An equitable approach is necessary to win a war against the global COVID-19 pandemic

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Abstract

There seems to be no end to the current COVID-19 pandemic. According to the World Health Organization (WHO), as of Nov. 25, 2020, there were 58,900,547 confirmed cases globally of COVID-19, including 1,393,305 deaths. Many pharmaceutical companies worldwide have been developing treatments; however, there is currently no cure for COVID-19, although there are a limited number of medications which treat the symptoms. Under these circumstances, attention has been focused on COVID-19 vaccines. Many pharmaceutical and biotechnology companies globally are actively developing COVID-19 vaccines. According to WHO, 48 vaccine candidates are undergoing clinical studies, while 164 are in pre-clinical studies stages. To date, no vaccine has been approved by any regulatory body. Wealthy nations, such as the U.S., U.K., and EU, have rushed to pre-purchase COVID-19 vaccines, which WHO criticized as “vaccine nationalism.” An international NGO/NPO working to secure access to COVID-19 vaccines has set up a scheme for fair allocation. Some leading countries expressed their commitment to this program; however, some large vaccine-producing nations, such as the U.S., China, and Russia, have not. This article first presents an overview of the current status of the COVID-19 pandemic, including treatment and vaccine development, then discusses possible implementation of an international effort to secure equitable allocation of COVID-19 vaccines once they are available.

Keywords: COVID-19, Intellectual Property Right (IPR), access to medicine, inclusive, equitable, globalism

1. Introduction

Can humans win the fierce battle against COVID-19? Currently, there seems to be no end in sight to the COVID-19 outbreak. According to the World Health Organization (WHO), as of Nov. 25, 2020, there were 58,900,547 confirmed cases of COVID-19, including 1,393,305 deaths [1], [2]. Moreover, on Nov. 25, 2020, 463,730 infections and 7,712 deaths worldwide were reported in a single day [3]. Although by Nov. 25, 2020, almost 11 months had passed since the first COVID-19 patient was identified in China, no remedy for COVID-19 has been found. To date, there is no miracle drug which cures the disease, and it seems it will take some time for them to be an effective COVID-19 medication and/or vaccine worldwide [4], [5], [6].

Several pharmaceutical and biotechnology companies globally have been struggling each other to develop medications to cure and vaccines to prevent COVID-19. According to the New York Times’ Coronavirus Vaccine Tracker, as of Nov. 25, 2020, researchers and scientists worldwide were testing 55 vaccines in human clinical trials, and at least 87 preclinical vaccines were actively undergoing animal trials [7]. However, it appears that such efforts will take some time to come to fruition [8].

Under the current circumstances, wealthy, advanced countries have been struggling to develop procurement deals in advance for hundreds of millions or even billions of doses of COVID-19 vaccines (actually vaccine candidates) each other to protect their own people [9]. On August 18, 2020, WHO Director-General Tedros Adhanom Ghebreyesus criticized such activities by calling them “vaccine nationalism” [10]. The present study aimed to examine current R&D activities related to new COVID-19 vaccines and advanced countries’ panicked purchasing of COVID-19 vaccines (or vaccine candidates), and to propose a policy for implementing a balanced vaccine distribution scheme on a global scale.

This article consists of seven chapters. Chapter I is the introduction, Chapter II analyzes the current status of COVID-19 infections, Chapter III shows the current status of COVID-19 vaccine development efforts, Chapter IV describes vaccine nationalism, Chapter V discusses possible solutions for vaccine nationalism, Chapter VI is the conclusion, and Chapter VII notes the limitations.

2. The Current Status of COVID-19 Pandemic Worldwide
COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which first emerged in Wuhan, China, in December 2019, and has since spread worldwide [11]. There has been a lot of discussion among scientists regarding the origin of SARS-CoV-2, with a number of scientific papers written. Some reports suggested that SARS-CoV-2 was accidentally leaked from a laboratory; however, WHO determined all available evidence suggests that SARS-CoV-2 has a zoonotic source, and does not support the virus being a laboratory construct [12], [13], [14], [15]. It is true, however, that the government of China mishandled aspects of the initial outbreak [16], [17], [18].

At a press conference held on March 11, 2020, WHO Director-General Tedros officially declared the COVID-19 outbreak to be a pandemic [19]. Since then, SARS-CoV-2 has continued to spread rapidly worldwide. According to WHO, as of Nov. 25, 2020, there have been 58,900,547 confirmed cases of COVID-19, including 1,393,305 deaths. The U.S., India, and Brazil are the three countries hit worst by COVID-19. Table 1 shows the number of confirmed cases and deaths globally, and in the U.S., India and Brazil [20].

