



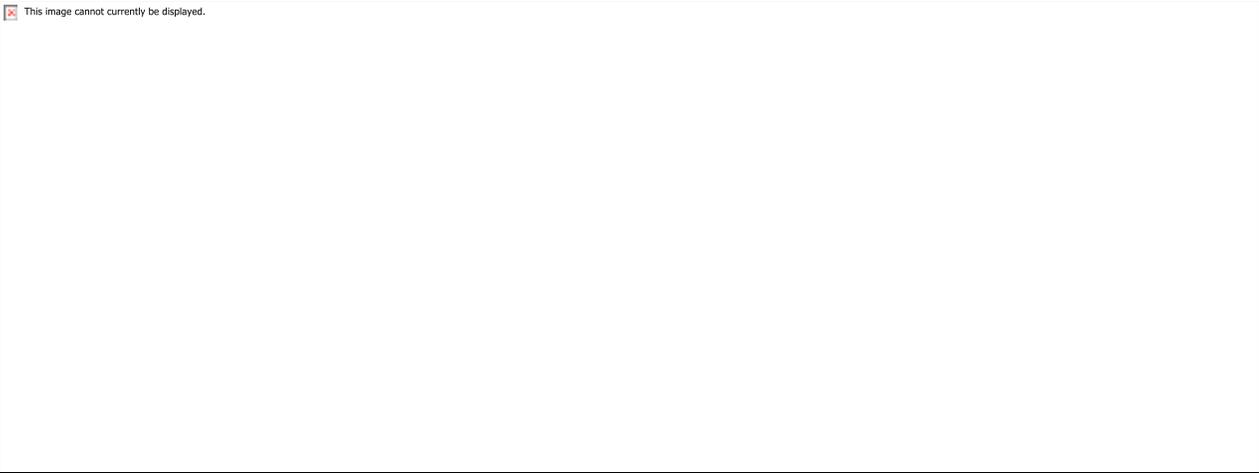
Review name: COVID-19 Transmission, Current Treatment, Future Therapeutic Strategies.

Miss. Ankita Jayram Moin, Miss. Pallavi. S . Kandalkar, Dr. Rajendra. M . Kawade

Student, Assistant Professor,, Principal
Nandkumar Shinde College Of Pharmacy

Abstract

At the stroke of the New Year 2020, COVID-19, a zoonotic disease that would turn into a global pandemic, was identified in the Chinese city of Wuhan. Although unique in its transmission and virulence, COVID-19 is similar to zoonotic diseases, including other SARS variants (e.g., SARS-CoV) and MERS, in exhibiting severe flu-like symptoms and acute respiratory distress. Even at the molecular level, many parallels have been identified between SARS and COVID-19 so much so that the COVID-19 virus has been named SARS-CoV-2. These similarities have provided several opportunities to treat COVID-19 patients using clinical approaches that were proven to be effective against SARS. Importantly, the identification of similarities in how SARS-CoV and SARS-CoV-2 access the host, replicate, and trigger life-threatening pathological conditions have revealed opportunities to repurpose drugs that were proven to be effective against SARS. In this article, we first provided an overview of COVID-19 etiology vis-à-vis other zoonotic diseases, particularly SARS and MERS. Then, we summarized the characteristics of droplets/aerosols emitted by COVID-19 patients and how they aid in the transmission of the virus among people. Moreover, we discussed the molecular mechanisms that enable SARS-CoV-2 to access the host and become more contagious than other betacoronaviruses such as SARS-CoV. Further, we outlined various approaches that are currently being employed to diagnose and symptomatically treat COVID-19 in the clinic. Finally, we reviewed various approaches and technologies employed to develop vaccines against COVID-19 and summarized the attempts to repurpose various classes of drugs and novel therapeutic approaches.

This image cannot currently be displayed.

Keywords: COVID-19, transmission, SARS-CoV-2, vaccines, therapeutic strategies,

Introduction:-

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a profound impact on global health, economies, and societies. Since its emergence in late 2019, it has spread rapidly across the world, leading to millions of infections and deaths. The virus primarily spreads through respiratory droplets, although other modes of transmission have been identified. Despite advances in vaccines and treatments, challenges remain in controlling the spread, treating severe cases, and preventing future outbreaks. This review aims to explore current knowledge on transmission, available treatments, and potential therapeutic strategies for the future.

COVID-19 primarily spreads through respiratory droplets expelled when an infected person coughs, sneezes, talks, or breathes. These droplets can infect people who are in close contact, typically within six feet. The virus can also be transmitted through airborne particles, especially in enclosed, poorly ventilated spaces, where tiny aerosolized droplets may linger in the air for extended periods. Additionally, transmission can occur via contact with contaminated surfaces (fomites), though this is considered less common. Other potential routes of transmission, such as through bodily fluids, are still under investigation. Proper hygiene practices, physical distancing, and mask-wearing are essential to reduce the spread.

Factor responsible for COVID-19 :

Human-to-Human Transmission: Close contact between individuals facilitates the spread of the virus, particularly through respiratory droplets and aerosols.

Asymptomatic and Pre-symptomatic Spread: Infected individuals can transmit the virus even before showing symptoms, making it harder to control transmission.

Global Travel: International travel enabled the virus to spread quickly between countries and continents before strict travel restrictions were in place.

