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# Evaluation of the recommended treatment and preventive measures of COVID-19

Hananeh Kordbacheh[1,2], Ahmet Aydin[1,2], Sonia Sanajou[2*], Gonul Sahin[1]

[1]Eastern Mediterranean University, Faculty of Pharmacy, Famagusta, North Cyprus, Mersin 10 Turkey.

[2]Yeditepe University, Faculty of Pharmacy, Istanbul, Turkey.

## Abstract

The COVID-19 pandemic is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) that is continuing to spread around the world threatens the human health and has an impact on global economic crisis.

As of 26th July 2020, no dedicated FDA-approved treatment and vaccine strategies have been confirmed for the treatment and prevention of COVID-19 patients. Many ongoing clinical trials are in progress, and varieties of possible treatments are being tested around the globe.

As a vital part of the healthcare system, doctors, nurses and pharmacists play an important role in providing guidelines of protection to the public not only to prevent and control the infection but also to develop treatment strategies and discover vaccine during the pandemic. Several countries around the world are in rush to discover a new and safe therapy and vaccine for novel coronavirus.

This review highlights current knowledge about the possible therapies, their mechanisms, safety considerations based on interventional trials, clinical data of *in vitro* studies and a patient response.

**Keywords**

COVID-19, *in vitro* studies, SARS-CoV-2.

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***Corresponding author:** Sonia Sanajou **email:** sonia.sanajou@emu.edu.tr

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## INTRODUCTION

As of 26th July, 2020, more than 16 million cases of coronavirus disease 2019 (COVID-19) have been reported around the world, with no proven effective therapies (Wang *et al.*, 2020). The outbreak was first identified in Wuhan, China, in December 2019, rapidly spread to all provinces in China and eventually throughout the world. The earliest sign of the virus was reported as severe respiratory failure, which was confused with regular flu and thought to be caused by the normal seasonal influenza virus. Later on, due to the increasing severity of symptoms and the number of infected cases, this virus was declared novel. The virus was identified as a novel coronavirus and named initially as 2019-n CoV (WHO, 2020a).

Severe acute respiratory syndrome-2 (SARS-CoV-2) is the official name given to the 2019-nCoV and COVID-19 is the disease associated with the virus. The infection was declared as a pandemic on 11th March (WHO, 2020a). The virus represents a unique global challenge due to its contagiousness and lethality. It has been believed that the SARV-CoV-2, similar to other coronaviruses, Severe Acute Respiratory Syndrome Coronavirus-1 (SARS-CoV) emerged in 2002 and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) emerged a decade later in 2012, has a zoonotic source. SARS-CoV-2 has infected more people than other coronaviruses and continues to spread rapidly through worldwide (Zheng, 2020).

The close genetic relations of SARS-CoV-1, MERS-CoV, and SARS-CoV-2, suggest that they all have the same origin in bat, but with a different intermediate animals in other to adopt to humans. The virus can transmit from bat to other animal species and mutate in these animals infect humans who are in close contact (Zhao *et al.*, 2004). Genetic analysis showed that coronavirus genomes have 85.5 to 92.4% sequence similarity to pangolin coronaviruses (Lam, 2020).

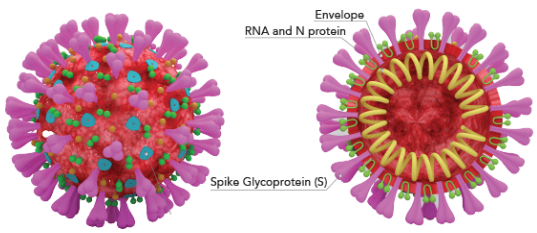


**Figure 1:** Structure of coronaviruses (Lam, 2020).

SARS-CoV-2 is an enveloped, single-stranded RNA virus that causes lethal respiratory tract infection.

**Transmission**

There is a preliminary evidence suggesting that the virus can be transmitted from person to person via direct or indirect contact. It has been long accepted that coughing and sneezing can transmit respiratory viruses through droplets. Coronavirus can remain in the air for nearly three hours, and airborne transmission is suspected to be one of the potential routes for the spreading of the disease (Dietz *et al.*, 2020). Coronavirus has been found in the feces of some COVID-19 patients; however, there has not been any confirmed report of the virus spreading from feces to person (Tang *et al.*, 2020).