Table 1. Covid-19 Cases and Deaths Confirmed by WHO: The Global, U.S., India and Brazil

| Country/Region | Cases - cumulative total | Cases - newly reported in last 24 hours | Deaths - cumulative total | Deaths - newly reported in last 24 hours |
|----------------|------------------------|----------------------------------------|--------------------------|-----------------------------------------|
| Global         | 58,900,547             | 463,730                                 | 1,393,305                | 7,712                                    |
| USA            | 12,119,654             | 147,098                                 | 254,798                  | 867                                      |
| India          | 9,177,840              | 37,975                                  | 134,218                  | 480                                      |
| Brazil         | 6,071,401              | 19,615                                  | 149,183                  | 194                                      |

Source: WHO Health Emergency Dashboard, WHO (COVID-19) Homepage, https://covid19.who.int/

The United States remains the nation worst hit by the COVID-19 pandemic which the world’s most infected cases and deaths, making up more than 20 percent of the global cases. All of the 50 states have been affected. Texas reported the country’s most cases, followed by California and Florida [21].

India has been the second hardest hit country by COVID-19, after the U.S., in infections but not in deaths. India has reported cases in a single day of 97,894 on Sept. 17, 2020. However, the number of infected cases in India has been gradually decreasing since then [22].

Brazil has the second highest COVID-19 death toll in the world after the U.S. and the third highest number of infected cases after the U.S. and India. The daily number of new cases in Brazil had been slowly falling since last summer when there were about 1,000 new deaths per day for two months. However, Brazil reported 638 deaths by COVID-19 on Nov. 24 in the 24 hours, indicating an upward trend in COVID-19 death [23].

3. COVID-19 Vaccine Development Efforts Worldwide

3.1 Current COVID-19 vaccine pipeline

Since SARS-CoV-2, the virus that causes COVID-19, was identified, pharmaceutical companies, biotech firms and public research institutes worldwide have been tirelessly working to develop new drugs and vaccines; however, at present, there are no drugs or vaccines to cure or prevent COVID-19.

However, several companies have launched late-stage clinical studies. Some experts have stated that a fast-tracked vaccine development process could rush a successful candidate to market within approximately 12–18 months, if the process goes smoothly from conception to market availability [24].

Table 2 and 3 show vaccines in the later stages of clinical studies. Currently, 10 vaccine candidates are in Phase III clinical studies, and three others are in Phase II/III studies [24]. Phase III is the last clinical stage before a vaccine can be approved by a regulatory body. Hundreds or thousands of volunteers participate in Phase III clinical studies to clarify safety, effectiveness, and common side effects [25].

Table 2. Vaccine Candidates in PIII Clinical Studies

| Candidate | Mechanism | Sponsor | Trial Phase |
|-----------|-----------|---------|-------------|
| AZD1222   | Replication-deficient viral vector vaccine (adenovirus from chimpanzees) | The University of Oxford, AstraZeneca, IQVI, Serum Institute of India | Phase 3 |
| SabinVax  | Inactivated virus | Bharat Biotech; National Institute of Virology | Phase 3 |
| CanSinoBioscience | Inactivated vaccine | China National Pharmaceutical Group | Phase 3 |
| NIBR-JD1375 | Non-replicating viral vector | Johnson & Johnson | Phase 3 |
| No name announced | Inactivated vaccine | Chinese National Pharmaceutical Group | Phase 3 |
| NVX-CoV2373 | Nanoparticle vaccine | Novavax | Phase 3 |
| Sputnik V | Non-replicating viral vector | Gamaleya Research Institute, Acellena | Phase 3 |

Source: Draft landscape of COVID-19 candidate vaccine (as of Nov. 12 2020)
An equitable approach is necessary to win a war against the global COVID-19 pandemic

Table 3. Vaccine Candidates in PII/PIII Stages of Clinical Studies

| Candidate | Mechanism | Sponsor | Trial Phase |
|-----------|-----------|---------|------------|
| Bacillus Calmette-Guérin (BCG) vaccine | live-attenuated vaccine | University of Melbourne and Murdoch Children's Research Institute; Radboud University Medical Center; Faustman Lab at Massachusetts General Hospital | Phase 2/3 |
| NO-4800 | DNA vaccine (plasmid) | Invivo Pharmaceuticals | Phase 2/3 |
| NR-7831 | Plant-based adjuvant vaccine | Medicago; GSK; Dynavax | Phase 2/3 |

