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Review Article

COVID-19: Implications Regarding the Currently Known Properties and Behaviors of the Coronavirus Disease 2019

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Abstract

The novel coronavirus SARS-Cov-2 or COVID-19 has created a global pandemic, and currently, no medically-approved treatment exists. SARS-Cov-2 acts similarly to SARS-CoV-1. The virus can survive a few hours in the air and up to seventy-two hours on distinct surfaces. The coronavirus mutates by introducing sequence errors in the host's RNA genome or by modifying proteins and enzymes. Social distancing and isolation are the most generally practiced management of COVID-19 in the world. At the time of this research, the most frequently utilized experimental pharmacological treatments for infected patients are hydroxychloroquine/azithromycin and the anti-viral remdesivir. Suggested non-pharmacological treatments consist of vitamin C, vitamin D, and zinc supplementation, which boost the immune response at the cellular level.

COVID-19 demonstrates an increased mortality rate in the elderly population and those with comorbid conditions. Pre-existing obesity, cardiovascular disease, and diabetes correlate with increased mortality. Outcome-effecting factors include viral load, viral mutations, and pre-existing conditions. Genomic studies of the virus reveal numerous variants.

The virus is spread by respiratory droplets—by inhaling coughed particles or touching susceptible membranes after contacting contaminated surfaces on which these droplets have been deposited. The virus thrives for 3 hours in the air and 4–72 hours on solid surfaces (depending on the surfaces' material). SARS-CoV-2 targets the upper and lower respiratory tracts principally, affecting other organs, mostly the heart and the brain, and thromboses in the liver, heart, and kidney.

The locale of SARS-CoV-2 emergence lacks concensus. The original assumption was that the virus emerged at the Hunan seafood market in Hubei Province, China. It was posited that a mutant version supposedly passed from an animal to human hosts. Social distancing and isolation are the most widely practiced management methods in preventing SARS-CoV-2 infections globally. Contrasting opinions suggest the quarantine and isolation of the 1% of the most virus-vulnerable population (the elderly, immunocompromised, and those with pre-existing conditions), while permitting the healthier population to be exposed to the virus to develop herd immunity.

The most employed experimental pharmacological treatments for infected patients are hydroxychloroquine/azithromycin and the anti-viral remdesivir. Remdesivir showed efficacy against multiple filo-, pneumo-, paramyxo-, and corona-viruses. Suggested non-pharmacological treatments include vitamin C, vitamin D, and zinc supplementation. The applications of ultraviolet (UV) light and riboflavin to eradicate SARS-Cov-2 have been considered.

COVID-19 has an increased mortality rate for the elderly and those with comorbidities.

Pre-existing conditions, such as obesity, cardiovascular disease, and diabetes, correlate closely with increased mortality. Obesity Is the most significant contributing factor after age. Hospitalized patients are more likely to be male with substantially more comorbidities than non-hospitalized patients, particularly cardiovascular disease.

Viral load, viral mutations, and pre-existing conditions strongly affect outcomes—patients who carried a higher viral load showed higher mortality than those with a lower viral load. It is opined that the number of deaths attributed to COVID-19 is not being calculated precisely and that the number of deaths might be much higher than reported.

At the time of this original research, there were several methods underway in developing a SARS-CoV-2 vaccine as follows: using inactivated virus particles to create an immune response, genetically engineering proteins, and a new technology of utilizing the virus's mRNA spike protein to induce immune system antibodies (a significantly rapid process). Convalescent plasma therapy is being studied for efficacy. Convalescent plasma is blood from a recovered patient containing antibodies to the virus, improving recovery chances. At the time of this publication, several vaccines have been developed and large-scale vaccination programs are underway.

Future research should focus further on prevention practices, comorbidities, genetic prevalence, reliable and systematic country-by-country reporting procedures, scrutiny regarding the efficacy of current vaccines, and the pursuit for innovative vaccines for the current virus and its variants.