**Pathogenesis**

Preliminary evidence suggests that inhaled virus-bearing droplets can deposit directly into the human respiratory tract. Once this virus penetrates deeply into the lower airways of the lung, it recognizes angiotensin-converting enzyme 2 (ACE II) receptor on the surface of alveolar epithelial cells called type II pneumocytes (Sriram and Insel, 2020). The spike (S) protein found on the surface of coronavirus facilitates viral attachment followed by receptor mediated endocytosis. Once the virus enters the host cell, it hijacks the host cell machinery to promote its replication and infects nearby cells. Understanding the mechanism of SARS-CoV-2 could help to identify therapeutic targets and discover a potential treatment (Astuti and Ysrafil, 2020). The virus infects the cell via binding its spike protein to the ACE II receptor, followed by cell membrane fusion. The coronavirus multiples throughout the body and cause more damage and destruction to the lung wall as well as other organs. The body tries to respond to the foreign invader by activating humoral and cellular branches of immune system, which are mediated by B cells and T cells, respectively (Takayama, 2020).

B cells produce antibodies like immunoglobulin M (IgM) and later on, immunoglobulin G (IgG). In the case of COVID-19 infection, B cells first produce IgM and then IgG after 7-14 days (Jacofsky *et al.*, 2020).

Natural killer cells, macrophage and neutrophils are also the main cells involved in viral detection and elimination. SARS-CoV-2 stimulates macrophages to increase their production of interleukin-1 (IL-1), interleukin-6 (IL-6) and tumor necrosis factor (TNF) as a response to the viral infection. The production of pro-inflammatory cytokines can lead to the production of reactive oxygen species (ROS). ROS damages type I and II pneumocytes, which are responsible for gas exchange and production of surfactants,

respectively. This process leads to the acute alveolar damage, reduction of the gas exchange and inability of the production of surfactant (Costela-Ruiz *et al.*, 2020).

Uncontrolled and excessive immune responses may cause immune damage and lead to a hyperinflammatory state, so-called cytokine storm, which is associated with worsening of symptoms and the promotion of lung damage (Ayala *et al.*, 2003).

Accumulating evidence suggests that severly affected patients are more likely to develop cytokine storm syndrome than patients with mild to moderate disease. In cytokine storm syndrome, a large number of cytokines are released in the bloodstream. Cytokine storm is considered to be one of the major causes of acute respiratory distress syndrome (ARDS) and multiple organ failure (Mehta *et al.*, 2020).

**Symptoms**

The main symptoms of infection by coronavirus are fever above 37.8 °C, dry cough and dyspnea (Table 1). Somehow, some patients never develop any symptoms, whereas some healthy people have severe or even fatal pneumonia. Some main factors and underlying medical conditions like severe lung or heart conditions, diabetes, conditions that trigger their immune system, cigarette smoking, and the elderly are at higher risk of severe illness from COVID-19 (Singhal, 2020).

The chest computed tomography (CT) findings in COVID-19 cases show consolidation and peripheral ground glass opacities, which means that the lung is filled up with inflammation and fluid rather than air. The patient may have abnormalities on chest imaging before the onset of symptoms. Thereby, a CT scan can be used for the diagnosis of COVID-19 patient and monitoring patient response to treatment (Kalra, 2020).

The sign and symptoms of COVID-19 patients can differ according to the severity of the disease. A large proportion of COVID-19 patients may be asymptomatic, but the risk of virus transmission is still high (Bikdeli *et al.*, 2020). Signs and symptoms of coronavirus disease have been classified under three groups as mild, moderate and severe. In Table 1 the symptoms of COVID-19 in mild, moderate and severe cases are shown (Garg, 2020).

**Table 1:** Signs and symptoms of COVID-19 disease in mild, moderate and severe cases of disease (Garg, 2020).

| Mild | Moderate | Severe |
|---|---|---|
| Fever (90% of cases) | Dyspnea | Severe pneumoniae |
| Dry cough (70%) | Increased heart rate | ARDS |
| Tiredness (49%) | Soreness from cough | Cytokine storm |
| Muscle pain (15%) | Dry mouth | Multiorgan failure |
| Headache | | |
| Sore throat | | |

**Control and prevention measures of COVID-19**

Informing the public about the early symptoms and preventive measures of COVID-19 to prevent and slow the spread and transmission of the virus. Personal protection, public health and social measures are necessary in order to fight against the pandemic all around the world. Especially high-risk group, including older people, people with chronic health conditions and severe illness, should take in to account the precautions in order to prevent getting infected by COVID-19. To decrease the risk of person-person transmission, it is strictly recommended that mouth and nose should be covered by a mask in public and crowded places, wash hands regularly with soap and water or alcohol-based hand rub. Cover mouth and nose with the flexed elbow or use disposable tissue during coughing and/or sneezing. Keeping social distance and staying at home as much as possible are critical for decreasing the risk of person-to-person transmission (CDC, 2020b; Murthy *et al.*, 2020).