High Reproduction Rate (R0): The basic reproduction number (R0) for COVID-19 was initially estimated to be between 2 and 3, meaning each infected person could potentially spread the virus to two or three others.

Dense Population Areas: Crowded environments, such as cities, public transportation, and healthcare facilities, allow the virus to spread more easily.

Inadequate Testing and Delayed Responses: Early delays in widespread testing and containment measures allowed undetected cases to escalate into larger outbreaks.

Mutations and Variants: The emergence of new variants, some of which are more transmissible or able to evade immune responses, has further complicated efforts to control the virus.

History and Background:-

Disease outbreaks When the outbreak is not contained, it spreads over a large population and affects an entire region or community of people, causing an epidemic. As infected people and/or objects contaminated with infectious material spread across the globe, an epidemic turns into a pandemic. Through the 16th and 19th centuries, pandemics such as smallpox, plagues, and cholera destroyed many cities throughout Europe and Asia. The 20th century witnessed the spread of the Spanish Flu (1918–1919), a pandemic causing pandemics such as Asian flu (1957–1958) and swine flu in 2009 that together killed more than a million people. Some of the influenza strains persisted with humanity, causing seasonal influenza, leading to thousands of deaths every year. Concerted efforts of the scientific community to tackle such pandemics have eventually led to research advances, which ultimately helped to develop vaccines for combating the seasonal flu.

The Similarity and Differences among SARS-CoV-2 and Other Coronaviruses. Coronaviruses contain a positive sense single-stranded RNA (+ssRNA) enclosed in a capsid with spikes, which resemble solar corona. Relative to positive RNA viruses, coronaviruses have a large, sophisticated machinery to overtake host cells. They are known to cross species barriers, infect humans, and hijack. As of now, there are four of the six coronaviruses that were previously known to infect humans cause common colds, upper respiratory, and intestinal illnesses. Of these, betacoronaviruses like SARS-CoV and Middle-East respiratory syndrome coronavirus (MERS) caused by the H1N1 strain of influenza that is most likely spread by soldiers returning home from World War I. Influenza recurred in

the human population with a variety of mutations -CoV) cause severe and often fatal lower respiratory tract infections. Viral RNA isolated from COVID-19 patients in Wuhan was sequenced and a betacoronavirus with unique genomic features, including a couple of novel putative short proteins that potentiate the replication and transmission of the viral proteins was identified. Multiple independent genomic sequencing studies conducted on SARS-CoV-2 viral RNA isolated from several COVID-19 patients have demonstrated a phylogenetic relationship to a bat coronavirus (bat-CoV-RATG13) and a pangolin coronavirus (pangolin-CoV) at the whole-genome level and a very close association to SARS-CoV at the molecular level. In particular, these two coronaviruses exhibited similarities in the coding region of the spike protein (S-protein), which enables the virus to bind to the cell surface receptors and facilitate its entry into the human host. Zhou et al. (2020) conducted a series of in vitro experiments to show that SARS CoV-2 infected cells that express angiotensin-converting enzyme 2 (ACE2) receptors, thus providing strong evidence that the virus enters cells by binding to the ACE2 receptor, which was also shown to mediate SARS-CoV internalization. Comparative information on these and other essential features between SARS-CoV and SARS-CoV-2 are provided.



Need and Objectives:

- Provide Recommendations for Policy and Analyze COVID-19 Transmission Dynamics
- Examine the modes of transmission (e.g., respiratory droplets, aerosols, surfaces)
- Discuss factors influencing transmission rates
- Review Current Treatment Options
- Evaluate the effectiveness of existing antiviral medications, monoclonal antibodies, and supportive care measures
- Discuss the role of vaccines in preventing COVID-19 and reducing transmission
- Explore Future Therapeutic Strategies
- Investigate emerging treatments and potential vaccine developments
- Highlight the Importance of Continued Research and Surveillance
- Emphasize the need for ongoing studies to monitor transmission patterns and treatment efficacy
- Analyze COVID-19 Transmission Dynamics
- Review Current Treatment Options
- Explore Future Therapeutic Strategies
- Highlight the Importance of Continued Research and Surveillance

Administration:-

The vaccine is approved for restricted use in emergency situation. Posology: CORBEVAX® vaccination course consists of two separate doses of 0.5 mL. The second dose should administered at least 4 weeks after the first dose. The vaccine should be administered intramuscularly in the deltoid muscle of upper arm.

This image cannot currently be displayed.

COVID Vaccine Chemical Name :

ChAdOx1 nCoV- 19 Corona Virus Vaccines (Recombinant)

COVID-19 Vaccine Name List:

Biological E Limited. Corbevax.

Serum Institute of India. COVOVAX (Novavax formulation)

Zydus Cadila. ZyCoV-D.

Moderna. Spikevax. Bharat Biotech. iNCOVACC.

Gamaleya. Sputnik Light.

Gamaleya. Sputnik V.

Half-life :



The half-life of the serum nAb response was estimated to be 56 to 66 days up to 6 months after 2 doses of BNT162b2 or mRNA1273 (6, 8, 9)

COVID-19 : Clinical manifestation , Diagnosis and Treatment :

The clinical manifestations of COVID-19 are not specific but somewhat similar to many viral illnesses. A high-level description and visualization of the disease and its symptoms are presented in After an incubation period of about 4–14 days, most individuals develop symptoms that can range from mild to very severe and even fulminant disease.