Keyword: *COVID-19; SARS-CoV-2; Coronavirus; Convalescent Plasma; Remdesivir; Hydroxychloroquine*

Abbreviations

Ad5: Adenovirus-5; CFR: Case Fatality Rate; DHS: Department of Homeland Security; FDA: (US) Food and Drug Administration; UV: Ultra-violet

Preface

The following review is the culmination of months of research. This research, however, was formed before the most up-to-date findings and developments regarding COVID-19, particularly the advent of vaccines, large-scale vaccination programs, and further knowledge of the ineffectiveness or inadequate efficacy of various medications, hydroxychloroquine, and combinations thereof. Nevertheless, most of the data and information provided herein remain relevant. Rather than deliver another extensive revision of this work (which has gone through various versions, fundamentally extracted and abridged from prior doctoral research), the authors offer this supplementary preface instead, trusting that the reader will pardon any time-relative defects while availing themself to most of the data and information presented. Wherever possible, brief addenda have been added following the few outdated statements.

Introduction

The novel coronavirus SARS-Cov-2 or COVID-19 has caused a global pandemic rapidly, and there is currently no medically approved treatment protocol. The challenge of research is that the data being published is constantly evolving [1].

The Lancet Respiratory Medicine (2020) reported that SARS-Cov-2 behaves similarly to the original SARS-CoV-1 in that both viruses utilize two proteins in the body to infect cells. Respiratory droplets spread the virus from an infected person to another person nearby or by someone touching an infected surface [2].

Tang (2009) demonstrated that the virus could exist from a few hours in the air to up to seventy-two hours on particular surfaces. Heat and humidity may affect viral survivability. Thus, some predictions have been presented that the amount of viral transmission may decrease once summer temperatures arrive. Sunlight is another existing environmental factor that appears to decrease viral survivability of the virus. Thus, being outdoors may decrease the possibility of transmission [3].

Denison., *et al*. (2011) described the coronavirus as mutating by introducing sequence errors into the host's RNA genome or modifying proteins or enzymes [4]. Further research is needed to determine the extent and speed at which the virus mutates to develop a variety of effective vaccines against the virus and any variants. (Regarding the currently available vaccines, their long-term effectiveness remains to be seen as well as their effect on variants).

Qian and Jiang (2020) noted that the most widely practiced management of COVID-19 in the world is social distancing and isolation [5]. This management protocol aims to decrease the transmission rate by "flattening the curve" and not overwhelming the healthcare system. Nevertheless, without herd immunity, if another another outbreak occurs, the cycle will begin again.

The most frequently applied experimental pharmacological treatments for infected patients are hydroxychloroquine/azithromycin and the anti-viral remdesivir [6]. The three drugs are approved to treat conditions other than COVID-19. Many physicians are concerned about these medications' potential side effects with off-label use. Hence, they must balance medicines versus treating patients supportively with no pharmaceutical intervention. Non-pharmacological treatments being suggested are vitamin C, vitamin D, and zinc supplementation. When supplemented to therapeutic dosage, all three have shown efficacy in boosting the immune response at the cellular level [7].

Sanyaolu., *et al.* (2020) noted that COVID-19 has an increased mortality rate for the elderly and those with comorbid conditions [8]. Liu., *et al.* (2020) stated that the virus is disproportionately lethal to the over-60-age group population due to immune system changes as

the body ages. Such immune system changes include a decreased cellular response due to the underproduction of T cells and B cells, the degeneration of the thymus gland and lymphoid tissue, and a more significant inflammatory response with age [9].

Flaherty., *et al.* (2020) observed that pre-existing obesity, cardiovascular disease, and diabetes correlate closely with increased mortality [10]. Overall, obese patients tend to have multiple health issues at the same time, such as high blood pressure, elevated cholesterol, cardiovascular conditions, diabetes, and depressed breathing abilities, which are risk factors for mortality [10].