Pharmacists play critical roles in providing guidelines, directing people to reliable resources and educating people about the prevention of infection and management of symptoms during COVID-19 pandemic (Murthy *et al.*, 2020). SARS-CoV-2 outbreak is unique and displays differences when compared to other viral infections. There is still no approved therapies and vaccine for COVID-19. Majority (80%) of the infected individuals recover from the disease without needing special treatment. Self-isolation and quarantine for a while and a regular follow-up by doctor and healthcare provider via the telephone, email and video visits are generally enough for mild cases. Nevertheless, ventilatory support and hospitalization in intensive care unit (ICU) are required, in the case of ARDS and critical ill cases (CDC, 2020a).

**Oxygenation and ventilation techniques in COVID-19 patients**

In COVID-19 patients with respiratory failure, mechanical ventilation should be applied. The duration of mechanical ventilation is adjusted based on the patient's oxygen saturation level (optimum is 95 to 100%). If oxygen saturation does not increase, low flow and high flow nasal cannula non-invasive respiratory support such as continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BiPAP) ventilators that both work via a tube into face mask, can be used. If non-invasive devices, do not boost oxygen levels to optimum level; a tube is inserted into the patient's trachea (endotracheal intubation) with long-lasting sedation to achieve more oxygen delivery (Meng *et al.*, 2020; Yang *et al.*, 2020). Extracorporeal membrane oxygenation (ECMO) can be

reserved as the last choice after the failure of other strategies in patients with COVID-19 respiratory failure. During ECMO, blood is removed from the body and passed through an oxygenator known as an artificial lung and then returned to the bloodstream (Pittman MA, 2020). Although ventilation can be lifesaving in COVID-19 patients, there is a chance for virus transmission to healthcare workers during the ventilation procedure. Ventilation is an aerosol-generating procedure and a high concentration of infectious respiratory aerosol can be exhaled from the patient and the virus stays viable in the airborne particles for about three hours. It is crucial to avoid unnecessary invasive ventilation procedures to the patients with COVID-19 and if necessary this procedures requires the use of appropriate personal protective equipments such as gown, face shield, N95 mask by health care provider and surgical mask by patients who are receiving oxygen by nasal cannula. Such patients should stay isolated in a room with negative airflow. Altogether these strategies can reduce the risk of transmission of the virus (Singhal, 2020).

**Inhaled nitric oxide therapy**

Nitric oxide (NO) is a powerful molecule that is produced by lung endothelial cells and acts as a selective pulmonary vasodilator. NO targets the vascular smooth muscle cells that surround the small arteries in the lung. The United States Food and Drug Administration (FDA) previously has approved the use of NO gas for patients with hypoxic respiratory failure associated with pulmonary hypertension. Based on the previously published findings, inhaled nitric oxide was used by a face mask or mechanical ventilator to treat a limited number of patients with pulmonary complications during the 2003 SARS-CoV outbreak. At that time, inhaled NO helped to improve lung function in severely hypoxemic patients and shortened the length of ventilatory support compared with matched control SARS-CoV patients (Tonelli *et al.*, 2013). Coronavirus can destroy the blood vessels in the lungs, which results in the failure of the production of NO. When NO is deficient, blood vessels constrict and the risk of blood clotting and thrombosis increases. There is a hypothesis that inhaling NO may cure severely ill COVID-19 patients who are already on a ventilator and may help them to get off the ventilator quickly or even prevent people and health care workers from being infected (Poyiadji *et al.*, 2020). Apart from its respiratory effects, NO is believed to have an antiviral activity, which can result in potential benefit against coronavirus infection via preventing viral replication. So far, reported adverse events associated with inhaled NO include the formation of methemoglobin and decrease in the blood

oxygenation level, which is primarily dose-dependent (dose higher than 20 part per million) (de Abajo and Francisco, 2020; Martel *et al.*, 2020).