The most common manifestations are cough (46–82%), fever (77–98%), fatigue, anorexia, and myalgias (muscle pain), although anosmia (loss of sense of smell) and dysgeusia (loss of sense of taste) are frequently seen and are believed to be characteristic, but not exclusive, to

COVID-19. Sore throat, headache, and rhinorrhea (runny nose) are also reported.

Gastrointestinal symptoms such as nausea and diarrhea and accompanying abdominal pain may precede the respiratory symptoms in up to 10% of patients. Asymptomatic individuals can test positive for COVID-19 (30%).

However, the majority of individuals will present mild to moderate disease (55%). About 30% of patients may develop dyspnea (shortness of breath) around day 5 after the

disease onset. Deterioration in the second week of illness is typical in patients with a more severe form of the disease. These patients commonly require hospitalization by day 7 or

8 and manifest hypoxemia (low blood oxygen) as well as bilateral pneumonia (75%).

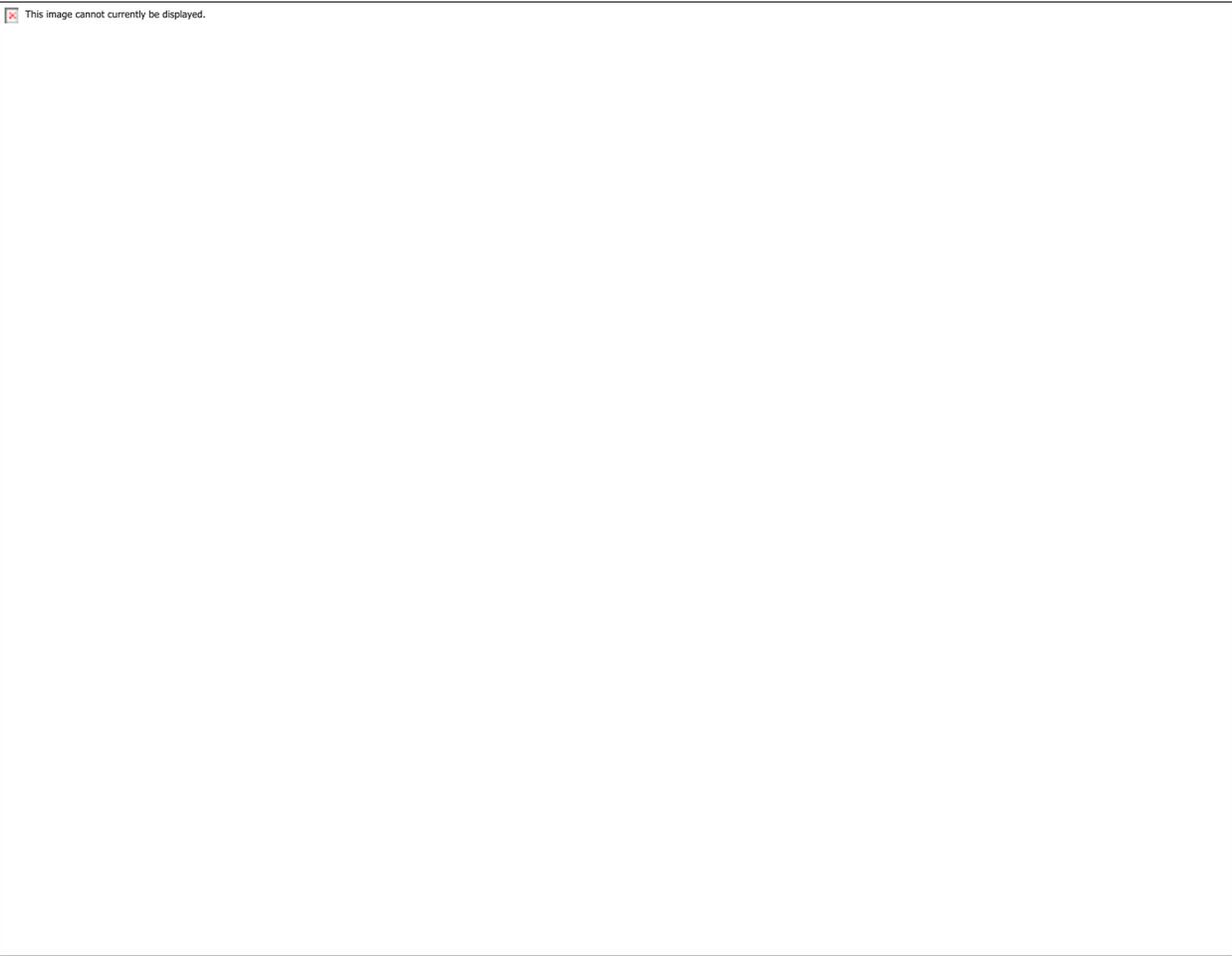
Elevation of the liver enzymes and creatinine are also common.

Most hospitalized patients

require a standard level of care, although about 20% may deteriorate quickly after the onset of dyspnea and develop severe respiratory failure. Complications.

Acute respiratory distress syndrome (ARDS) is one of the most severe complications of patients with COVID-19. It is associated with prolonged hospitalization and high mortality, especially if patients develop multiorgan system failure.

