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An Insight into Post COVID-19 Interventions

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Abstract

The World Health Organization has labelled the current COVID-19 outbreak a worldwide public health emergency of international significance (WHO). The latest data on 7.86 L cases and 5,30,740 death records globally (until February 1, 2023) illustrate the severity of this viral illness. According to WHO estimates through February 1st 2023, COVID-19 infection is a pandemic, surface-to-surface infectious illness with a case fatality rate of 1.2%. The only options available to combat COVID-19 are vaccination and the implementation of an efficient preventative strategy. Also, a retrospective examination offers data that raises the question of how crucially important preventative efforts were in containing the 2003 SARS outbreak. The potency of surface disinfectants, the makeup of hand sanitizer, and the right material used to create personal protective equipment are all essential components of preventative measures' efficacy (PPE). During COVID-19, antiviral medications, corticosteroids, vaccinations, and monoclonal antibodies were some of the frequently utilised treatments. Increasing testing and contact tracing, expanding virtual healthcare services, investing in vaccination distribution and administration, and providing mental health support and resources are some of the common post-COVID-19 actions. This article clarifies the numerous preventative actions, such as choosing the right surface cleaners, performing the proper hand sanitization, and empowering PPE that may be a viable intervention to combat COVID-19.

Keywords: COVID-19 Infection; Antiviral Medications; Corticosteroids, Vaccinations; and Monoclonal Antibodies

Abbreviations

WHO: World Health Organization; ARDS: Acute Respiratory Distress Syndrome; USFDA: United States Food and Drug Administration; IL-6: Interleukin-6; DVT: Deep Vein Thrombosis; PE: Pulmonary Embolism; AKI: Acute Kidney Injury; CKD: Chronic Kidney Disease; PTSD: Post Traumatic Stress Disorder.

Introduction

The SARS-CoV-2 virus is the root cause of COVID-19, a contagious respiratory illness that is spreading rapidly across the globe. Initially observed in Wuhan, China in late 2019, the virus has caused significant disruption to economies and societies worldwide, resulting in a global pandemic [1]. The primary mode of transmission is through respiratory droplets when an infected person coughs, sneezes, talks or breathes, while it can also be spread by touching infected surfaces then touching one's face. The symptoms of COVID-19 vary from mild to severe, with fever, cough, and difficulty breathing being the most frequent, although some individuals may not experience any symptoms [2]. The structure of novel Corona Virus (COVID-19) is shown in Figure 1.

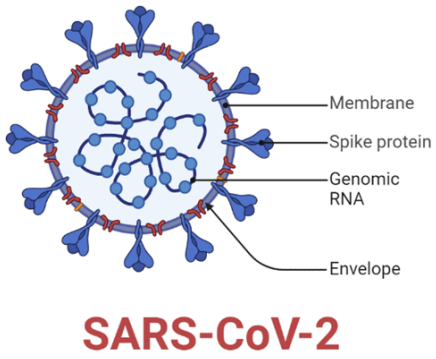

Figure 1: Structure of novel Corona Virus (COVID-19).

Ever since COVID-19 appeared, extensive efforts have been made to trace and comprehend the virus. The World Health Organization (WHO) has been vigilantly monitoring the situation and has provided guidance on how to prevent the virus's spread. Governments and health organizations worldwide have put in place measures such as social distancing, wearing masks, and lockdowns to decelerate the virus's propagation. COVID-19 has had a considerable global impact. As of March 2023, approximately 500 million COVID-19 cases have been confirmed worldwide, and over 7 million people have died as a consequence. This pandemic has exerted immense pressure on healthcare systems and economies worldwide, with many countries grappling to provide suitable medical care and assistance to their citizens [3].

The COVID-19 pandemic has presented a major challenge due to its unpredictable nature, with the virus spreading quickly and having varying effects on different individuals. Governments and health organizations have faced difficult decisions in responding to the pandemic, often with limited information and resources. Initially, there were many unknowns about the virus, including its transmission, surface survival, and impact on different populations. Researchers and scientists have worked tirelessly to find answers and develop effective treatments and vaccines. In late 2020, highly effective vaccines were developed and distributed globally, but distribution has been unequal, with many low-income countries struggling to access them [4].