**Renin-Angiotensin-Aldosterone system inhibitors**

Animal studies suggested that the renin-angiotensin-aldosterone system (RAAS) inhibitor drugs like angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) may increase the expression of ACE II. The same receptor, which is known as an entry point for the SARS-CoV-2 virus, thereby may result in more severe infection and adverse outcomes during the COVID-19 pandemic (Ingraham, 2020). In contrast, other researches have suggested that ACE inhibitor may enhance the vasodilatory and anti-inflammatory properties by converting more angiotensin II to angiotensin 1-7. RAAS inhibitors are a group of drugs that are prescribed worldwide for managing hypertension and heart failure. ACE inhibitors such as enalapril and captopril act by inhibiting the production of angiotensin II. Angiotensin II increases blood pressure and vascular permeability and also has a strong vasoconstriction effect (Herman *et al.*, 2020). ARBs like losartan and valsartan act through blocking the angiotensin I receptors. Hence, they inhibit the binding of angiotensin II to its receptor. ACE II receptor is a key regulatory protein that can degrade angiotensin II to angiotensin 1-7. Angiotensin 1-7 is a vasodilator agent and has hypotensive and anti-inflammatory effects. SARS-CoV-2 downregulates the level of ACE II receptor by binding to it. Therefore, ACE II is unable to exert a protective effect for the body. This situation can result in the production of more angiotensin II and less angiotensin 1-7 that leads to endothelial cell dysfunction. Based on observational database among hospitalized patients with COVID-19 who have underlying cardiovascular diseases and are on medications like ACE and RAAS inhibitors, death rates are unrelated to medications and the relationship between ACE inhibitors or ARBs and death have not been comfirmed yet. The latest data support not to discontinue of ACE inhibitors and ARB medicines during the COVID-19 pandemic (de Abajo and Francisco, 2020).

**Anticoagulant agents in patients infected with SARS-CoV-2**

It has been reported worldwide that individuals can respond differently to the virus. One third of hospitalized patients develop complications related with clotting, in small vessels, deep vein thromboses in the leg, clots in the lung and stroke (Levi *et al.*, 2020). The reason for blood clotting is still unclear. One possibility is that the virus can enter endothelial cells because ACE II receptor is found on the surface of endothelial cells that line the blood vessels.

As a result, the virus damages the endothelial cells by increasing angiotensin II and decreasing angiotensin 1-7 function and activating platelets. The second possible reason can be the overactivation of the immune system, which leads to an imbalance in clotting factors, that can cause clotting or bleeding. Another theory is that patients in ICU are more likely to develop clots, particularly because of being immobile for a while. Blood tests in COVID-19 patients show an elevated level of D-dimer, which is a by-product of blood clotting. An increase in D-dimer level indicates the presence of blood clot and body inflammation (Li *et al.*, 2020).

Multiple studies so far have shown that the use of a prophylactic dose of low-molecular-weight-heparin (LMWH) is associated with a decreased rate of mortality. LMWH is currently being prescribed for COVID-19 patients with coagulopathy in the absence of any contraindication such as active bleeding and platelet count less than 25 x $10^9$ / L. The recommended daily dose is IV 40-60 mg and LMWH is continued until the lab result of a patient turns to normal and the patients is discharged from the hospital. LMWH is preferable over unfractionated heparin due to its more predictable pharmacokinetic characteristic and the lower risk of bleeding. However, LMWH is contraindicated in patients with kidney dysfunction and those whom creatinine clearance is 30 mL/min or less because the decrease in its excretion leads to an increase in the anticoagulation effects (Polderman, 2012).

Because of the risk of venous thromboembolism, pulmonary embolism and renal insufficiency, unfractionated heparin may be a better choice of anticoagulant in COVID-19 patiens because it is extensively cleared by the hepatobiliary system, and protamine sulfate can be given as an antidote in case of bleeding (Kow and Syed 2020; Millar and Laffan, 2017). Thus far, no studies have identified a beneficial effect of aspirin in COVID-19 cases.

**Systemic corticosteroid**

Patients with severe COVID-19 pneumoniae had markedly increased inflammatory markers such as C-reactive protein, IL-6 and may have cytokine storm syndrome. It is well-known that corticosteroids have potent anti-inflammatory action. In the past, steroid administration did not improve the outcome and reduce the risk of death in patients with SARS-CoV and MERS-CoV but also delayed and impaired viral clearance and increased the risk of secondary infection (Hadjadj, 2020).