Factors that can affect outcomes include viral load, viral mutations, and pre-existing conditions, as determined by Meyerowitz., *et al.* (2021) [11]. Robson (2020) reported on retrospective studies from China that a higher viral load in patients (for more prolonged periods) resulted in higher mortality. Also, the virus's current genomic studies show that variants are abundant, with six mutations in the virus's S-protein (spike structure). However, at this time, the mutations have not shown significant pathogenicity [12]. As discussed previously, patients with pre-existing conditions such as obesity, cardiovascular disease, or diabetes have worse outcomes from COVID-19.

In four study populations (Khafaie and Rahim, 2020), the case fatality rates (CFRs) revealed that China and the US were close at 5.5% and 5.7%, Italy was very high at 13.5%, and Taiwan was very low at 1.4% [13]. (The CFR is calculated as the number of deaths from a disease/number of diagnosed cases of a disease.) Ioannidis., *et al.* (2020) argued that the actual mortality rate might be closer to 0.5% [14].

Amanat and Krammer (2020) reported that several pharmaceutical companies are developing the first vaccines for SARS-CoV-2. However, it will take time to determine if these vaccines will meet the desired goals and bring an end to the pandemic [15]. (At the time of this publication, vaccines are available; however, it still their long-term effectiveness remains to be determined; also, the appearance of variants must be considered.)

Discussion

Characteristics of SARS-CoV-2

SARS-CoV-2 is a large coronavirus with multiple spike proteins covering its outer spherical surface. Its mode of infection is by utilizing two proteins in the host to attack the cells ACE2 receptors to bind to the cell and TMPRSS2 enzyme, which primes the spike protein bound to ACE2, mediating infection of the cell. Through genetic and cellular database studies, researchers have learned that there are several types of cells in the human body that express both proteins: Type II pneumocytes in the lungs, enterocytes in the intestinal walls, goblet cells of the nasal passages, endothelial cells of vascular tissues, and epidermal keratinocytes of the skin [16–18].

A study by Chinese researchers Wang., *et al*. (2020) confirmed specific tissues in which the virus RNA was most frequently found. They concluded from RT-PCR (reverse transcriptase-polymerase chain reaction), that COVID-19 was found in lung washing 93% of the time, sputum 72% of the time, nasal swabs 63% of the time, throat swabs 32% of the time, feces 29% of the time, and blood 1% of the time [19].

The World Health Organization (2020) outlined that the virus is spread exclusively by respiratory droplets—either by inhaling coughed particles or contacting susceptible membranes after touching surfaces on which these droplets have been deposited. Thus, the recommendations for staying at least six feet apart from another person. The transmission occurs when someone touches their mouth, nose, or eyes after touching an infected surface, allowing the virus entry into the respiratory system [20]. The Centers for Disease Control and Prevention (2020) cautioned that air-particle transmission could occur with prolonged exposure to infected patients; health care workers with direct contact with these patients should wear at least an N-95 rated mask, face mask, and gloves at all times [21].

Data collated by van Doremalen., *et al.* (2020) showed that the virus thrives for 3 hours in the air and 4–72 hours on solid surfaces (depending on the material: SARS-CoV-2: copper 3.4h, cardboard 8.45h, steel 13.10h, and plastic 15.90; SARS-CoV-1: copper 3.76h, cardboard 1.74h, steel 9.77h, and plastic 17.70h) [22]. There appears to be is no direct correlation in the increase or decrease of viability times between the two variants.

Research conducted by the Department of Homeland Security (DHS) (2020) revealed preliminary data regarding the ameliorating effects of sunlight, temperature, and humidity. The DHS study found that full sunlight, similar to the sun's intensity at noon on a summer day, effectively reduced viral load by half in a saliva droplet in approximately two minutes. Ultraviolet rays sever DNA and RNA into fragments, affecting the virus RNA structure. The DHS found that the virus dies faster in saliva droplets at higher temperatures. Regarding humidity, it was found that the virus is less stable in higher humidity and degrades more rapidly [23].