Apart from the physical effects, COVID-19 has brought about significant social and economic consequences. Many nations have gone through economic decline due to business closures and job losses. Schools and universities have shut down or transitioned to online learning, while social events have been limited or prohibited in several regions. The pandemic has also exposed the existing inequalities in healthcare and resource access. COVID-19 has had a more profound impact on low-income and marginalized communities, leading to higher infection and mortality rates. The pandemic has emphasized the importance of addressing these disparities and assuring that all communities have equal access to resources and support [5].

Waves of COVID-19

Since its emergence in late 2019, the COVID-19 pandemic has resulted in multiple waves of infections in various parts of the world [6]. Each wave differs in characteristics, influenced by factors like the prevalence of COVID-19 variants, the efficiency of public health measures, and the extent of vaccination coverage. Nevertheless, some common trends have been noticed across all the waves [7].

First Wave: The initial outbreak of COVID-19 began in Wuhan, China towards the end of 2019 and early 2020. This led to the virus rapidly spreading to other parts of the world, resulting in a global pandemic. During the first wave, there was a lot of confusion and uncertainty among scientists and health officials as they tried to comprehend the virus and devise effective public health strategies. The initial wave resulted in a significant number of infections and deaths in several countries due to overwhelmed healthcare systems. To curb the spread of the virus, many countries enforced strict measures such as lockdowns, social distancing, and sanitization procedures. People were also encouraged to work from home and refrain from large gatherings [8].

Second Wave: Starting from late 2020 and early 2021, many countries, including the United States and several European countries, experienced a second wave of COVID-19. This wave was characterized by a resurgence of cases after a period of stability and the emergence of new virus variants such as the B.1.1.7 variant, first detected in the UK. The second wave also varied significantly in terms of how different countries tackled the pandemic. While some nations imposed strict lockdowns and measures similar to those of the first wave, others opted for more targeted actions, such as localized lockdowns or curfews. No information has been omitted during the paraphrasing process [9].

Third Wave: In the beginning of 2021, various countries like India, Brazil, and some parts of Europe experienced the onset of the third wave of COVID-19. The third wave was characterized by a sharp increase in the number of cases and deaths, and the emergence of new virus variants such as B.1.617 that was first detected in India. The third wave also saw notable disparities in the availability and distribution of vaccines across different countries. While some countries with high vaccination rates were able to minimize the impact of the third wave, others with low vaccination rates experienced a significant rise in cases and fatalities [10].

Fourth Wave: Starting from late 2021 and early 2022, many countries, including the United States, Canada, and several European countries, experienced the beginning of the fourth wave of COVID-19 [11]. This wave was characterized

by a significant increase in the number of cases and hospitalizations, as well as the emergence of new virus variants, such as the Omicron variant, which was initially detected in South Africa. Furthermore, the fourth wave saw increased availability and distribution of vaccines in many countries, along with the development of new COVID-19 treatments and therapies. To slow down the virus's spread and minimize the fourth wave's impact, some countries implemented a combination of public health measures, such as mask mandates and vaccine mandates [12].

Variants of COVID-19

Starting from late 2021 and early 2022, many countries, including the United States, Canada, and several European countries, experienced the beginning of the fourth wave of COVID-19. This wave was characterized by a significant increase in the number of cases and hospitalizations, as well as the emergence of new virus variants, such as the Omicron variant, which was initially detected in South Africa. Furthermore, the fourth wave saw increased availability and distribution of vaccines in many countries, along with the development of new COVID-19 treatments and therapies. To slow down the virus's spread and minimize the fourth wave's impact, some countries implemented a combination of public health measures, such as mask mandates and vaccine mandates [13]. A diagrammatic representation of COVID-19 variants is shown in Figure 2.

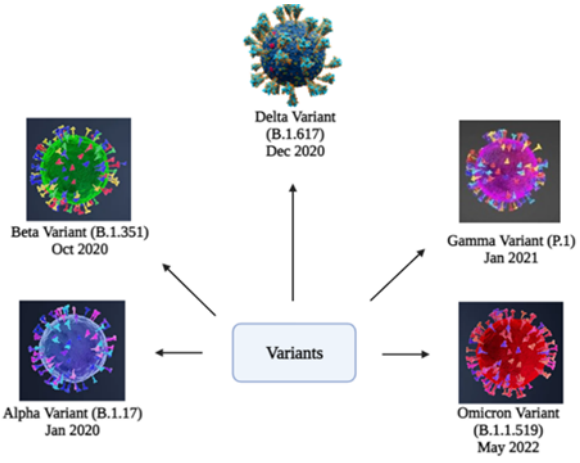

Figure 2: Variants of COVID-19.