Source: Draft landscape of COVID-19 candidate vaccine (as of Nov. 12 2020)

Table 4-6 show vaccines in the early stages of clinical studies. At present, two vaccine candidates are in Phase II studies, nine are in Phase I/II studies, and 13 are in Phase I clinical studies [24]. Phase II is the second step in clinical studies when developing a new medication. Normally, several hundred volunteers participate in Phase II studies to clarify short-term side effects and effectiveness, with the latter measured by how the volunteers’ immune systems respond to the vaccine [25].

Phase I is the first step in clinical studies. Usually 20 to 100 healthy volunteers participate in Phase I studies to clarify a drug’s safety, effectiveness, and potentially serious side effects [25].

Table 4. Vaccine Candidates in PII Clinical Studies

| Candidate | Mechanism | Sponsor | Trial Phase |
|-----------|-----------|---------|------------|
| No name announced | Recombinant vaccine | Anhui Zhifei Longcom Biopharmaceutical, Institute of Microbiology of the Chinese Academy of Sciences | Phase 2 |
| ZCoV-D | DNA vaccine (plasmid) | ZymoCure | Phase 2 |

Source: Draft landscape of COVID-19 candidate vaccine (as of Nov. 12 2020)

Table 5. Vaccine Candidates in PI/II Clinical Studies

| Candidate | Mechanism | Sponsor | Trial Phase |
|-----------|-----------|---------|------------|
| No name announced | Adjuvanted protein subunit vaccine | | Phase 1/2 |
| AG0301-COVID19 | DNA vaccine | AnGe, Inc. | Phase 1/2 |
| BBIP-CovV | inactivated vaccine | Beijing Institute of Biological Products, China National Pharmaceutical Group (Sinopharm) | Phase 1/2 |
| EpVacCorona | Peptide vaccine | Federal Budgetary Research Institute State Research Center of Virology and Biotechnology | Phase 1/2 |
| IX-19 | DNA vaccine | Genevac | Phase 1/2 |
| LNP-mCoVsaRNA | self-amplifying RNA vaccine | Imperial College London | Phase 1/2 |
| PMCT-COVID-19 (LUNAR-COV19) | self-replicating RNA vaccine | Arcturus Therapeutics and Duke-NUS Medical School | Phase 1/2 |

Source: Draft landscape of COVID-19 candidate vaccine (as of Nov. 12 2020)
Third, mRNA vaccines have the potential for rapid, thereby allowing rapid intake and expression in cytoplasm. Achieved by formulating mRNA into carrier molecules, mutagenesis. Second, efficient in vivo delivery can be there are no potential risks of infection or insertional mRNA is a non-infectious, non-integrating platform, mRNA vaccines have several beneficial features. First, as mRNA vaccines:

DNA vaccines:
These vaccines involve the direct introduction of plasmid DNA that contains DNA sequences encoding the antigens against which an immune response is sought. DNA vaccines offer a number of potential advantages, including the stimulation of both B- and T-cell responses, improved vaccine stability, absence of any infectious agents, and relative ease of large-scale manufacturing [26].

mRNA vaccines:
mRNA vaccines have several beneficial features. First, as mRNA is a non-infectious, non-integrating platform, there are no potential risks of infection or insertional mutagenesis. Second, efficient in vivo delivery can be achieved by formulating mRNA into carrier molecules, thereby allowing rapid intake and expression in cytoplasm. Third, mRNA vaccines have the potential for rapid, inexpensive, and scalable manufacturing [27].

VLP vaccines:
Virus-like particles (VLPs), composed of one or more structural proteins but no genomes of native viruses, mimic the organization and conformation of authentic virions without the ability to self-replicate in cells, potentially yielding safer vaccine candidates. VLPs have been employed in the production of human vaccines, such as those for hepatitis B and the human papillomavirus. VLPs contain repetitive, high-density displays of viral surface proteins that present conformational viral epitopes to draw out strong immune responses [28].

Viral vector vaccines:
Viral vectors have been developed as a potential tool to deliver vaccines. Viral vectors have been extensively studied in animal models, and many have entered clinical evaluation. Some of the more promising approaches include combining "prime-boost" strategies with other types of vaccines, such as recombinant antigens. Although the use of viral vectors is a promising system for developing effective and safe vaccines against many important diseases, more studies are needed before the ideal vector is developed and licensed for human use [29].