In June 2020, Oxford University published a randomized clinical trial to test the potential beneficial use of corticosteroid in

COVID-19 patients. They declared that dexamethasone is the first drug shown to save the lives of critically ill COVID-19 patients on ventilators. In this clinical trial, patients received dexamethasone 6 mg per day either orally or intravenously for ten days and the outcome was compared with that of control group. The researchers concluded that the death rate was reduced by one-third in ventilated patients and by one-fifth in patient, who received oxygen only. There was no benefit among those patients who did not require respiratory support. In people with COVID-19, corticosteroids may theoretically modulate the inflammatory response and reduce the risk of developing ARDS. However, there is currently limited evidence on the topic and clinical trials have still being carried out (Brotherton *et al.*, 2020).

**Chloroquine and hydroxychloroquine**

Chloroquine (CQ) and hydroxychloroquine (HCQ) are FDA approved drugs for the treatment of malaria and lupus rheumatoid arthritis. Researches have suggested that these drugs could possibly be effective in the treatment of COVID-19. FDA issued an Emergency Use Authorization on 27 March 2020, allowed the use of these drugs, under careful heart monitoring, in COVID-19 patients who are admitted to hospitals with evidence of pneumoniae. HCQ and CQ are alkaline compounds. I*n vitro* studies show that CQ and HCQ increase the pH of the lysosome and endosome inhibiting SARS-CoV-2 replication. An interesting new finding demonstrated that HCQ acts as a zinc ionophore that allows the influx of zinc into cells and lysosomes. There is a hypothesis that HCQ or CQ plus zinc supplementation may be more effective in reducing COVID-19 morbidity and mortality. However, on 15$^{th}$ of June 2020, FDA stated that according to ongoing analyses and recent results from a large, randomized clinical trial in hospital, these two drugs resulted in little or no reduction in the likelihood of death or recovery time but prolonged QT interval and led to ventricular arrhythmias and torsades de pointes that leads to sudden cardiac death. Therefore, the potential benefits of CQ and HCQ no longer outweigh their risks (Mehra *et al.*, 2020).

**Lopinavir/ ritonavir**

The combination of lopinavir and ritonavir is used to treat Human Immunodeficiency Virus (HIV). Lopinavir/ritonavir is classified under protease inhibitors. Lopinavir is an antiretroviral agent given together with ritonavir, which is a potent CYP3A4 inhibitor that helps to increase the level of lopinavir in serum (Chandwani and Shuter, 2008).

There was a hope that these medicines could be effective in the treatment of SARS-CoV-2. On 4$^{th}$ July 2020, WHO announced that hydroxychloroquine and

lopinavir/ritonavir had little or no reduction in the mortality of hospitalized patients when compared to standard care protocols (WHO, 2020b).

The common side effects of lopinavir/ritonavir include gastrointestinal disturbance and diarrhea. Drug interactions with ritonavir are common due to the inhibition of CYP3A4 enzyme activity that leads to an increased level of co-administrated drug which is metabolized by the enzyme (Chandwani and Shuter, 2008).

**Remdesivir**

Remdesivir is an antiviral drug that is still under investigation and has not been approved by the FDA for any use. It was developed in 2009 as a possible treatment for Hepatitis C and tested for Ebola virus in 2015. During the Ebola epidemic it was not found to be effective enough. In May 2020, FDA issued an emergency use authorization for remdesivir in the treatment of COVID-19 in adults and children with severe disease. FDA defined severe disease as a patient with low blood oxygen levels who needs oxygen therapy or more intensive breathing support such as mechanical ventilation. Remdesivir is a prodrug and turns to its active form called GS-441524, which is known as a adenosine nucleoside analog (FDA, 2020). *In vitro* study shows that remdesivir prevents further replication of viral RNA once it gets incorporated leaving the RNA strand incomplete. A literature review concluded that remdesivir treated patients had shortened recovery time and improvement in the lower respiratory tract infection when compared to the placebo group. Observational studies revealed that remdesivir should be used in the early stage of the disease and the treatment should start with a 200 mg intravenous infusion on the first day, followed by 100-mg a day for at least four consecutive days and not more than nine days for the intubated patient (David Norrie 2020; Wang *et al.*, 2020).

The common side effects of remdesivir are reported to be anemia, decreased hemoglobin, hyperglycemia and transaminitis (Fan *et al.*, 2020).

**Favipiravir**

Favipiravir is a broad spectrum antiviral prodrug that has been approved in Japan for the treatment of influenza virus infections. The mechanism of action of this drug is to selectively inhibit RNA polymerase and prevent the replication of the viral genome. Favipiravir has a similar mechanism of action to remdesivir but is orally administrated (Wang *et al.*, 2020). Clinical trials have been performed all over the world to assess the efficacy of favipiravir in the treatment of COVID-19 infection. Researches showed that the high concentrations of favipiravir shorten the viral clearance and lead to improvement in

chest imaging of mild and moderate cases. Similar to other antiviral drugs, favipiravir should be admimistered early after the onset of symptoms in order to be effective to reduce the viral load in blood. Diarrhea, liver toxicity and hyperuricemia were reported as adverse effects in some patients. Thus, the concerns related with the safety of favipiravir is still under investigation (Singhal, 2020).