Alpha Variant (B.1.1.7): During September 2020, the B.1.1.7 variant, commonly known as the Alpha variant, was initially identified in the UK. It has since become the dominant variant in several nations, including the US. The Alpha variant is considered to be more contagious than the original virus strain, with estimates suggesting it could be up to 50% more transmissible. Data suggests that the Alpha variant may result in more severe illness and may be more resistant to various COVID-19 treatments. However, the good news is that the presently available vaccines seem to be effective against the Alpha variant [14].

Beta Variant (B.1.351): In December 2020, the B.1.351 variant or Beta variant was discovered in South Africa. This variant, like the Alpha variant, is believed to be more contagious than the original virus. However, it is also thought to be more resistant to certain COVID-19 treatments and vaccines. According to studies, the Beta variant may evade some of the antibodies produced by the immune system in response to the original virus or the COVID-19 vaccines, which raises concerns about potential reinfections or reduced vaccine efficacy [15].

Gamma Variant (P.1): In January 2021, the P.1 variant, also known as the Gamma variant, was initially discovered in Brazil. Just like the Alpha and Beta variants, it is believed that the Gamma variant is more contagious than the original virus strain. However, there is presently insufficient information on whether the Gamma variant can cause severe illness or avoid the immune system. Preliminary research has indicated that some COVID-19 therapies and vaccines may be less effective against the Gamma variant, although further investigation is required to validate this [16].

Delta Variant (B.1.617.2): Initially detected in India in December 2020, the Delta variant (also referred to as the B.1.617.2 variant) has emerged as the dominant strain in several countries, including the US and UK. It is believed to be significantly more contagious than previous variants, with estimates proposing up to a 60% increase in transmissibility compared to the Alpha variant. Furthermore, some data indicates the Delta variant may carry a greater risk of hospitalization and death than prior strains. Nonetheless, current vaccines are proving to be effective against the Delta variant, particularly following the administration of two doses [17].

Lambda Variant (C.37): The C.37 variant or Lambda variant was initially identified in Peru in December 2020 and has since been found in other countries, such as the United States. Although there is insufficient data on the Lambda variant's infectiousness or severity, preliminary investigations have indicated that it may be more contagious and have the ability to avoid some antibodies generated by the immune system in response to COVID-19 vaccines or the original virus strain [18].

Mu Variant (B.1.621): In January 2021, the Mu variant (also called B.1.621) was initially detected in Colombia and has since spread to other countries, including the United States. This variant has various mutations in the spike protein, such as E484K and K417N, which have been linked to evading the immune system [19].

Therapies Used During COVID-19

The global impact of COVID-19 has resulted in an urgent

requirement for effective therapies to address the disease. Various treatments have been utilized to alleviate symptoms and improve outcomes, including oxygen therapy and antiviral therapy [20].

Oxygen Therapy: Oxygen therapy is critical for COVID-19 patients with low oxygen levels and can be administered through nasal prongs, face masks, or high-flow nasal cannulas depending on symptom severity. In severe cases, mechanical ventilation may be necessary. Studies have shown that oxygen therapy can improve survival rates and reduce the need for invasive mechanical ventilation [21].

Antiviral Therapy: Antiviral therapies are drugs that target the virus and prevent it from replicating in the body. Remdesivir is an antiviral drug that was approved by the USFDA for COVID-19 treatment in late 2020. It works by inhibiting the virus's replication [22].

Corticosteroids: Anti-inflammatory medications known as corticosteroids have been utilized to manage severe cases of COVID-19. One specific corticosteroid, Dexamethasone, has been found to decrease the death rate in critically ill COVID-19 patients. Additionally, corticosteroids can enhance oxygenation and decrease inflammation in COVID-19 patients who have acute respiratory distress syndrome (ARDS). All of this information is crucial when considering the use of corticosteroids in the treatment of COVID-19 [23].

Immunomodulators: Immunomodulators are a type of medication that affect how the immune system responds to COVID-19. Tocilizumab, an immunomodulator, has been utilized in treating severe cases of COVID-19. Its mechanism involves blocking the effects of a cytokine called interleukin-6 (IL-6), which plays a crucial role in the inflammatory response associated with COVID-19. Studies have shown that Tocilizumab can decrease the likelihood of mechanical ventilation and increase the chances of survival in severe COVID-19 patients with respiratory symptoms [24].