Huang., et al. (2020) reported that about 60.0% of confirmed cases of coronavirus disease 2019 (COVID-19) occurred in places where the air temperature ranged from 5°C to 15°C and peaked in cases at 11.54°C. Moreover, approximately 73.8% of the confirmed cases were concentrated in regions with absolute humidity of 3 g/m^3 to 10 g/m^3. SARS-CoV-2 appears to be spreading toward higher latitudes. These findings suggest an optimal climatic zone in which the concentration of SARS-CoV-2 markedly increases in the ambient environment (including the surfaces of objects). These results strongly imply that the COVID-19 pandemic may spread cyclically, and outbreaks may recur in large cities in the mid-latitudes in the autumn months [24].

SARS-CoV-2 mutates by sequence errors in its RNA genome by changing its proteins/enzymes [25]. It differs from flu viruses in that they proofread their replicating genomes and excise pieces of the RNA that are aberrant, thus decreasing the number of virus mutations in a specific period [26]. The other area the virus can mutate is in its protein structures. Scientists have found at least six variations of the spike protein combined with genomic mutations [27]. Kennedy and Read (2020) opined that although many mutation variations are being identified, their pathogenicity seems relatively stable—meaning an effective vaccine treatment could be developed with long-term efficacy as fewer mutations typically mean less resistance to treatment [28]. (At the time of this publication, vaccines are available; however, their long-term effectiveness remains to be determined; also, the appearance of variants must be considered).

SARS-CoV-2 mainly targets the upper and lower respiratory tracts mainly. However, Fox., *et al*. (2020) implicated its effects on other organs, most notably the heart and brain [29]. Lung tissue, especially areas with alveoli, becomes damaged or destroyed by inflammatory reactions. Thus, causing blood plasma to leak across the endothelial cells into the lungs, leading to a slow and persistent buildup of fluid in the lungs, eventually leading to death. Patients who have died from COVID-19 have exhibited microangiopathies and substantial amounts of blood clots in the lungs, contributing to death [29].

Rapkiewicz., *et al.* (2020) observed thromboses in other organs, such as the liver, heart, and kidney. The blood clots can lead to multiple organ failure—as seen in COVID-19 patients [30]. Bryce., *et al.* (2020) posited that SARS-CoV-2 infections result in widespread heart necrosis without inducing typical lymphocytic myocarditis symptoms. Autopsies revealed the near-universal absence of lymphocytes in cardiac muscles, despite large swaths of dead cardiac muscle cells [31]. The effect of SARS-CoV-2 infections on the brain and central nervous system can be seen relatively early. Patients have reported changes in their sense of smell and becoming lethargic as some of the earliest symptoms. Those individuals not requiring hospitalization suffer from persistent fatigue and exhaustion [30,31].

Liu., *et al.* (2020) considered that this pathophysiologic progression leads to coma [9]. From autopsies of crucial brain areas, Solomon., *et al.* (2020) confirmed that—in patients who died from a COVID-19 infection—multiple blood clots were present in the brain, presumably leading to oxygen-deprivation and loss of several brain areas [32].

Ciotti., *et al.* (2020) conveyed that the location of SARS-CoV-2 emergence lacks consensus [33]. Initial opinions placed its origin at the Hunan Seafood Market in Hubei province, China, where a mutated version supposedly jumped from an animal to human hosts. This hypothesis is supported by sequence similarities between human SARS-CoV-2 and similar coronaviruses widespread in mice, bats, pangolins, and other species, as reported by Dallavilla., *et al.* (2020) [34]. There is ample evidence that SARS-like coronaviruses can spread from bats to humans via zoonotic transmission [35]. However, animal-to-human transmissions of viral diseases typically come from the Southeast of China, not Wuhan, a more central part of China.

The Wuhan Institute of Virology is located near by to the seafood market, first identified as the source of the COVID-19 outbreak. Raposa (2020) supposed the possibility that bats and other animals carrying the coronavirus were studied in the institute and managed to escape, infecting other animals [36]. A paper concluded that SARS-CoV-2 must have been the result of laboratory experiments, based on the observation that the virus contained a large part of sequences found in HIV. However, it was unclear whether the sequences were sufficiently unique to exclude a virus's zoonotic transmission. Thus, the paper was withdrawn. Nevertheless, it remains possible that the virus sequence was chiefly typical but exited at one point from the lab [37,38].