Respiratory support is crucial and ranges from high flow oxygen to providing noninvasive as well as invasive mechanical ventilation. Prone positioning has been noted to be beneficial in improving the oxygenation. A subset of patients may develop an acute inflammatory state with fevers and increased expression of inflammatory markers as well as cytokines, similar to that observed in cytokine release syndrome

 This image cannot currently be displayed.

COVID 19 Diagnosis :

The complete blood cell count can be normal, but the most common abnormal laboratory findings are lymphopenia (63%), leukopenia (9–25%), leukocytosis (24–30%), and thrombocytopenia (36%). Liver enzymes are elevated in about 37% of the patients.

Other inflammatory markers [erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP)], D-dimer, ferritin, and IL-6, are also commonly elevated. \

Procalcitonin is usually normal but can be high, especially if there is a superimposed bacterial infection.

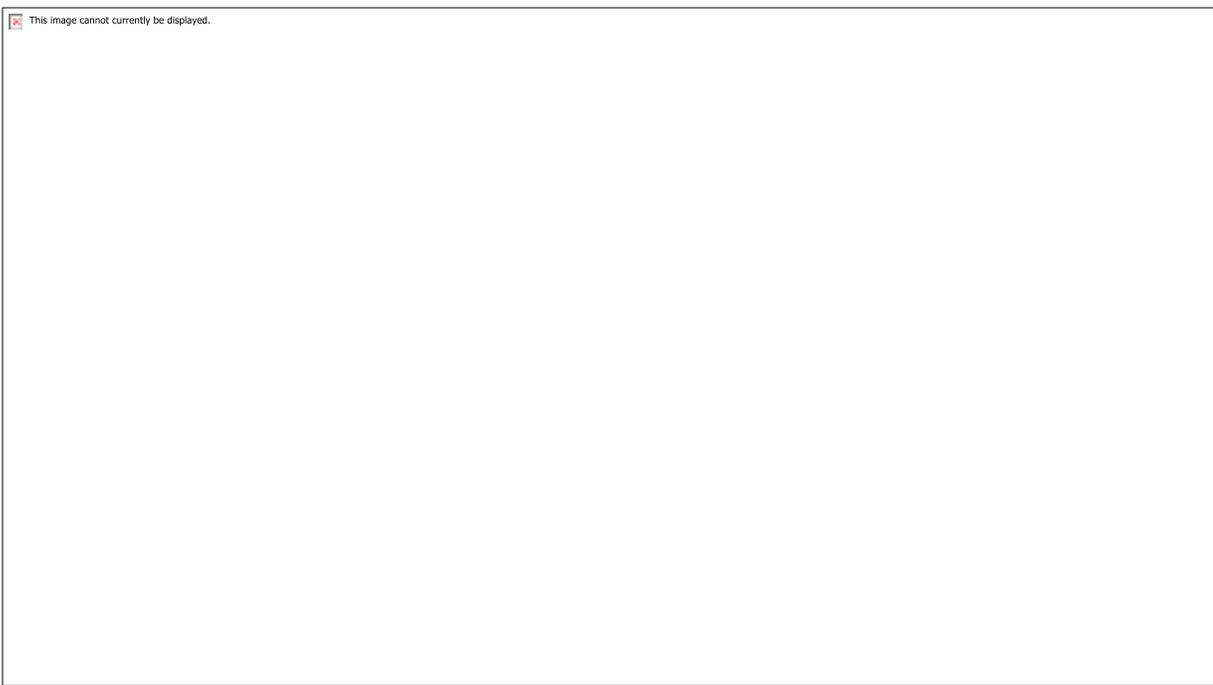
Radiographic Findings and Other Imaging Studies important to be aware that up to 50% of the patients may have normal chest X-ray (CXR), especially in the early stages of However, for those that develop pneumonia,

Point of Care Ultrasound. It is especially helpful for those patients in the ICU setting to assess the lung (presence of B-

Diagnosis and PCR Technique: clinical presentation laboratory, radiological features, and exposure history (travel, positive contact, etc.) should raise the suspicion for COVID-19 infection. However, a definitive diagnosis should be made with microbiologic testing by the confirmation of the presence of SARS-CoV-2 RNA in clinical specimens.

Initially, a reverse-transcription polymerase chain reaction (RT-PCR)-based test was only performed by the CDC. However, similar tests are now also available at several hospitals and commercial laboratories. The sensitivity of the test is about 70–75%.

Common factors that can affect the positivity of the test are the type and quality of the specimen (nasopharyngeal has better sensitivity than oropharyngeal), stage and severity of the disease (in the early stages, viral concentrations are higher in the oropharynx, while sputum and broncho alveolar lavage tend to have higher sensitivity as the disease progresses), and the characteristics of the Specific test. A negative test does not rule out COVID-19. Therefore, if there is a high clinical suspicion for COVID-19 infection, PCR should be repeated in about 24–48 h; meanwhile, the should remain in isolation.

 This image cannot currently be displayed.

Current Treatment Strategies for COVID-19 :

Due to the unknown efficacy of the available antiviral drugs, the standard of care, especially for those patients with mild disease, should center on the prevention of transmission.