Plant-derived vaccines:
Plant-derived vaccines can be produced cheaply in very high amounts, carrier plants such as potatoes and corn are readily accepted by patients, and antigens derived from them are stable and can be stored for long periods. Moreover, contamination from a plant virus almost never occurs. However, there are several technical challenges related to plant-derived vaccines that must be resolved before they can be used on a wide-scale, and regulatory requirements for this novel vaccine class still need to be established [30].

Inactivated vaccines:
Inactivated vaccines are created by inactivating a pathogen, for instance, by using heat or chemicals such as formaldehyde or formalin. This process destroys the pathogen’s ability to replicate, but keeps it intact so that the immune system can still recognize it. Since inactivated pathogens cannot replicate at all, they cannot revert to a more virulent form capable of causing disease [31].

Attenuated vaccines:
Attenuated vaccines can be made several different ways. A common method involves passing the disease-causing virus through a series of cell cultures or animal embryos, typically chick embryos. With each pass, the virus becomes better at replicating in chick cells, but loses its ability to replicate in human cells. Eventually, the attenuated virus will be unable to replicate well in human cells and can be used as a vaccine. However, one concern is the potential for the virus used in the vaccine to revert to a form capable of causing disease [32].
An equitable approach is necessary to win a war against the global COVID-19 pandemic

As shown in Table 8, each vaccine type has its own strengths and weaknesses [26], [27], [28], [29], [30], [31], [32], [33], [34], [35].

Table 8. Vaccines with Different Modalities: Strengths and Weaknesses

| Description                        | Strengths                                                                 | Weaknesses                                                                 |
|------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| **Inactivated Vaccine**             | A vaccine created by inactivating a pathogen, typically by using heat or chemicals (e.g., formaldehyde or formalin). | Requires a large amount of a virus to produce. Optimization is required to inactivate the pathogen. |
| **Attenuated Vaccine**              | A vaccine created by passaging the disease-causing virus through a series of cell cultures. | Takes time to design and develop. Concerns about safety.                   |
| **DNA Vaccine**                    | A new type of vaccine that provides acquired immunity through a DNA molecule encoding antigens (e.g., adenovirus is injected into the human body). | Cannot be produced in large amounts. Concerns about safety. Weak efficiency. |
| **Viral Vector Vaccine**            | A virus containing DNA encoding antigens (e.g., Adenovirus is injected into the human body). | Requires a well-established method. Can be designed in a short time span. |
| **Inactivated Vaccine**             | A vaccine created by inactivating a pathogen, typically by using heat or chemicals (e.g., formaldehyde or formalin). | Requires a large amount of a virus to produce. Optimization is required to inactivate the pathogen. |
| **Attenuated Vaccine**              | A vaccine created by passaging the disease-causing virus through a series of cell cultures. | Takes time to design and develop. Concerns about safety.                   |
| **RNA Vaccine**                    | A new type of vaccine that provides acquired immunity through an RNA containing sequence, such as lipid nanoparticles. | Absence of any infectious agent. Can be designed in a short time span. Easy to inject. Does not hurt host genome. |
| **DNA Vaccine**                    | A new type of vaccine that provides acquired immunity through plasmid DNA that codes for specific proteins (antigens) from a pathogen. | Absence of any infectious agent. Can be designed in a short time span. Applied for treatment. Can be produced cheaply. |

Source: Author-created based on several sources.

4. Vaccine Nationalism
4.1 Vaccine development time span

According to vaccine experts, it takes years—or even decades—to bring a vaccine from the laboratory to market [36]. However, for COVID-19, governments and companies worldwide have been trying to develop vaccines in a span of as little as 12–18 months. This might not be unrealistic when considering the following: (a) advancements in the technology and skills of the global biopharma research network, (b) huge investments in vaccine development made by governments and the pharmaceutical sector, and (c) urgent necessity for COVID-19 vaccines at present [37]. As mentioned above, to date, researchers and scientists globally have begun clinical human trials for 55 vaccines, and at least 87 preclinical vaccines are actively undergoing animal testing.

4.2 What is vaccine nationalism?

Although all COVID-19 vaccine candidates are still in development and being tested using either humans or animals/cells, wealthy advanced nations have rushed to pre-purchase them. On August 23, 2020, WHO Director-General Tedros warned against such behavior, by stating, “We need to prevent vaccine nationalism. Sharing finite supplies strategically and globally is actually in each country’s national interest.” [38].

