong inhibitory activity in diminishing the reproduction of SARS-CoV infection 41. Low-level proof including a review study, case reports, and case arrangement uncovered that arbidol alone or combined with antiviral drugs created certain advantages in the treatment of SARS-CoV-2 pneumonia. In China, many randomized controlled clinical trials are proceeding to examine the efficacy of Arbidol in SARS-CoV-2 pneumonia 42.

8. Oseltamivir

It is another class of antiviral drug having movement against influenza flu which is a neuraminidase enzyme inhibitor that acts as a potential treatment alternative for SARS-CoV-2 infection 43. Oseltamivir was not focused as a treatment option for SARS-CoV-2 infection, however the absence of information on the causative pathogen at the time of treatment and the craving to experimentally treat influenza flu 44. In Wuhan, China Huang et al. exacerbated the underlying report from patients who dealt with SARS-CoV-2 infection got oseltamivir alongside with broad-spectrum antimicrobials and the results showed that no in vitro activity of oseltamivir accounted against SARS-CoV-2 infection along with antimicrobials drugs 45.

9. Interferon Alpha (IFN α)

IFN α is a family member of IFNs-type 1 which plays an important role in host resistance to viral infection. It suppresses viral infection by directly interfering with a copy of viruses by promoting adaptive immune responses 46. Interferon-α and -β have been studied for novel coronaviruses, while interferon-β showed its activity against MERS infection 47. In vitro experiments showed that IFN α effectively inhibits SARS-CoV replication and has been reported that Cynomolgus monkeys are protected from SARS-CoV infection by treatment with IFN α 48. Most reported result of published studies shows that the treatment combined with Lopinavir/Ritonavir or Ribavirin. Additionally, the therapeutic advantage of IFN α for patients with SARS was shown in a pilot-scale clinical trial.

So, in this manner, IFN α ought to be viewed as a suitable therapy for SARS-CoV-2 infection 49.

10. Tocilizumab

A monoclonal antibody derivative marketed as Actemra that inhibits IL-6-mediated signals by competitively binds to membrane-bound and soluble IL-6 receptors, a pro-inflammatory cytokine that is engaged with differing physiological procedures, for example, T-cell enactment, immunoglobulin secretion induction, hepatic acute-phase protein synthesis initiation, and hematopoietic precursor cell multiplication and separation incitement 50. In China, Xiaoqing Xu et al. used tocilizumab on 21 severe SARS-CoV-2 infected patients, showed big changes in lymphocytes count, C-reactive protein levels, and also reduced oxygen intake suggests positive outcomes that tocilizumab is effective in the treatment of severe SARS-CoV-2 patients, which provided a new therapeutic strategy for this fatal infectious disease and officially under Phase 3 clinical trial 51.

11. Siltuximab

It is also an IL-6 targeted monoclonal Ab drug that inhibits IL-6-mediated signals same as tocilizumab and has been approved by the Food and Drug Administration (FDA) as well as the European Medicines Agency (EMA) in the treatment of Multicentric Castleman Disease (MCD) who are Human Immunodeficiency Virus (HIV) and Human Herpesvirus-8 (HHV-8) negative 52. The study suggests that patients with SARS-CoV-2 infection may respond to the overproduction of IL-6 leading to a cytokine storm, caused serious lung injuries, or Acute Respiratory Distress Syndrome (ARDS). Therefore, potentially reducing SARS-CoV-2 disease progression with Siltuximab may prevent patients from serious symptoms and entering ITU also allow patients to leave the ITU at an earlier stage. In Italy, Gritti G et. al and its colleague's studies show evidence of benefits in 21 patients of SARS-CoV-2 infection by use of intravenous Siltuximab showed reduced CRP levels, 33% showed clinical improvement, 43% stabilized, and 24% worsened after 8 days and those patients who experienced a worsening in their condition, one patient died, and one patient experienced a cerebrovascular event 53.

12. Ivermectin

Ivermectin is a broad-spectrum antiparasitic agent that also have anti-viral activity against a wide range of viruses such as DENV 1-4, West Nile Virus, Venezuelan Equine-encephalitis virus, Influenza virus as well as shows its activity against DNA virus, for example, Pseudorabies virus (PRV) in vitro and in vivo due to the reliance by many different RNA viruses on IMPs/β1 during infection 54. It hinders the cooperation between the Human Immunodeficiency Virus-1 (HIV-1) integrase protein (IN) and the importin (IMP) α/β1 heterodimer responsible for IN atomic import to restrain viral replication. Another mode of action of ivermectin, it restrains nuclear import of host and viral proteins, including Simian Virus SV40 huge tumor antigen (T-ag) and Dengue Virus (DENV) non-structural protein 5 55. In an in vitro study, Ivermectin demonstrated to be powerful against SARS-CoV-2 disease by scientists at Monash University in Melbourne, Australia recommends that Vero cells + SARS-CoV-2 for 2 hours, at that point ivermectin was introduced, following 24 hours supernatant viral RNA were diminished and following 48 hours all viral material lost. Further clinical trials should be completed to affirm the viability of medicine in humans with SARS-CoV-2 disease 56.

