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*Review Article*

# Covid-19 Vaccines' Function And Limitations In The Tough Transition From Pandemic Mitigation To Endemic Control.

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**Abstract**

The introduction of the Omicron variety, which caused the current rise in COVID-19, has cast a harsh light on the management of epidemics in the near future. The scientific and medical community should start to doubt the long-term vaccine approach for controlling SARS-CoV-2 as a result of this. Here we offer a critical viewpoint on the epidemiological features, immunological factors, and virological progression of COVID-19 control, including a vaccine approach. All things considered, additional vaccine development improvements are required to lessen the COVID-19 burden in the long run. Perhaps the best solution would be increased collaboration between academic institutions, biotech firms, and pharmaceutical businesses.

**Keywords** : *SARS-CoV-2; COVID-19; vaccine; variant; Omicron; Delta; pandemic; disease control.*

## INTRODUCTION

Future pandemic control has been harshly illuminated by the current spike in COVID-19 linked to the Omicron strain. According to recent research, the Omicron variation partially evades the immunological protection brought about by both prior infections and current vaccinations [1,2].

This ought to cause the medical and scientific community to doubt the long-term vaccine.

method for effectively combating this pathogen. A partial outbreak of COVID-19 occurred in the summer of 2021, following a huge COVID-19 vaccination effort that began nearly two years ago in the winter of 2020–21 (many other factors were at play, including non-pharmaceutical measures).Nonetheless, the Delta version struck the majority of European nations, and in the first semester of 2022, the Omicron wave followed. Nonpharmaceutical measures like travel bans, physical separation, face covering, hand washing, and closing of big gatherings have been loosened in the majority of high-income nations.

throughout 2022's first half. The COVID-19 vaccine is currently regarded as the most remarkable and successful vaccination developed since its start. It was anticipated that the COVID-19 vaccine prevented over half a million fatalities in the WHO Europe region between December 2020 and November 2021 [3]. Without a doubt, the mRNA vaccine technology emerged victorious in the global vaccination race [4,5].The mRNA vaccines were the answer that reduced their rivals to secondary competitors since they were quick to develop, scalable for large production, relatively stable at low negative temperatures, simple to administer, and effective with just two doses. When The return to regular life was a fantasy for most individuals following the initial COVID-19 vaccine miracle [6].

A year later, the situation is a little sour due to the emergence of sublineages of Omicron variants BA.1 to BA.5, which are evading prior immunity and could pose a threat to the majority of healthcare systems that have been strained for nearly two years [7]. I hope Omicron Compared to the earlier Delta variant, variants and their subtypes will cause a less severe illness.There could be a massive surge of new COVID-19 instances in the future, much like Sisyphus rolling his stone at the base of his mountain [8]. The world cannot continue to improve a constantly declining immune defense while maintaining the idea of endless confinement.

each four to six months of the whole population. Furthermore, a good and equitable worldwide vaccination coverage is still a long way off. We are still far from disease control at this point, and no true worldwide plan has been developed for COVID-19 control [9].

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There is no true public health goal set globally, and very few nations have embraced a zero-COVID goal at the expense of an extremely strict containment approach [10].

Throughout the COVID-19 pandemic, the scientific community has taken the lead in coming up with new countermeasures and providing a range of vaccine approaches. Given the intense scientific and commercial competition, it makes sense for governments, pharmaceutical corporations, and medical authorities to select the most effective vaccinations that are accessible. We believe that it is important to critically examine the underlying assumptions of current vaccination tactics in light of the impending Omicron subtype waves (as well as the possible future emergence of non-Omicron variants) and the pressing need for booster shots.

## VIROLOGICAL ISSUES ADJUSTING TO THE CHANGING VIRAL EVOLUTION

SARS-CoV-2's development as a pandemic respiratory agent is remarkable in the annals of contemporary medicine. Between 50 and 100 million people died worldwide from the 1918 influenza A (H1N1) virus, the last pandemic of similar magnitude in the 20th century.

throughout the majority of continents with multiple fatal waves [11]. This was a long time before the advent of modern virology, and even before the first flu vaccine or the first virus identified by electron microscopy. It's interesting to note that the 1918 influenza A H1N1 pandemic virus persisted in hiding in human or animal reservoirs, leading to "pandemic bursts" in 1947, 1951, and 1999 [12].