Close monitoring is important for patients that are being managed at home, and prompt escalation of care is required if deterioration occurs. Data regarding the risk of increasing viral replication versus anti-inflammatory benefits of cortico-steroids is inconclusive. However, they can be considered in the presence of other indications such as severe COPD. The use of inhalers is preferred over nebulized therapies to avoid aerosol-generating procedures that could potentially increase airborne viral spread.

Nonsteroidal anti-inflammatory drugs :

(NSAIDs) have been deemed to affect the levels of ACE2 receptors in epithelial cells and potentially increase viral infection. However, this is debatable. It is uncertain if all NSAIDs have the same potential for adverse reactions in COVID-19.

NSAIDs are proposed to lead to a theoretical increased risk of ARDS via leukotriene release and, subsequently, bronchoconstriction. Therefore, the use of NSAIDs for symptom relief should be individualized. The European Medicines Agency (EMA) and the World Health Organization (WHO) do not recommend that NSAIDs be avoided.

The use of acetaminophen is generally preferred in hospital settings due to the increased risk of bleeding and renal injury associated with NSAIDs. The use of ACE inhibitors and angiotensin receptor blockers has also been controversial. However, the American Society of Cardiology and the European Society of Cardiology currently do not recommend initiation or discontinuation of these agents. The decision to administer antiviral and other anti-inflammatory therapies to COVID-19 patients should be made on a case-by-case basis, if possible, in consultation with infectious disease specialists, and preferably as part of a clinical trial or registry. Patients with moderate to severe illness frequently benefit from oxygen supplementation (nasal cannula and high flow oxygen), and for those with acute respiratory failure, noninvasive and invasive mechanical ventilation is frequently needed. Positive airway pressure (PAP) should be used with the recognition that it is an aerosol-generating procedure and requires a higher level of personal protection equipment (PPE) used by healthcare providers.

Pharmacological prevention of venous thromboembolism should be offered to all hospitalized patients unless there are specific contraindications due to the increased risk of venous thromboembolism in these patients.

Drug interactions:

Chloroquine, hydroxychloroquine The two aminoquinolines, chloroquine (CQ) and hydroxychloroquine (HCQ) are used for malaria and rheumatic diseases. They showed the activity against the COVID-19 in Vero E6 cells and recommended it as a primary treatment option for the COVID-19 CQ and HCQ have weak diprotic features, and they could increase the pH of the endosome during the fusion of the virus to the host cell .

Several clinical trials were preceded in China for CQ and HCQ on COVID-19 infected patients. One of them disclosed that promising results in a reduction of the disease progression . One clinical trial was performed in France to find the efficacy of HCQ using at different doses, along with azithromycin on COVID-19 infected patients.

The clinical demonstration noticed that the treated rate was considerably higher in HCQ used in combination with azithromycin . Even though this study showed favorable results, extensive clinical data are required to confirm the efficacy and safety of HCQ with azithromycin .

Similarly, a postexposure prophylaxis clinical trial (NCT04308668) using an oral dosing regimen has been conducted in the USA. The latest study revealed that HCQ had little or no effect on hospitalized patients with COVID-19, as suggested by overall mortality, initiation of ventilation

Drug-drug interaction

The HCQ elimination half-life is likely > 40 days. The CYP and its isoform could play a vital role in the metabolism of HCQ and CQ. The hepatic metabolism of HCQ is not exactly exemplified. To see the chloroquine data, the effect of CYP3A4/5 CYP2C8 and CYP2D6 were extrapolated.

Both change into active metabolites through the dealkylation process by CYP isomers . The single nucleotide polymorphism (SNPs) of CYP2D6 showed on the variable metabolism of HCQ and CQ in SLE [140]. The administration of HCQ for the management of COVID-19 infection was challenged by several side effects among individuals with different CYP genotypes. CYP genotyping, especially for CYP2D6, may help to determine the optimum HCQ dosage in personalized medicine.

Precautions:

Continue with COVID-19 appropriate behaviour-The most important thing to do post-vaccination is to continue wearing masks, regularly washing, or sanitizing your hands, maintaining physical distance, avoid crowded places and avoid touching surfaces.

The contraindications to second dose of vaccine are:

Severe allergic reaction after a previous dose of this vaccine. ...

Patients who have experienced major blood clotting (venous and/or arterial thrombosis) in combination with low platelet count (thrombocytopenia) following first dose of vaccine.



Future therapeutic strategies:

Current treatments for COVID-19 focus on managing symptoms, preventing severe complications, and reducing viral replication. The treatment options include:

Antiviral Medications: Drugs like remdesivir are used to inhibit viral replication in hospitalized patients with moderate to severe disease. Other antiviral agents such as molnupiravir and nirmatrelvir/ritonavir (Paxlovid) have shown effectiveness in treating mild to moderate cases in high-risk patients.

Corticosteroids: Dexamethasone is commonly used in severe COVID-19 cases to reduce inflammation and prevent an overactive immune response, especially in patients requiring oxygen or ventilation.

Monoclonal Antibodies: These lab-produced antibodies, such as sotrovimab and casirivimab/imdevimab, are used for patients at high risk of severe disease, helping to neutralize the virus.

Anticoagulants: Blood thinners are used to prevent or treat blood clots, which are a common complication in COVID-19 patients, particularly those who are hospitalized or critically ill.

