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Distribution Strategy: Lessons from the United States COVID-19 Vaccine Distribution

Dongho KIM¹, Myoung-Kil YOUN²

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Abstract

Purpose: The purpose of this paper is to analyze and examine the issues that are directly associated with the United States COVID-19 vaccine distribution and its strategies so that other countries may learn from it and develop sound distribution strategies. **Research design, data and methodology:** This paper has applied both historical and narrative models to review, identify, and analyze existing literatures to assess the United States' vaccine distribution strategy. **Results:** Distribution strategy developed by the United States seems to have focused heavily on the basic tenets of physical distribution, i.e., transportation, warehousing, inventory, and large-venue mass-vaccination sites, and the strategy seems to have been successful when looking only at the physical tenets of distribution. However, the analysis indicates that the distribution strategy has not either focused on or included the major activities of distribution, such as inward and outward communication, information, and customer satisfaction. **Conclusions:** The countries that are currently developing or implementing COVID-19 vaccine distribution strategy should review and learn from the United States' vaccine distribution strategy and its implementation. The countries should include and address all the activities of distribution, including inward and outward communication, information, and customer satisfaction to achieve their vaccination goals, minimize confusion, reduce wasting of doses and vaccine desserts, and improve vaccination rates.

Keywords : Distribution Strategy, COVID-19 Vaccine Distribution, Physical Distribution, Distribution.

JEL Classification Code: I18, M38, N71

1. Introduction

From the beginning emergence of the Corona Virus (COVID-19) pandemic in 2019, the world witnessed mounting disruption in the production and distribution of personal protective equipment (PPE) supplies. The director-general of the World Health Organization (WHO) indicated, "Without secure supply chains, the risk to healthcare workers around the world is real. Industry and governments must act quickly to boost supply, ease export

restrictions, and put measures in place to stop speculation and hoarding". "We can't stop COVID-19 without protecting health workers first" (Chaib, 2020, p.1). In 2020, every country experienced shortage and distribution issues of the personal protective equipment (PPE), including face masks and hand sanitizers. Although the world recognized the severity of this pandemic throughout 2020 and applied different strategies, such as mandating face masks and social distancing, to minimize the spread of COVID-19, everyone generally recognized that the only way to truly prevent and combat the spread of COVID-19 and return to normalcy would be to achieve herd immunity through COVID-19 vaccinations. As such, while the world struggled to resolve and improve the distribution and shortage issues of PPE supplies to minimize the spread of COVID-19 and to protect both the healthcare workers and the public, some of the economically advanced countries, including the United States, raced to develop and distribute COVID-19 vaccines to achieve herd immunity in their

1 First Author, Associate Professor and Department Chair, SUNY Empire State College, USA, Tel: 607-319-2139, Email: Dongho.Kim@esc.edu

2 Corresponding Author, Professor, College of Health Industry, Eulji University, Korea, Tel: +82-31-740-7292, Email: retail21@hanmail.net

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respective countries.

In the United States, the federal government created Operation Warp Speed (OWS), a program to accelerate and deploy COVID-19 vaccines for free (AJMC, 2020). In September of 2020, the United States government released a vaccine distribution plan, and once the testing of both Pfizer and Moderna COVID-19 vaccines were completed, Food and Drug Administration (FDA) approved Emergency Use Authorization for the vaccines in early December of 2020. The United States successfully administered the first dose of the vaccine on December 14, 2020. By this time, the COVID-19 pandemic had infected 16 million and killed 300,000 people in the United States (Guarino, Cha, Wood, & Witte, 2020) partly because the United States was relying heavily or solely on developing and deploying COVID-19 vaccines instead of applying preventive measures such as facemask and social distance mandates (See AJMC Staff 2020).

Under OWS, the COVID-19 vaccines were quickly deployed to the states and their local partners, but within the first few weeks of distribution of COVID-19 vaccines, the public experienced the same shortage and distribution problems that were previously associated with the PPE supplies. According to the public health experts, “federal officials have left many of the details of the final stage of the vaccine distribution process, such as scheduling and staffing, to overstretched local health officials and hospitals” (Robbins, Robles, & Arango, 2021). By early June of 2021, COVID-19 had infected more than 33 million and killed 600,000 people in the United States.