For the first time, we have gathered useful phylogenetic information about the origins and development of SARS-CoV-2 and its variants (more than 12.3 million full sequences are available on GISAID, https://www.gisaid.org/ 15 September 2022). For example, A exact time-lapse of a phylo-geography's evolution is provided by data [13]. Under evolutionary limitations, it is now evident that the SARS-CoV-2 is genetically wandering [14]. We do not, however, fully recognize the SARS-CoV-2's capacity for evolution, particularly when it is restricted by the pressure of universal immunity. The spike protein, particularly the receptor binding domain that interacts with the cell entry receptor ACE-2, is mutated in the majority of variations.One of the primary antibody targets for modern vaccines is the receptor binding domain [15]. Although SARS-CoV-2's evolution has been linked to an increase in the virus's fitness and contagiousness, some variations also show an

The Omicron form and its subgroups appear to exhibit the immunological escape phenotype the most. It's unclear exactly how immunological pressure affected the evolution of the virus [6]. According to a study, the common cold-causing endemic human coronavirus 229E (hCo229E) underwent gradual evolution through mutations in its spike protein. Within ten years of evolution, these cumulative changes allowed the virus to evade neutralization [16].

Originating in bats, SARS-CoV-2 has been found in a variety of mammals [13–17] and has caused reverse zoonosis, the most recent of which was observed in wild white-tailed deer [18]. Given this significant animal tropism, COVID-19 has turned into a health concern, and the worldwide goal of the vaccination program cannot be the eradication of SARS-CoV-2 [9]. If we could develop a vaccine that prevents the virus from spreading, the most ambitious goal could be to stop its spread in a few geographic areas before attempting to stop it from spreading more widely. Long-term, recurring seasonal waves of infections would be caused by variation emergence.

## CONCERNS ABOUT EPIDEMIOLOGY EXPANDING ACCESS TO THE CURRENT VACCINE WORLDWIDE

Vaccines 2022, 10, 1555 3 of 7 Despite the fact that over 11 billion doses of the COVID-19 vaccine have been administered so far, epidemiological management of the virus requires greater equality in the vaccine roll-out worldwide, particularly between the richest and poorest nations [19]. Recent findings show that a startling 2.7 billion people worldwide still need to receive vaccinations, with less than 15% of people in low-income countries having received vaccinations to date [20]. As demonstrated by the history of the smallpox eradication campaign [21] and the current WHO-led polio eradication campaign [22], an infectious disease control plan should be worldwide.Interestingly, all of the SARS-CoV-2 emerging variants of concern (VOC) that have been identified thus far have come from nations with low vaccination rates or those that started their vaccination campaigns earlier (Brazil and the UK for gamma and UK for alpha VOCs, respectively).

(South Africa for Beta and Omicron VOCs, and India for Delta VOCs) [13]. Thus, the globalization of vaccine distribution is not only a concept of equality but also provides biosecurity insurance for all nations.

Additionally, we want to enhance the tactics in nations where vaccines are widely available.The most vulnerable and vulnerable groups were the focus of the initial vaccination program.But we've purposefully put a barrier between an adult population that is fully inoculated and a population of utterly innocent children. This was founded on the finding that youngsters were comparatively immune to the illness and that individuals under the age of eleven who contract the few severe forms of COVID-19 had an unfavorable risk-benefit ratio. While the incidence rate was increasing in children aged 5 to 11, the Delta variant triggered a dramatic increase in pediatric cases globally in the fall of 2021, forcing medical authorities to change course [23, 24].

Globally, the vaccination should be more widely available, indicating the need for a concerted international effort for

COVAX enhancement. Furthermore, in the majority of nations, vaccination hesitancy poses an additional obstacle to the lack of vaccine access [25].

## IMMUNOLOGICAL ISSUES ENHANCING UPCOMING VACCINATIONS

The two main shortcomings of the vaccines created thus far are their limited impact on host-to-host transmission [27] and their quick drop in efficacy within a few months [26].

First, scientists are anxiously awaiting additional data regarding the mechanisms underlying vaccine protection against severe, symptomatic, and pauci-symptomatic COVID-19 [28, 29]. As time goes on, declining antibody levels are thought to be associated with a resurgence of sensitivity to The infection. Though there are other components that contribute to global immunity (neutralizing and non-neutralizing antibodies, CD8+ and CD4+ T cells), the humoral response—the most easily measured endpoint—offers a worldwide correlation of antibody level to early protection [30] [28].The vaccine should elicit memory B and T cell responses in addition to the neutralizing power of serum antibodies, which can lessen the effects of illness. According to recent data, the mRNA vaccine BNT162b causes long-lasting The production of memory B cells and long-lived plasma cells [31], as well as long-term T cell immunity [32], depend on follicular helper T cells. Although its precise function is unknown, the T cell response is thought to guard against serious illness.To learn why vaccine immunity declines over a few months and how to better stimulate the memory T and B cell compartments, more research is required. Additionally, a Although the duration of the booster effect is unknown, booster doses can increase the effectiveness of vaccines [29].