As defined in the Indian Express, “vaccine nationalism” is when a country manages to secure vaccine doses for its own citizens or residents, prioritizing its own domestic market before the vaccine is made available in other countries. This is done through pre-purchase agreements between governments and vaccine manufacturers [39].

In 2009, vaccine nationalism became an issue during the swine flu (H1N1 virus) pandemic, which killed as many as 284,000 people worldwide. Luckily, a vaccine was developed within seven months; however, wealthy countries directly negotiated with vaccine producers for large advance orders, thus crowding out developing countries. Although several of those wealthy countries, including the U.S., agreed to donate vaccines to low- and middle-income countries, they only made those donations after first ensuring they could cover their own populations. As a result, distribution of the H1N1 vaccine was based on a nation’s purchasing power, not infection risk [40], [41].

4.3 Advanced purchases of COVID-19 vaccine candidates

Although WHO issued a warning about vaccine nationalism, wealthy countries moved quickly to make advanced purchases of not to yet selling vaccine candidates. Currently, the country pursuing this the most aggressively is the U.S. The Trump administration set up “Operation Warp Speed” by combining the efforts of several U.S. federal agencies—including the Departments of Health and Human Services (and its subagencies), Agriculture, Energy, and Veterans Affairs—and the private sector to accelerate the development, manufacturing, and distribution of COVID-19 vaccines, therapeutics, and diagnostics.

Operation Warp Speed has chosen three vaccine candidates to fund for their Phase 3 trials: Moderna’s mRNA 1273, the University of Oxford and AstraZeneca’s AZD 1222, and Pfizer and BioNTech’s BNT162. While funding several COVID-19 vaccine candidates, the U.S. government has made substantial pre-purchases: $2.0B for 100M doses from Sanofi-GSK, $1.95B for 100M doses from BioNTech-Pfizer, $1.7B for 100M doses from Novavax, $1.2B for 300M doses from AstraZeneca-Oxford, $1.5B for 100M doses from NIAID/Moderna, and $1.0B for 100M doses from Janssen/Johnson & Johnson.

Other governments are also making advanced purchases of yet-to-be approved vaccines. The U.K. has secured a total of 400M vaccine doses from six companies or company groups: Oxford/AstraZeneca, BioNTech/Pfizer, Janssen/Johnson & Johnson, Novavax, Sanofi/GSK and Valneva.

The EU has contracts with four leading candidate developers—Oxford/AstraZeneca, Janssen/Johnson & Johnson, Sanofi/GlaxoSmithKline, and CureVac—for a total procurement of over 1B doses. Neither the U.K. nor EU has disclosed any financial terms. Japan, although slow to start, has recently aggressively purchased vaccine candidates with three big players—Oxford/AstraZeneca, BioNTech/Pfizer, and Novavax—for a combined purchase of 490M doses [42], [43].

China is actively working to develop COVID-19 vaccines. At present, three of its six COVID-19 vaccine candidates are in Phase III trials. In addition to actively developing its own, China has been dealing with foreign...
pharmaceutical companies to secure COVID-19 vaccines, including Oxford/AstraZeneca to secure 200M doses of its vaccine.

5. Discussion: Possible Solution to Vaccine Nationalism

During the current COVID-19 pandemic, wealthy and advanced countries have rushed to pre-purchase COVID-19 vaccines. The U.S., the EU, and Japan have already secured doses of COVID-19 vaccines (candidates) in numbers exceeding their total populations. In response, WHO has expressed concerns regarding the geopolitical fight for COVID-19 vaccines. Thus, some international NGOs and NPOs have proposed a fairer distribution system for COVID-19 vaccines and called for international participation.

5.1 2009 swine flu pandemic experience

As mentioned above, when the swine flu pandemic hit in 2009, some of the world’s wealthy countries rushed to secure a vaccine against it. Poorer countries—including those most severely hit—were pushed to the back of the line as wealthy nations signed deals with pharmaceutical companies to guarantee access to the vaccine.

Many global health experts warned that COVID-19 is more serious than swine flu. While swine flu reportedly killed 284,000 people, COVID-19 has already killed more than 1.3 M people and struck a significant blow to the world economy. These global health experts fear the current pandemic could lead to a geopolitical fight over vaccines that would exceed those during the swine flu pandemic [44].