The purpose of this paper is to analyze and examine the issues and problems that were directly associated with the United States COVID-19 vaccine distribution and its strategies so that other countries may learn from the United States and develop and apply sound distribution strategies.

2. Distribution Concept and Scope

Clearly understanding and defining the concept of “distribution” are essential in analyzing and examining the COVID-19 vaccine distribution strategy of the United States and in identifying distribution issues accurately and precisely. Although there is a clear definition of “physical distribution” as a part of the marketing mix, the general concept of “distribution” used by many for-profit and non-profit organizations is very similar to “logistics.” Ballou (2007) has suggested that the general concept of “physical distribution” was introduced around 1960 in a college textbook, and the term focused only on outbound movement of “... activities such as transportation, inventory control, warehousing, and facility location . . .” (p. 334). The concept of “business logistics” that address

both inbound and outbound orientations was introduced in 1964, and this term was developed based on the basic concept of physical distribution: “... that area of business management responsible for the movement of raw materials and finished products and the development of movement systems” (p. 335).

Then in the early 90s, Staude (1993) defined physical distribution as “a customer-oriented business philosophy supported by integrated physical distribution activities directed at generating customer satisfactions to meet organizational goal”. He described physical distribution based on four economic utilities of form, time, place, and possession and linked physical distribution to time, place, and possession utilities. Physical distribution creates time, place, and possession utilities “to ensure that the right product is in the right place at the right time” and “to satisfy the needs and wants of consumers by informing consumers both the availability of products, and of their merits” (p.32). Staude (1993) concluded that physical distribution is an important part of marketing that requires greater attention from manufacturers. Hence, it seems that some scholars and practitioners in the early years used and applied the terms “business logistics”, “logistics”, “physical distribution”, and “distribution” interchangeably as managing and coordinating product movements i.e., moving of final products to consumers efficiently and effectively.

According to McGinnis (1992), the initial term of “business logistics” or “logistics” was founded by the definition of “physical distribution” that focused only on all the activities of moving finished products to consumers. This definition of logistics evolved over time, and the recent definition of logistics focuses on “...flows of goods, services and information inbound, outbound, internal and external for the purpose of meeting customer requests” (p. 22). Kwon, Youn, and Namkung (2007) examined and traced the definitions of logistics and distribution and found similar definitions that are identified and described above. They applied six types of social and economic functions to show distribution activities: place, time, quantity, quality, price, and personality. They also suggested that the concepts and definitions of physical distribution and logistics are interchangeable but that the usage and application of physical distribution and its definition has been replaced by those of logistics.

In recent years, these concepts and definitions expanded to the concept of logistics and Supply Chain Management (SCM), which includes managing and coordinating sourcing, procurement, and conversion (Ballou, 2017, P. 338). Lummus, Krumweide, and Vokurka (2001) defined both logistics and SCM based on historical perspectives. They suggested that the term “logistics” first related to the military applications of late 19th century:

“Strategy is the art of handling troops in the theatre of war; tactics that of handling them on the field of battle... The French have a third process, which they call logistics, the art of moving and quartering troops”. The term and application of logistics moved into the business over time, being seen as “...the management of all inbound and outbound materials, parts, and finished goods. The term logistics should be distinguished from physical distribution in that the latter normally applies to only the post-production channel” (p. 426). They also suggested that the application and term of supply chain management can be traced to the textile and apparel industries in the 1980s, where the analyzing efficiency in the apparel supply chain resulted in development of Quick Response and Efficient Consumer Response Program. As the term of logistics evolved over time, the definition of supply chain management also evolved over time, including “...all the activities involved in delivering a product from raw material through to the customer, including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, delivery to the customer, and the information systems necessary to monitor all of these activities” (p. 428). Lummus, Krumweide, and Vokurka (2001) concluded, “logistics is generally viewed as within one company where supply chain management includes the logistical flows, the customer order management and production processes, and the information flow necessary to monitor all the activities at the supply chain modes” (p. 431).