Management and treatment of COVID-19

Currently, the most widely practiced management of COVID-19 in the world is social distancing and isolation. According to Lin., *et al*. (2020), these management practice goals are to decrease the transmission rate in the population, flattening the curve, and not overwhelming the healthcare system. Although current reports in the US show that in most of the regions outside of the hotspots (such as New York City and New Jersey), medical personnel are being furloughed or working fewer hours as patient volume and procedures have dramatically decreased [39]. (More current data has superseded the preceding statement).

Due to social distancing, less of the population is being exposed to the virus. Without a majority of the population being exposed to the virus and producing antibodies against the virus, it may continue to spread—without an effective vaccine. (At the time of this publication, vaccines are available; however, their long-term effectiveness remains to be determined; also, the appearance of variants must be considered). Social distancing slows the spread of the virus, but this infection cycle might repeatedly occur.

Yoannidis (2020) proposed an unorthodox approach. Quarantine and isolate 1% of the most vulnerable population to the virus (elderly, immunocompromised, and pre-existing conditions) and allow the remainder of the healthy population to be exposed to the virus. With symptoms ranging from none to severe flu for most of the population, herd immunity could be achieved in a shorter amount of time, halting the spread of COVID-19 [40].

Franks (2020) suggested that Sweden could be used as a model for this perspective. Sweden is one of the few countries in Europe that did not lock down the entire population and allowed schools and businesses to reopen. The government of Sweden recently stated that the population is approaching herd immunity from exposure. The overall data is mixed as Sweden's mortality rate from COVID-19 is 10th globally at 17.3 deaths/100,000. If this population acquires herd immunity, a significant decline in infection and death might occur in the coming months [41].

Arshad., *et al.* (2020) confirmed that the most utilized experimental pharmacological treatments for infected patients are hydroxychloroquine/azithromycin and anti-viral remdesivir [42]. (However, more current research has cast doubt on the efficacy of this drug combination in such application.) Frediansyah., *et al.* (2021) described hydroxychloroquine as a medication used for malaria, lupus, and rheumatoid arthritis. Its typical side effects are headache, dizziness, nausea, vision changes. Azithromycin is a macrolide antibiotic used for bacterial infections, such as ear infections, sore throat, pneumonia, STDs, and malaria. Its typical side effects are nausea, diarrhea, anaphylaxis allergic reaction, and QT prolongation affecting heart rate. Remdesivir is an anti-viral created initially for the treatment of Ebola and Marburg virus infections. The researcher's laboratory investigation discovered that remdesivir demonstrated efficacy against multiple filo-, pneumo-, paramyxo-, and corona-viruses [43]. The drug's mechanism of action blocks RNA-dependent RNA polymerase, causing replication of the virus to cease. Common side effects are nausea, vomiting, and possible liver damage [44–46].

Hemilä and Chalker (2020) suggested non-pharmacological treatments with vitamin C, vitamin D, and zinc supplementation [47]. Vitamin C is a potent antioxidant, contributing to the immune system by supporting epithelial barrier function against pathogens and decreasing oxidative stress. It helps with the cellular processes of chemotaxis and phagocytosis. Vitamin C assists in the transformation of T cells and the production of interferon. It prevents and treats both respiratory and systemic infections. Side effects include nausea, diarrhea, and kidney stones from excessive dosage [47–49].

Vitamin D has several mechanisms that reduce the risk of infection. It can lower viral replication rates, reduce inflammatory cytokines that cause damage to linings of the lungs, and increase anti-inflammatory cytokines. Some observational studies and clinical trials reported a decrease in influenza rates with vitamin D supplementation. Side effects include nausea, constipation, kidney stones, bone pain, and confusion [49].