13. Azithromycin

It is a broad-spectrum antibiotic that may prevent bacterial superinfection, immunomodulators to act as adjuvant therapy in pulmonary inflammatory disorders 57. They may downregulate the inflammatory reactions by diminishing excessive cytokine production related to respiratory viral infections and immunomodulatory mechanism may incorporate reducing chemotaxis of neutrophils (PMNs) to the lungs by repressing cytokines (i.e., IL-8), restraint of mucus fluid hypersecretion, diminished production of reactive oxygen species, fastening neutrophil apoptosis, and blocking the activation of nuclear interpretation factors 58. The study suggests that an open-label, non-randomized clinical trial of combination (hydroxychloroquine and azithromycin) administered to prevent bacterial superinfection in 6 patients suggests potential benefit as an adjunct therapy. On day 6, all patients treated with the combination (hydroxychloroquine and azithromycin) were virally cured compared to patients treated with hydroxychloroquine alone 59.

14. Angiotensin-Converting Enzyme Inhibitors (ACEI)

Early data from China during the SARS-CoV-2 pandemic suggest that patients with hypertension or diabetes are at higher risk of severe SARS-CoV-2 disease 60. As we as a whole realizes that the receptor for SARS-CoV-2 binds to ACE-2 and they went into cells and it has been speculated that treatment with ACE-inhibitors (ACEI) or angiotensin receptor blockers (ARB) in such patients may build the expression of ACE-2 60. The study in the UK suggests that
Immunological response for COVID-19 patients, for example, may prompt more awful results in SARS-CoV-2 patients. ESICM and SCCM Surviving Sepsis Campaign proposes that acetaminophen for temperature control in fundamentally sick patients in SARS-CoV-2 67.

17. Convalescent Plasma Therapy

Convalescent plasma is versatile immunotherapy used in the prevention and treatment of numerous irresistible ailments for over multi decades in which plasma gathered from donors who recovered from SARS-CoV-2 infection damage may contain antibodies to SARS-CoV-2 disease utilized as prophylaxis or given shortly within 14 days in SARS-CoV-2 patients to dispose of the infection before it makes genuine to lungs 68. Firstly, in the year 1918, it was utilized during the deadly influenza flu outbreak and in the year 1930, it was utilized in the treatment of measeas 69. In the year 2014, convalescent plasma gathered from recovered patients of Ebola disease was suggested by WHO as an alternative treatment option during the outbreak, and in the year 2015, a protocol for the utilization of convalescent plasma in the treatment of Middle East Respiratory Syndrome (MERS) was built up 70. Till now, more than 1.5 million and more than 300,000 SARS-CoV-2 patients present a significant asset of recovering convalescent plasma 71. The fundamentals while collecting plasma were mentioned pictorially in Figure 4.

Figure 4: Convalescent Plasma Collections Workflow

Mode of Action of Convalescent Plasma

The antibodies present in insusceptible for example convalescent plasma intervene in their remedial activity through a variety of mechanisms. Antibodies bind to a given pathogen for example virus, thereby neutralizing its infection directly, while another counter-acting agent intervened pathway for example, supplement activation, immune response subordinate cell cytocytotoxicity, or phagocytosis may add to its therapeutic activity. However, passive antibody administration offers an only short-term improvement to confer immediate immunity to susceptible individuals particularly in emerging infectious diseases such as SARS-CoV-2 and human anti-SARS-CoV-2 plasma is the only therapeutic strategy that is quickly available for prevention and treatment of SARS-CoV-2 infection 72.

Convalescent Plasma Case Studies

In China, Shen et al. conducted studies in 5 critically ill patients of SARS-CoV-2 disease with convalescent plasma. All 5 patients on IVM received plasma in the range of 10–22 days and the plasma contained IgG and IgM anti-SARS-CoV2
antibodies. The volume transferred 2 doses of 200 mL (x2) of convalescent plasma with neutralizing antibody titers at >1:1000 and the patient outcome result was normalized body temperature within 3 days in 4 or 5 patients, SOFA score decreases, improved oxygenation like PAO2/FIO2 within 12 days, ARDS resolved in 4 patients at 12 days with reduced inflammation and viral loads become negative after 12 days; ultimately patients recovered from infection.