Convalescent Plasma Therapy: The procedure of convalescent plasma therapy entails the infusion of plasma obtained from individuals who have recuperated from COVID-19 into those who are currently suffering from the virus. This plasma comprises antibodies that can aid the immune system of the recipient in battling the infection. Although it has demonstrated the ability to alleviate the intensity of COVID-19 symptoms, convalescent plasma therapy is not a uniform treatment [25].

Monoclonal Antibody Therapy: Monoclonal antibody therapy involves using laboratory-engineered antibodies to target specific parts of the virus. These antibodies can help neutralize the virus and prevent it from replicating in the body. Regeneron's monoclonal antibody cocktail, casirivimab/imdevimab, has been approved for emergency use authorization by the USFDA for the treatment of mild to moderate COVID-19 cases [26].

Anticoagulant Therapy: COVID-19 has been associated with an increased risk of blood clots, which can lead to serious complications such as stroke and pulmonary embolism. Anticoagulant therapy is a treatment that helps prevent blood clots from forming. Heparin, an anticoagulant drug, has been used to prevent blood clots in hospitalized COVID-19 patients [27].

Rehabilitation Therapy: COVID-19 patients may experience long-term effects such as weakness, fatigue, and difficulty breathing. Rehabilitation therapy, including physical and occupational therapy, can help COVID-19 patients regain strength and improve their ability to perform daily activities. Pulmonary rehabilitation, in particular, can help patients recover lung function and improve their overall quality of life [28].

Vaccination

The COVID-19 pandemic has affected millions of people worldwide, and vaccines have been developed as an essential tool to help control the spread of the virus. Several vaccines have been developed and authorized for use in different countries. Each vaccine has its unique characteristics and provides different levels of protection against the virus [29].

Pfizer-BioNTech Vaccine: The Pfizer-BioNTech vaccine is a messenger RNA (mRNA) vaccine. It requires two doses, given three weeks apart. It has been shown to be highly effective in preventing COVID-19, with an efficacy rate of around 95%. The vaccine works by instructing cells in the body to make a protein found on the surface of the COVID-19 virus. An immunological response is then brought on by this protein, aiding in viral defence [30].

Moderna Vaccine: The Moderna vaccine is also an mRNA vaccine. Like the Pfizer-BioNTech vaccine, it requires two doses, given four weeks apart. The Moderna vaccine has been shown to be highly effective in preventing COVID-19, with an efficacy rate of around 94%. Similar to the Pfizer-BioNTech vaccine, it works by instructing cells to make a protein found on the surface of the virus to trigger an immune response [31].

Johnson & Johnson Vaccine: This type of vaccine comes under viral vector vaccine. Unlike mRNA vaccines, it uses a harmless adenovirus (the same type of virus that causes the common cold) to deliver genetic material from the COVID-19 virus into cells. This prompts an immune response against the virus. One dosage of the Johnson & Johnson vaccine is all that is necessary to avoid COVID-19-related severe illness and hospitalisation [32].

AstraZeneca Vaccine: AstraZeneca vaccine is another viral vector vaccine. Like the Johnson & Johnson vaccine, it uses a harmless adenovirus to deliver genetic material from the COVID-19 virus into cells. It requires two doses given four to twelve weeks apart. The AstraZeneca vaccine has been shown to be highly effective in preventing severe disease and hospitalization, with an efficacy rate of around 70% [33].

Sinovac Vaccine: The Sinovac vaccine is an inactivated

vaccine. It uses particles of the COVID-19 virus that have been killed or inactivated to stimulate an immune response. The Sinovac vaccine requires two doses, given two to four weeks apart. Its efficacy rate is around 50-60% for preventing symptomatic disease and higher for preventing severe disease and hospitalization [34].

Sinopharm Vaccine: The Sinopharm vaccine is also an inactivated vaccine. It requires two doses given three to four weeks apart. Its efficacy rate is around 79% for preventing symptomatic disease and higher for preventing severe disease and hospitalization [35].

Post COVID-19 Complications

The COVID-19 pandemic has impacted the world in ways that were previously unimaginable. Although the disease primarily affects the respiratory system, there is a growing concern among healthcare professionals that COVID-19 may have long-lasting effects on the body, even after the initial infection has subsided. These post-COVID-19 complications have been reported in a significant number of patients and have become a cause for concern in the medical community [36].