Oxygen Therapy and Ventilation: Patients with severe respiratory distress may require supplemental oxygen or mechanical ventilation to support breathing.

Immunomodulators: Drugs like tocilizumab, which target the inflammatory response, are sometimes used in patients with severe COVID-19 to reduce the risk of cytokine storms, a dangerous immune overreaction.

Supportive Care: Hydration, rest, and medications for fever and pain are provided to help manage symptoms in mild to moderate cases.

Vaccines remain the most critical tool in preventing severe illness and death from COVID-19, but these treatments have significantly improved outcomes for those infected.

More than 200 clinical trials are currently underway to test various novel and repurposed compounds against COVID-19. However, the promise of vaccines is alluring as they have the potential to prevent disease transmission in a larger population.

Before deploying these vaccines in a larger population, their safety and efficacy should be thoroughly established; ineffective vaccines may not only fail to protect the individual from the virus but could also cause disease through antibody-dependent enhancement or other mechanisms Treatment.

Molecular pharmaceuticals :

Novel Therapies :

Convalescent plasma treatment is being developed at a remarkable speed. In August 2020, the FDA authorized the use of high titer and low titer convalescent plasma for the treatment of patients hospitalized with COVID-19.

The convalescent patient plasma may contain antibodies that not only block viral infection but also improve the clearance of cells infected with the virus.

Thus, convalescent plasma from patients recovered from COVID-19 might be useful to alleviate symptoms in critically ill patients. When five COVID-19 patients suffering from ARDS were infused with 400 mL of convalescent plasma (with SARS-CoV-2-specific antibody binding titer greater than 1:1000 and neutralization titer greater than 40), viral load decreased within 3–4 days after the infusion;

moreover, the majority of the patients did not need mechanical ventilation following 12 days of plasma infusion. In this small sample study, patients have also received steroids and other antiviral agents. In a larger study of 5000 patients, convalescent plasma appeared to be safe in hospitalized patients with COVID-19.

Recent reports from the follow-up study conducted on 35,322 transfused COVID-19 patients have shown that the patients receiving high IgG plasma (>18.45 signal-to-cut off ratio (S/Co)) had lower mortality (8.9%) than those receiving medium (4.62–18.45 S/Co) or low IgG plasma (<4.62 S/Co). It targets a single epitope, which allows. Although data support the safety and potential efficacy of convalescent plasma, rigorous randomized clinical trials are needed to determine which subset of patients and to what extent they are most likely to benefit.

potentially be an effective clinical treatment against COVID-19 for a higher specificity on a predetermined target. Monoclonal antibodies that are produced on a large scale have reduced batch variations in comparison to polyclonal antibodies. Lilly has developed a neutralizing monoclonal antibody drug candidate, bamlanivimab (LY-CoV555), from the convalescent plasma of COVID-19 patients. Bamlanivimab has an activity against the SARS-CoV2 receptor-binding domain. It blocks the attachment of the virus to the host cell and prevents its entry into human cells.

In the phase 2 clinical trial for bamlanivimab in outpatients, a reduction in viral load was observed at day 11 when compared to the placebo group. The symptom severity and COVID-19 hospitalization rate were also reduced in patients who received bamlanivimab. It currently has received emergency use authorization by the FDA for the treatment of COVID-19 in recently diagnosed patients. Regeneron has developed a novel two monoclonal antibody cocktail, REGN-COV2, from humanized VI mice and blood from recovered COVID-19 patients.

It is known to reduce SARS-CoV-2 viral infectivity by binding to the RBD of the spike protein at two distinct, nonoverlapping locations. This interaction hinders the binding of the virus to the host cell and is able to neutralize the virus and prevent infection. Moreover, the two-antibody cocktail combination prevents mutant viral escape,

which is usually seen with single antibody therapies. REGN-COV2 prevents the escape of viral mutants by simultaneously binding to two distinct regions of the virus. REGN-COV2 is being evaluated in four late-stage clinical trials.

Two phase 2/3 clinical trials conducted on hospitalized and no hospitalized patients have shown a reduction of viral symptoms in no hospitalized patients. Two phase 3 recovery and prevention trials of hospitalized COVID-19 patients are currently underway. Antibody immunotherapy is therapeutically promising against SARS-COV2, but still, there are certain challenges. Patients who have previously died of SARS-CoV infection have exhibited a strong neutralizing antibody response in addition to pulmonary inflammation.

Due to a pathological link between the neutralizing antibody response and pulmonary inflammation, it is necessary to consider the patient's adaptive immune responses when administering an antiviral immunotherapy. Additionally, patients with severe COVID-19 may not be responsive to antibody therapy because they would have developed several underlying conditions such as acute inflammation and coagulopathy during the course of infection. In such cases, the patient's condition deteriorates so drastically that decreasing viral load in these patients may not be helpful.

Despite being promising therapeutic agents to treat COVID-19, immunoglobulins pose several challenges for large scale manufacturing and quality control. Moreover, immunoglobulins have to be given intravenously, at doses as high as 8 g for REGN-COV2, which requires hospitalization of the patient. These constraints may increase the expense and limit the widespread use of immunoglobulins for COVID-19 treatment. Randomized controlled trial investigating the efficacy and safety of tocilizumab in COVID-19 treatment has been conducted in Wuhan, China.