**Interleukin-6 inhibitors**

Cytokine storm which is which is marked by an elevated level of various chemokines such as IL-1, IL-6 and IFN in serum is associated with high mortality and increased death rates among severe cases of COVID-19. It has been suggested that targeting the inflammatory mediators such as IL-6 may help decrease the inflammatory response, thus reducing the severity of disease such as acute respiratory syndrome. Tocilizumab is an immunosuppressive drug that targets chemokines by binding to IL-6 receptors (Costela-Ruiz *et al.,* 2020). The drug has FDA approval for the treatment of rheumatoid arthritis and cytokine release syndrome. Tocilizumab is an option in patients with severe respiratory symptoms associated with COVID-19. Many clinical trials are undertaken to evaluate the safety and efficacy of the treatment. However, there is still no evidence for the appropriate time to begin the drug. If tocilizumab is administered in the early stage of infection, it can supress the immune system, which is responsible for fighting against the virus. On the other hand, the treatment strategy should be done as early as possible before IL-6 gives the damage (Atal and Fatima, 2020). Tocilizumab consumption poses a risk of severe infections such as upper respiratory tract bacterial infections, skin and soft tissue infections and is not recommended for COVID-19 patients with bacterial pneumonia (Zhang *et al.,* 2020).

**Convalescent plasma therapy**

After exposure to an infectious agent, the body's immune system response against the agent by producing IgM antibodies within the first week of symptom onset. IgM then gradually decreases where as the level of IgG antibodies increases after 12-17 days following the infection. IgG persists for a relatively longer period than IgM. Antibodies are crucial for the body to fight against infection. These antibodies are found in blood plasma. Convalescent plasma therapy is an experimental treatment and has not been approved for any use by the FDA (FDA, 2020). Through the process, healthcare providers collect the plasma that contain antibodies from COVID-19 patients who have recovered and meet all donor eligibility requirements by FDA. The plasma is then administered to patients who have been infected with SARS-CoV-2 so that the antibodies already

present in the plasma neutralizes the viruses and prevent the entry of the virus in to new cells. Researchers hope that convalescent plasma can be helpful in severe COVID-19 patients. However, this investigational treatment has not yet been confirmed to be safe and effective (Jacofsky *et al.*, 2020).

The possible risks for this therapy are allergic reactions, lung damage, difficulty breathing and transmission of other blood-borne infection such as HIV, hepatitis B and Hepatits C. In order to rpeevent to transmission of blood-borne pathogens, donated blood must be screened for safety as outlined by FDA (Rajendran *et al.*, 2020).

## CONCLUSION

In addition to the public health crisis, which results in large-scale loss of life, the COVID-19 pandemic has negatively been affecting the social life, economic and financial markets across the globe. Although seven months have passed, there are still questions and mysteries about how SARS-CoV-2 causes severe disease, how it leads to death in some patients and whether a vaccine or an antiviral drug can be developed to end the pandemic (Murphy *et al.*, 2020). The benefits of some of the potentially effective treatments that are listed in the present review are likely outweigh the adverse events in a short course of treatment. However, the evidence remains unfinished and new information replace the old one day by day. Careful consideration should be given and effective prevention measures should be taken in order to minimize the risk of the transmission of the virus (Burki, 2020). It is recommended strictly by the Center of Disease Control and Prevention (CDC) wearing a medical or cloth face mask in public settings, maintaining physical distance of at least one meter, washing hands regularly, performing alcohol-based hand rubbing, avoiding touching eyes, nose and mouth (CDC, 2020b). Following these simple behaviors can limit the spread of the virus. Governments should increase the rate of diagnostic testing in order to follow up the spread of the virus accurately. It has already been shown that the rate of recovery is higher than the rate of death rate. However, it is not yet definite that people who have recovered from COVID-19 will be protected from reinfections. Overwhelming efforts of healthcare providers including doctors, nurses and pharmacists to manage and care for the health crisis is noble and appreciable to keep people safe and provide supportive care for COVID-19 way (CDC, 2020b; Rosenbaum, 2020)

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