Zinc is essential for developing cells mediating immunity, such as neutrophils, NK cells, and T and B cells. It can prevent free-radical injury to cell membranes. Cytokine production and phagocytosis are affected by levels of zinc in the body. Zinc is involved in fundamental cellular functions, such as DNA replication, RNA transcription, cell division, and cell activation. Side effects include nausea, vomiting, diarrhea, taste changes, and increased infection rate [50,51].

The applications of ultraviolet (UV) light and riboflavin to eradicate SARS-Cov-2 have been considered. An experiment revealed that after the virus was introduced into plasma and platelet units, treatment with UV light and riboflavin, a vitamin B complex, reduced the virus below detectable limits while maintaining blood product quality [52].

Factors affecting mortality rates and outcomes

Data has shown that COVID-19 has an increased mortality rate for the elderly and those with comorbidities. The virus is disproportionately lethal to the over-60-years-of-age population due to immune system changes as the human body ages: fewer T-cells to fight infections; fewer B-cells, which produce antibodies against viruses. Cytokine storms occur more frequently in older patients—males having more cytokine-producing cells than females. Montecino-Rodriguez., *et al*. (2013) offered a list of possible interventions to rejuvenate the aging immune system [53].

Petrilli., *et al.* (2020) reported that pre-existing conditions, such as obesity, cardiovascular disease, and diabetes, correlate closely with increased mortality. The most extensive US study of COVID-19 revealed that obesity was the most significant single chronic factor after age. Hospitalized patients were more likely to be male than female (62.6% vs. 39.0%) and had substantially more comorbidities than non-hospitalized patients, particularly regarding cardiovascular disease (44.6% vs. 16.4%), diabetes (31.8% vs. 5.4%), and obesity (39.8% vs. 14.5%). In a maximum information-gain decision-tree for admission, the most important feature at the top-level branch point was age > 65, obesity, then cardiovascular disease, followed by diabetes [54].

Zou., *et al*. (2020) suggested the following factors affecting outcomes: viral load, viral mutations, and pre-existing conditions [55]. Viral mutations and pre-existing conditions have been described above. Retrospective studies showed the following:

- The median duration of viral shedding was 20 days in survivors.
- SARS-Cov-2 was detectable until death in non-survivors.
- Severe lymphopenia was observed until death in non-survivors.
- Higher viral loads are detected soon after symptom onset.
- Viral loads were similar in asymptomatic and symptomatic patients, confirming the potential of asymptomatic spread.

In patients who carried a higher viral load for longer durations, results correlated in increased mortality. Nasal swabs on the same patients revealed higher viral load than throat swabs, suggesting the virus has a predilection for nasopharyngeal tissue [55].

The following data, adapted from *Mortality Analysis* (Johns Hopkins University School of Medicine, 2020), compared the mortality rates of COVID-19 in various countries, using CFRs and deaths/100,000 in four study populations. Due to testing limitations worldwide, this data is limited and should be deemed reasonable estimates, but not exact [56].

China

- Case Fatality Rate: 5.5%
- 0.33 deaths/100,000.

Italy

- Case Fatality Rate: 13.5%
- 44.09 deaths/100,000.

United States of America

- Case Fatality Rate: 5.7%
- 16.77 deaths/100,000.

Taiwan

- Case Fatality Rate: 1.4%
- 0.03 deaths/100,000.

Italy's COVID-19 mortality rate is among the highest in the world due to the country's steep elderly population and those with co-morbidities. Age, smoking, and obesity are all driving factors in this high percentage. Taiwan has done an exceptionally well in limiting exposure from travelling to and from China at the beginning of the pandemic. Along with proactive testing and quarantine for the at-risk population, Taiwan was able to keep the viral spread low [56].

The conundrum is why the US rate is on par with China's numbers when the US medical system is more technologically advanced than China. Perhaps the answer is that the US is not as totalitarian as mainland China. China was able to "wall off" nearly entire cities and regions from the outside world. It would take extraordinary measures for Martial Law to be approved by the US government. Even with social distancing and the shutdown of non-essential businesses, there is not a complete quarantine process. The entire US population can still go to grocery stores, banks, gas stations, pharmacies, post offices—where there are possibilities for asymptomatic spread. It seems that the US needs to decide whether a total lockdown is a choice or would herd immunity be the best option for this country [56].