Pulmonary Complications: The most common post-COVID-19 complication is pulmonary, or lung-related. COVID-19 is primarily a respiratory illness, and severe cases of the disease can lead to pneumonia, acute respiratory distress syndrome (ARDS), and other lung-related complications. Even after recovering from COVID-19, patients may experience persistent respiratory symptoms such as shortness of breath, coughing, and chest pain. Recent studies have shown that up to 50% of patients who have recovered from COVID-19 have abnormal lung function tests, such as decreased lung capacity and reduced diffusion capacity. These abnormalities can persist for months after the initial infection, and it is unclear whether they will resolve over time [37].

Cardiovascular Complications: Another significant post-COVID-19 complication is cardiovascular, or heart-related. COVID-19 can cause inflammation of the heart muscle, or myocarditis, which can lead to heart failure, arrhythmias, and other cardiac complications. Patients who have recovered from COVID-19 may experience persistent chest pain, palpitations, and shortness of breath, which can be indicative of underlying heart problems. Recent studies have shown that COVID-19 can also cause blood clots, which can lead to deep vein thrombosis (DVT), pulmonary embolism (PE), and stroke. These complications can occur even in patients who have recovered from COVID-19, and they can be life-threatening if not detected and treated promptly [38].

Neurological Complications: COVID-19 can also affect the nervous system and lead to neurological complications. Patients who have recovered from COVID-19 may experience symptoms such as headache, dizziness, fatigue, and brain fog. Some patients have also reported more severe neurological complications, such as seizures, encephalitis, and Guillain-Barré syndrome. Recent studies have shown that COVID-19 can cause damage to the brain's blood vessels, which can lead to cognitive decline and other neurological problems. It is also believed that COVID-19 may trigger an autoimmune response that can attack the nervous system, leading to a range of neurological symptoms [39].

Gastrointestinal Complications: COVID-19 can also cause gastrointestinal complications, such as diarrhoea, nausea, and vomiting. These symptoms are more common in patients with severe COVID-19, but they can also occur in patients with mild or asymptomatic cases of the disease. Recent studies have shown that COVID-19 can also cause damage to the liver, leading to elevated liver enzymes and other liver-related complications. It is unclear whether these complications will resolve over time or if they will have long-term effects on patient's liver function [40].

Renal Complications: COVID-19 can also affect the kidneys, leading to renal complications such as acute kidney injury (AKI) and proteinuria. These complications are more common in patients with severe COVID-19, but they can also occur in patients with mild or asymptomatic cases of the disease. Recent studies have shown that COVID-19 can cause damage to the kidneys' blood vessels, leading to long-term kidney damage and an increased risk of chronic kidney disease (CKD). Patients who have recovered from COVID-19 may experience persistent kidney-related symptoms, such as decreased urine output and swelling in the legs [41].

Psychological Complications: COVID-19 has not only affected physical health but also mental health. The pandemic has caused stress, anxiety, and depression in many people due to social isolation, financial stress, and fear of the disease. Patients who have recovered from COVID-19 may also experience persistent psychological symptoms such as post-traumatic stress disorder (PTSD), insomnia, and mood disorders. Recent studies have shown that COVID-19 can also affect the brain and lead to neuropsychiatric complications. Some patients have reported symptoms such as hallucinations, delirium, and depression, which may be related to the virus's impact on the central nervous system [42].

Long COVID: One of the most significant post-COVID-19 complications is a condition known as "long COVID". Long COVID is a term used to describe the persistent symptoms that some patients experience long after recovering from COVID-19. These symptoms can include fatigue, shortness of breath, chest pain, joint pain, brain fog, and other cognitive and physical symptoms. Recent studies have shown that up to 30% of patients who have recovered from COVID-19 experience long COVID symptoms, and the condition can affect patients of all ages and severity of illness. It is unclear why some patients develop long COVID, but it is believed to be related to the virus's impact on the immune system and

the body's ability to heal [43].

Conclusion

In conclusion, post-COVID-19 interventions are crucial in addressing the pandemic's long-term effects on public health, economies, mental health, education, and technology. The pandemic has had a significant impact on the world, and post-COVID-19 interventions aim to support individuals, communities, and economies as they recover from its effects. Vaccination, economic support, mental health and well-being, education and training, and technological innovation are essential areas for post-COVID-19 interventions. Governments and international organizations must work together to ensure that these interventions are implemented effectively, particularly in low-income countries. By prioritizing post-COVID-19 interventions, we can move towards a brighter future and build a more resilient world.

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