Tocilizumab is a monoclonal antibody which blocks IL-6 receptors. Initial studies concluded that tocilizumab was associated with reduced mortality and clinical improvement in patients with severe COVID-19. Further studies are needed to confirm the efficacy and safety of tocilizumab prior to routine use in clinical practice. Interferons are a family of proteins produced by the host cells in response to a viral infection. Interferon- β is known to increase the production of anti-inflammatory cytokines and downregulate the production of pro-inflammatory cytokines. Interferon- α is known to extend the activated T cell response, increase humoral immunity, and antigen-presenting cell response. Interferon- α has been used in combination with ribavirin to treat MERS-CoV.

Inhalation formulation of interferon- β -1a, which is expected to decrease symptoms of respiratory illness and pneumonia in COVID-19 patients, is currently in phase 2 clinical trials (Synairgen, England). Eculizumab, a monoclonal antibody that binds to complement component 5, is currently being evaluated to treat COVID-19. Preliminary evidence demonstrated that 4 patients with severe ARDS or pneumonia in the intensive care unit recovered after treatment with eculizumab. Cord mesenchymal stem cells (UC-MSCs) have been regarded as a possible treatment for SARS-CoV-2.

The MSCs have powerful immunomodulatory properties and can secrete anti-inflammatory factors. Theoretically, the accumulation of MSCs in the lung could protect alveolar epithelial cells and improve lung function. Promising preclinical and preliminary clinical data have demonstrated the feasibility of stem cell therapy to enhance the recovery of COVID-19 patients. Among the types of stem cells that are available for clinical use, UC-MSCs appear to be the best candidates to treat corona virus. The UC-MSCs derived from umbilical cords have a rapid doubling time, which makes it easy to scale up in the lab.

Moreover, they can be harvested noninvasively, unlike bone marrow stem cells. Highlight the Importance of Continued Research and Surveillance Continued research and surveillance are crucial in the ongoing battle against COVID-19 and future pandemics. The virus continues to evolve, with new variants potentially evading current vaccines and treatments. Ongoing research is essential to develop more effective therapies, improve vaccines, and understand long-term effects like Long COVID.

Surveillance systems are equally important for early detection of new variants, outbreaks, and changes in the virus's behavior. Real-time data collection helps guide public health responses, inform policy decisions, and prevent future waves of infection. Without continued research and surveillance, we risk being unprepared for emerging challenges in managing COVID-19 and other infectious diseases.

Provide Recommendations for Policy and Practice:

To effectively manage COVID-19 and future pandemics, several policy and practice recommendations are essential:

Strengthen Global Surveillance Systems: Governments and health organizations must enhance global surveillance to detect new variants and outbreaks early. This includes sharing data transparently across borders to enable timely responses.

Investment in Healthcare Infrastructure: Policies should prioritize strengthening healthcare systems, including expanding ICU capacity, improving access to medical supplies, and ensuring frontline workers are well-protected and trained.

Boost Vaccine Research and Distribution: Governments must continue investing in the development of new vaccines, especially those targeting variants and improving global access to vaccines. Equitable distribution, especially in low-income countries, is key to global containment.

Support for Long COVID Research and Treatment: Policymakers should support ongoing research into long COVID and ensure healthcare systems are equipped to diagnose and treat patients with persistent symptoms.

Preparedness for Future Pandemics: Establishing contingency plans, stockpiling essential supplies, and funding research into potential future pathogens are vital to being ready for future outbreaks. Policies should emphasize flexible and scalable responses.

Public Health Education and Communication:

Governments must foster trust through transparent communication about public health measures and continue educating the public on best practices such as vaccination, mask-wearing, and hygiene.

Encourage Global Collaboration: Coordinated global efforts are critical to address pandemics. Strengthening partnerships between nations, the WHO, and other organizations will ensure a united, efficient response to global health threats.

These recommendations aim to ensure a sustainable, comprehensive approach to managing the current pandemic and preparing for future public health challenges.

Summary :

Despite similarities in the clinical manifestations and molecular mechanisms with other diseases caused by betacoronaviruses, COVID-19 turned out to be so contagious and deadly that it triggered commitment and collaboration among scientists across the globe to protect humanity against this juggernaut. This coordinated effort has not only been accelerating our understanding of COVID-19 pathophysiology and its clinical manifestations but also contributing to the better prognosis of hospitalized patients. Vaccine development against COVID-19 is in full swing, and several vaccine candidates are in phase 3 trials.

On the other hand, high-throughput drug discovery platforms are being harnessed to repurpose existing drugs and develop formulation strategies for COVID-19 treatment. As of now, there are more than 300 clinical trials underway to test the safety and efficacy of various drug candidates in COVID-19 patients. A recent flurry of articles in various scientific journals on COVID-19 etiology, pathophysiology, clinical treatments, and drug discovery, as well as on repurposing efforts, are serving as beacons of optimism that a vaccine and/or effective treatment may soon become available for this devastating disease. The current review article is intended to summarize COVID-19 pathophysiology from the perspective of pharmacological interventions that are being investigated and provide a snapshot of this rapidly moving frontier in the fight against COVID-19.