5.2 Priority of Vaccination

Currently, a number of pharmaceutical and biotech companies are worldwide are developing COVID-19 vaccines, with some of them already launching Phase III, or late-stage clinical studies. Some companies might obtain approval from their regulatory bodies within a couple of months; however, initial vaccine batches should be strictly limited in quantity. Thus, international prioritization of vaccine distribution should be determined carefully to avoid geopolitical struggles.

In his article titled “Vaccine nationalism threatens global plan to distribute COVID-19 shots fairly,” Kai Kupferschmidt argued for an order to prioritize who should receive a vaccine when it is available: first, global healthcare workers; second, people at a higher risk of severe disease; third, those in areas where the disease is spreading rapidly; and fourth, the rest of the population [45]. This prioritization of the vaccine might be acceptable for everybody.

5.3 Needs equitable approach toward vaccines

The Bill and Melinda Gates Foundation, a global NPO that has been fighting the COVID-19 pandemic, warned that COVID-19 will continue to be a threat to humans for many years to come if a vaccine is not distributed equitably to every person who needs it worldwide [46]. Brad Tytel, a senior program officer at the Bill and Melinda Gates Foundation, stated, “This (COVID-19) is a global pandemic, so it affects everybody. The best way for us all to be protected is to have an equitable approach to access—to ensure we’re doing what makes the most sense for the pandemic and for all of our protection, not just whoever can spend the most money” [46].

5.4 Gavi and COVAX

With the aim of working toward truly equitable distribution of COVID-19 vaccines worldwide, the Global Alliance for Vaccines and Immunisation (GAVI), Coalition for Epidemic Preparedness Innovations (CEPI), and WHO jointly set up COVID-19 Vaccine Global Access (COVAX). The goal of COVAX is to deliver two billion doses of safe, effective vaccines that have passed regulatory approval and/or WHO prequalification by the end of 2021. These vaccines will be delivered equally to all participating countries, proportional to their populations, initially prioritizing healthcare workers, then expanding to cover 20% of the participating countries’ populations. Further doses will then be made available based on each country’s needs, vulnerability, and COVID-19 risk.

To launch this program, the COVAX Advance Market Commitment (AMC), a financial instrument of GAVI, has aimed to collect US$2B from high-income countries and the private sector. AMC has reported raising US$600M to date.

Low- and middle-income countries will enjoy benefits from the COVAX program through its allocation of a COVID-19 vaccine to 20% of each country’s population. High income countries will also benefit from COVAX. If the vaccines these countries have invested in fail, they would still have access to other vaccines through COVAX, although only enough for 20% of their populations. According to COVAX, 76 upper-middle- and high-income countries have already committed to joining. However, several countries working to develop vaccines, such as the U.S., China, and Russia, have not joined the program.

6. Conclusion

Almost one year has passed since the COVID-19 outbreak began, yet even today, the numbers of cases and deaths have been rapidly increasing. Scientists worldwide have been carefully studying the virus, while pharmaceutical companies have focused all of their efforts on developing treatments. Although there are some treatments that can
An equitable approach is necessary to win a war against the global COVID-19 pandemic

Therefore, governments and pharmaceutical companies globally have decided to develop COVID-19 vaccines. According to WHO, 48 vaccines candidates are undergoing clinical studies, while 164 vaccines candidates are in pre-clinical stages. To secure enough vaccine doses for their own people, some wealthy countries, such as the U.S., the U.K., the EU, and Japan have rushed to pre-purchase vaccine candidates that are not yet approved. WHO Director-General Tedros condemned such maneuvers as “vaccine nationalism.” Since COVID-19 is a global issue, an equitable approach to vaccine distribution is required. Now, WHO, along with other international organizations, has set up the COVAX program aimed at distributing COVID-19 vaccines, which hopefully can be equitably procured and delivered by the end of 2021. To date, 76 countries have joined the program; however, large vaccine-producing nations, such as the U.S., Russia, and China, are missing from the list.

To win the battle against the global COVID-19 pandemic, people need to take an equitable approach to vaccine development and distribution, in which all major countries must participate.

7. Limitation

The COVID-19 pandemic has been spreading rapidly. Cases and deaths have been rising daily, while pharmaceutical and biotechnology companies worldwide work hard to develop COVID-19 treatments and vaccines. Each government has been carefully developing its policy and strategy toward COVID-19. This issue should be carefully followed by the author and the people who are in charge for the time being.

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International Journal of Japan Association for Management Systems - 118 -