Wu., *et al.* (2020) argued that many more infected and recovered cases are unknown; thus, the actual mortality rate may be closer to 0.5% [57]. Further, they reported that some researchers have stated that the number of deaths attributed to COVID-19 is not being calculated accurately and that the number of deaths might be much higher than reported [57]. It will take time and retrospective studies to reveal this pandemic's actual mortality rate.

Future of SARS-CoV-2 treatment and vaccines

Cohen (2020) conveyed that, currently, there are several approaches to developing a SARS-CoV-2 vaccine: using inactivated virus particles to cause an immune response, genetically engineering proteins, and the new technology of using the mRNA of the virus spike protein to develop antibodies by the immune system (which is a much faster process) [58].

The company Moderna is using the mRNA approach, which is in Phase I of clinical trials. Sinovac Biotech is developing a SARS-CoV-2 vaccine by chemically inactivating whole virus particles and adding the immune–booster alum. The advantage of this technique is that

manufacturing plants are already in place for this technology. CanSino is testing another approach, using a non-replicating version of adenovirus-5 (Ad5), which also causes the common cold, as a "vector" to carry in the gene for the coronavirus spike protein [58].

Gilead company recently released data on its clinical trial of the anti-viral remdesivir in Phase III, but the results were disappointing. Gilead released a statement that the report was not a finished product and should not be considered factual data [59].

According to a CDC report (updated April 23, 2021), currently, the US has three approved and available vaccines (Pfizer-BioNTech, Moderna, and Johnson & Johnson / Janssen); many countries in Europe have available these three vaccines plus the Astra Zeneca vaccine.

Convalescent plasma therapy is another treatment method being investigated for efficacy against SARS-CoV-2. Joyner (2020) described that convalescent plasma is blood from a recovered patient containing antibodies to the virus. If this plasma is administered to a COVID-19-afflicted patient, the antibodies will enhance recovery chances [60]. The US Food and Drug Administration (FDA) has recently established guidelines regarding collecting and administering plasma for trial studies as the treatment is currently not FDA approved.

Conclusion

The SARS-CoV-2 or COVID-19 pandemic has presented a worldwide challenge to contain a deadly disease, easily spread between people through surfaces and droplets. While it may have been an excellent decision to close the borders to travelers from countries with confirmed COVID-19 outbreaks, individuals may still have carried the virus without showing symptoms and traveled to other locales and countries. While the wearing of surgical masks may significantly reduce person-to-person transmission, protection is not 100% effective. As SARS-CoV-2 virus particles can persist on surfaces for a more extended time than in air droplets, a distinct possibility exists that people can become infected despite wearing a mask. A typical SARS-CoV-2 infection moves from the initial infection to an inflammatory reaction and cytokine storm, which can then further devolve into ARDS, at which point symptoms can only be managed until the patient's body becomes strong enough to fight the infection off on its own. Currently, the leading drug is HCQ, either alone or in combination with azithromycin.

Notably, concerning the spread of SARS-CoV-2, while some countries seemed to have had better outcomes than other countries regarding case fatality rates and infections, the differences in how the virus spread may have been significantly affected by the wearing of masks, lockdown procedures, and social distancing measures. However, it may also be that the relative incidence of comorbidities, such as age, obesity, and heart disease is a more significant determinator of death rates within a population. Genetic factors and reporting procedures should also be considered regarding the discrepancy of country-specific outcomes.

Future research must focus on prevention methods, comorbidities, genetic prevalence, uniform and consistent country-by-country reporting procedures, analysis of the efficacy of current vaccines, and the search for novel vaccines for the current virus and any current and future variants.

Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

Supplementary Note

This paper is based on prior doctoral research: Chen M.H. (2019). "SARS-CoV-2: Dynamic Stimulation and Control of the Immune System by Integrated Therapies" (unpublished doctoral dissertation).

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