Notably, the duration of immune protection induced by the majority of vaccines designed to prevent respiratory tract infections varies. Only viruses with systemic viremic dissemination, such as variola, measles, mumps, and others, have been proposed to provide strong protection. rubella viruses), however, not respiratory tract-specific viruses as coronaviruses and influenza viruses [33]. The measles vaccination provides lifetime protection, whereas the vaccinia virus produced a 10-year protection and was employed as a post-exposure prophylactic. The new mRNA and adenovirus-based vaccinations, in contrast, seem to have a short half-life against diseases.It is critical to determine if this brief protection is connected to the virus's tropism or the kind of vaccination platform that was employed. Accordingly, additional vaccine platforms that are already effective against SARS-CoV-2 in 2022, 10, 1555 Vaccines Four out of seven animal models are highly desirable for additional clinical studies, including the Ankara (MVA) platform for vaccines [36,37] and the measles vaccine [34,35].

In conclusion, it has been proposed that COVID-19, similar to all other human coronaviruses, is gradually changing from an emerging agent that circulates in a naïve population to an endemic virus that spreads more slowly in a population that has already been infected or immunized [38]. Since every everyone is exposed to several things through one or more vaccination shots or viral encounters, the illness may gradually subside into a range of less severe symptoms [39]. Although it is unknown if this is because of an inherent feature of the variant, this may be what is seen with the Omicron variant these days [40].

Additionally, transmission control highlights the necessity of a more focused immunological response to the mucosal immune system [27]. Despite the fact that lung infections are among the most deadly infectious diseases in the world, little is known about how to strengthen lung immunity.

Because live attenuated vaccines disseminate systemically during their replication, they provide long-term mucosal protection against respiratory-acquired illnesses (measles, mumps, and smallpox) even when they are delivered intramuscularly.The intramuscular injection used for all currently licensed SARS-CoV-2 vaccines may not be the best method of delivery for mucosal education. Without live-attenuated vaccinations to prevent SARS-CoV-2, It is necessary to test the local administration of current vaccinations in order to enhance mucosal protection and sterilize transmission. Animal models have successfully tested a number of intranasal vaccinations [36,41,42]. It is without a doubt a promising method for producing tissue-resident memory T cells and delivering vaccinations [43].

## FROM IMMUNIZATIONS TO A VACCINATION PLAN

Herd immunity appears to be a pipe dream for controlling the pandemic, and SARS-CoV-2 cannot be eradicated. The decision between safeguarding the nation's health care system, lowering the prevalence of severe forms, and/or upholding national economic interests is still challenging, as it is with any emergence. Health systems' continued existence is still the primary driver for today's vaccination approach. It means that efforts to vaccinate the entire population—especially the most vulnerable—must continue. The only available strategic options are persuasion, coercion, and vaccine requirements. Even in high-income nations, a population-wide approach that involves frequent vaccination boosters does not appear to be sustainable. The mRNA vaccine is a suitable technology for an immediate pandemic response, but it is hardly the Holy Grail given the rising prevalence of breakthrough infections. Be mindful. This thereby gives more time for more effective but slower-developing vaccinations to reach the market. Every nation establishes its own health plan, such as the European influenza vaccination program, which has several

goals (protecting healthy children, adolescents, and adults, as well as health care workers) [44].The answer would come from contrasting these various approaches (vaccines, target demographics) to determine which work best. Heterologous vaccination approaches, such as ChAdOx1-S-nCoV-19 and In a real-world observational study of healthcare workers, BNT162b2 combination) was found to be more effective than homologous BNT162b2 and BNT162b2 combination [45].
Some high-income nations have gained access to national health databases, which include COVID 19 diagnoses and patient outcomes, for the first time during a pandemic. This makes it possible to evaluate the illness burden in real time using population health summary metrics like disability-adjusted life years (DALYs) because of both acute and chronic morbimortality. DALYs could offer comprehensive and comparable public health data to evaluate and direct vaccine strategy decision-making, surpassing incidence and infection fatality rates. [46, 47]

## CONCLUSION

The COVID-19 pandemic resolution seems more complicated than first believed.Combating a new virus that affects the respiratory system and spreads to a gullible populace is a difficult undertaking that requires creativity and global responsiveness. With the With fewer deaths from the Omicron form, we might be moving from a pandemic to an endemic phase (Vaccines 2022, 10, 1555, 5 of 7).Despite more than 50 years of widespread immunization with one of the most effective live attenuated vaccines, our experience with measles management and elimination shows that dealing with this newcomer will take many years. Achieving endemic success Better collaboration between the scientific community, big pharma, decision makers, and health authorities—all motivated by a strong public health spirit—will lead to the control of SARS-CoV-2 or any other new agent.

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### Conflicts of Interest
The authors declare no conflict of interest.

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