Another contextual investigation in China by Duan et al. conducted, a pilot study in 19 patients, and 9 patients got 1 portion of 200 mL convalescent plasma with killing neutralizer titers of >1:640 and the middle time from the beginning of aiment to healing plasma transfusion was 16.5 days. Within 3 days, the patients demonstrated improved clinical manifestations alongside an increment of oxyhemoglobin saturation, decreased inflammation, and viral load. The remaining 10 patients among them have a safety study and no adverse effects were reported.

Another investigation in China by Zhang et al., conducted pilot studies in 4 critically ill patients of SARS-CoV-2 infection with convalescent plasma and the meantime from the onset of illness to plasma was 15.5 days with 1-8 infusion dose of 200–2400 mL with no antibody titers. The patients showed improved clinical symptoms and all patients were recovered and ultimately no adverse effects were reported from transfusion of convalescent plasma.

After further clinical examinations directed in China, their adequacy and their effect on the condition of those treated and recovered patient from SARS-CoV-2 infection, medical hospitals in New York City are getting ready to utilize the plasma blood of those recovered from SARS-CoV-2 infection as a potential remedy for the disease. Also, a little possibility of the risk of utilizing Convalescent Plasma treatment by the transmission of some blood-borne pathogen, for example, Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), or Hepatitis C Virus (HCV) 77. The safety and viability of gaining strength plasma transfusion have not been settled and no conventions exist at present in the United States for SARS-CoV-2 patients yet conventions are allegedly being created at The Johns Hopkins University Hospital. The USFDA has affirmed the utilizing of blood plasma with a high killing antibodies titter from patients who have recovered from SARS-CoV-2 disease and might be an important donor for convalescent plasma.

18. The ChAdOx1 nCoV-19 Vaccine

It is an antibody produced by using an infection (ChAdOx1) which is a weakened version of a typical cold infection (adenovirus) that causes infections in chimpanzees. It is at present under scrutiny for prophylaxis agent against SARS-CoV-2 disease yet the viral vector was initially evolved at the University of Oxford’s Jenner Institute and Italian Pharmaceutical Manufacturer Advent Srl against MERS-CoV infection. The hereditary material has been added to the ChAdOx1 vaccine used to make proteins from SARS-CoV-2 infection called spike glycoprotein and taking into account the arrangement of endogenous antibodies against these glycoproteins and thus against the SARS-CoV-2 infection 79. The thought is to show the body to perceive the spike protein of the infection by first presenting it to the ChAdOx1 nCoV-19 vaccine and an immune response is generated when SARS-CoV2 enters the body. The vaccine is under the clinical human trials preliminaries Stage 3 under the aegis of the US National Institutes of Health (NIH). For the safety studies, 320 individuals had already been proven but for the efficacy studies, a total of 1,102 individuals was selected across Oxford, Southampton, London, and Bristol 80.

19. SARS-CoV-2 Phase 1 NCT04283461

As of 6th April 2020, the worldwide SARS-CoV-2 vaccine includes 115 vaccines out of which 78 are affirmed as dynamic and presently at exploratory or preclinical stages, rest 37 are under development state. The mRNA-1273 is a novel vaccine composed of Lipid Nanoparticle (LNP) encapsulated mRNA based vaccine that encodes a full-length prefusion stabilized spike (S) protein of SARS-CoV-2, recently under clinical trials by Moderna TX, Inc. which offers great flexibility in terms of antigen manipulation as well as in potential activities. In this Clinical Human Trials, 105 patients were enrolled and administered an intramuscular (IM) injection of mRNA-1273 from Days 1-29 and will be finished in 12 months that provides information about the safety, reactogenicity, and immunogenicity of the vaccine 81.

20. AstraZeneca Case Study to Succumb SARS-CoV-2 Pandemic

As of 30 April 2020, AstraZeneca and the University of Oxford reported an understanding of the worldwide development and conveyance of the University’s recombinant adenovirus immunization vaccine focused on the avoidance of SARS-CoV-2 infection 82. Under the understanding, AstraZeneca would be liable for the development, manufacturing, and distribution of the vaccine at the worldwide level and guarantee that the British individuals and individuals over the world particularly in low and middle-income nations will be shielded from this horrible infection as fast as could reasonably be possible 83.

Conclusion

In a nutshell, the outbreak of SARS-CoV-2 viruses has spread worldwide causes severe illnesses, sustained human-to-human transmission, and ultimately death making it a serious and public-health concern. Also, it is necessary to make a detailed study of the pathogenic mechanism at the cellular and molecular level as well as the life cycle study of SARS-CoV-2 viruses are also needed. However, the vaccine development efforts and identification of therapeutics including drug repurposing against SARS-CoV-2 infection should be pursued on an urgent basis. Furthermore, a broad-spectrum anti-viral drug previously used against influenza flu, SARS-CoV, and MERS-CoV can be inspected in future studies. Overall, the control of this ongoing outbreak is a challenge at a worldwide level and it needs our deliberate and immediate action.

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