Conclusion :

In conclusion, COVID-19 has profoundly impacted global health, highlighting the need for sustained vigilance, research, and innovation. Understanding its transmission dynamics has guided public health responses, including preventive measures and treatments. Current therapies have reduced mortality and morbidity, but ongoing research is crucial to address emerging variants, long COVID, and future pandemics. Strengthening healthcare infrastructure, enhancing global collaboration, and ensuring equitable access to vaccines and treatments are vital to controlling the spread of the virus. As we move forward, a proactive approach, grounded in scientific research and public health policy, will be key to safeguarding future generations from similar health crises.

Reference :

- (1) Rewar, S.; Mirdha, D.; Rewar, P. Treatment and Prevention of Pandemic H1N1 Influenza. *Annals of global health*. 2018, 81 (5),645–653.
- (2) Kruse, H.; Kirkemo, A.-M.; Handeland, K. Wildlife as source of zoonotic infections. *Emerging Infect. Dis.* 2004, 10 (12), 2067–2072.
- (3) Deeks, S. G.; Overbaugh, J.; Phillips, A.; Buchbinder, S. HIVinfection. *Nature Reviews Disease Primers*. 2015, 1 (1), 15035.
- (4) Baseler, L.; Chertow, D. S.; Johnson, K. M.; Feldmann, H.; Morens, D. M. The Pathogenesis of Ebola Virus Disease. *Annu. Rev. Pathol.: Mech. Dis.* 2017, 12, 387–418. (5) Wong, M. C.; Javornik Cregeen, S. J.; Ajami, N. J.; Petrosino, J.
- (5)F. Evidence of recombination in coronaviruses implicating pangolin origins of nCoV-2019. *Microbiology* 2020, 1 .
- (6) Xu, X.; Chen, P.; Wang, J.; et al. Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission. *Sci. China: Life Sci.* 2020,63 (3), 457–460.
- (7) de Wilde, A. H.; Snijder, E. J.; Kikkert, M.; van Hemert, M. Host Factors in Coronavirus Replication. *Curr. Top. Microbiol.Immunol.* 2017, 419, 1 –42.
- (8) Chan, J. F.; Kok, K. H.; Zhu, Z.; et al. Genomic characterizationof the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan. *Emerging Microbes Infect.* 2020, 9 (1), 221–236.
- (9) Chan, J. F.; Yuan, S.; Kok, K. H.; et al. A familial cluster opneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*–523.
- (10) Wu, A.; Peng, Y.; Huang, B.; et al. Genome Composition andDivergence of the Novel Coronavirus (2019-nCoV) Originating inChina. *Cell Host Microbe* 2020, 27 (3), 325–328.
- (11) Sungnak, W.; Huang, N.; Becavin, C.; Berg, M.; Queen, R.;Litvinukova, M.; Talavera-Lopez, C.; Maatz, H.; Reichart, D.;Sampaziotis, F.; Worlock, K. B.; Yoshida, M.; Barnes, J. L. SARS-CoV-2 Entry Genes Are Most Highly Expressed in Nasal Goblet andCiliated Cells within Human Airways. *Nat. Med.* 2020, 26 (5), 681–687.
- (12) Zhou, P.; Yang, X. L.; Wang, X. G.; et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin.*Nature* 2020, 579 (7798), 270–273.
- (13) van Doremalen, N.; Bushmaker, T.; Morris, D. H.; et al. *N.Engl. J. Med.* 2020, 382 (16), 1564–1567.

- (14) Peiris, J. S.; Yuen, K. Y.; Osterhaus, A. D.; Sto'hr, K. The severe acute respiratory syndrome. *N. Engl. J. Med.* 2003, 349 (25), 2431–2441.
- (15) Gostic, K.; Gomez, A. C.; Mummah, R. O.; Kucharski, A. J.; Lloyd-Smith, J. O. Estimated effectiveness of symptom and riskscreening to prevent the spread of COVID-19. *eLife* 2020, 9, 9 .
- (16) Petrosillo, N.; Viceconte, G.; Ergonul, O.; Ippolito, G.; Petersen, E. COVID-19, SARS and MERS: are they closely related? *Clin. Microbiol. Infect.* 2020, 26 (6), 729–734.
- (17) Sanche, S.; Lin, Y. T.; Xu, C.; Romero-Severson, E.; Hengartner, N.; Ke, R. High Contagiousness and Rapid Spread of Severe Acute Respiratory Syndrome Coronavirus 2. *Emerging Infect. Dis.* 2020, 26 (7), 1470–1477.
- (18) Jayaweera, M.; Perera, H.; Gunawardana, B.; Manatunge, J. Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy. *Environ. Res.* 2020, 188, 109819.
- (19) Yang, S.; Lee, G. W.; Chen, C. M.; Wu, C. C.; Yu, K. P. The size and concentration of droplets generated by coughing in human subjects. *J. Aerosol Med.* 2007, 20 (4), 484–494.
- (20) Duguid, J. P. The numbers and the sites of origin of the droplets expelled during expiratory activities. *Edinb Med. J.* 1945, 52, 385–401.
- (21) Zayas, G.; Chiang, M. C.; Wong, E.; MacDonald, F.; Lange, C. F.; Senthilselvan, A.; King, M.; et al. Cough aerosol in healthy participants: fundamental knowledge to optimize droplet-spread infectious respiratory disease management. *BMC Pulm. Med.* 2012, 12, 11.