As the analysis indicates above, the definition and scope of distribution are very similar to those of business logistics, physical distribution, and logistics in terms of managing and coordinating the movement of goods, and it seems the definition of logistics or SCM was an expansion of the definition and scope of physical distribution,

distribution, and business logistics. The only difference is that distribution deals with the process after the production, not with managing raw materials or manufacturing. The appropriate and applicable definition of distribution should be clearly distinguished from the definitions of physical distribution, logistics, and SCM. The activities of logistics and SCM include pre and postproduction (Lummus, Krumweide, & Vokurka, 2001), whereas the activities of both physical distribution and distribution mainly deal with postproduction, where physical distribution is generally associated with outbound activities, such as transportation, inventory control, warehousing, and facility location (Ballou, 2007).

As such, the definition of distribution should be “managing and coordinating all the transactional activities that are directly associated with the movement of goods to achieve customer satisfaction and organizational goals”. The paper will apply this definition of distribution to analyze and examine the United States COVID-19 vaccine distribution.

3. COVID-19 Vaccine Distribution Timeline and Issues

As previously indicated, the United States government developed OWS in 2020 to develop and implement distribution strategies for COVID-19 vaccines - “the principal purpose and objective of Operation Warp Speed (OWS): ensuring that every American who wants to receive a COVID-19 vaccine can receive one, by delivering safe and effective vaccine doses to the American people beginning January 2021” (Homeland Security Digital Library, 2020).

Table 1: Overall Strategy and Key Distribution Components.

OWS Overall Strategy	Key Distribution Components
Continue engaging with state, tribal, territorial, and local partners, other stakeholders, and the public to communicate public health information, before and after distribution begins, around the vaccine and promote vaccine confidence and uptake.	Partnerships with state, local and tribal health departments, territories, Tribes, and federal entities to allocate and distribute vaccines, augmented by direct distribution to commercial partners.
Distribute vaccines immediately upon granting of Emergency Use Authorization/ Biologics License Application, using a transparently developed, phased allocation methodology.	A centralized distributor contract with potential for back-up distributors for additional storage and handling requirements.
Ensure safe administration of the vaccine and availability of administration supplies.	A flexible, scalable, secure web-based IT vaccine tracking system for ongoing vaccine allocation, ordering, uptake, and management.
Monitor necessary data from the vaccination program through an information technology (IT) system capable of supporting and tracking distribution, administration, and other necessary data.	

Note: Homeland Security Digital Library. (2020, September 16). *From the factory to the frontlines: The operation warp speed strategy for distributing a COVID-19 vaccine.*

Simply, OWS was to coordinate with different distribution channels to allocate and distribute vaccines to the American people efficiently and effectively upon EUA from the Food and Drug Administration (FDA).

Furthermore, OWS was to continuously communicate and promote vaccine confidence and apply appropriate information technology to manage vaccine and vaccination related data (see Table 1).

Table 2: A timeline of COVID-19 vaccine developments in the United States in 2020 and 2021.

Timeline	Developments and Issues
January 2020	Chinese scientists confirm COVID-19 human transmission; WHO issues global health emergency
February	The United States declares public health emergency; CDC says COVID-19 is heading toward pandemic status
March	WHO declares COVID-19 a Pandemic; California becomes the first state to issue a stay-at-home order
June	US COVID-19 cases reach 2 million; The United States' Operation Warp Speed, a project to rapidly develop and deploy a COVID-19 vaccine, explains that the vaccine would be provided for free
August	The United States rural hotspots face lack of intensive care unit beds; COVID-19 becomes the third-leading causes of death in the US
September	Trump administration releases vaccine distribution plan
October	Global cases top 40 million, and more than 1.1 million people have been killed
November	Pfizer releases data from its COVID-19 vaccine trial showing that the vaccination was 90% effective; Moderna reveals vaccine efficacy results; Pfizer, BioNTech submit Emergency Use Authorization
December	FDA agrees to EUA for COVID-19 vaccine from Pfizer, BioNTech, FDA signs off EUA for Moderna's COVID-19 vaccine; UK approves EUA for the AstraZeneca and Oxford COVID-19 vaccine; US falls short of goal to give 20 million vaccinations by year end (about 14 million doses have been distributed out of total of 20 million allocated doses and 2.8 million received an initial vaccination)
January 2021	HHS (Health and Human Services) announces that the CDC (Center for Disease Control and Prevention) plans provide more than \$22 billion in funding for states and territories to support the nation's COVID-19 response; American Hospital Association pushes for faster vaccine roll out; Pharmacies tapped to distribute vaccines; States face significant rollout hurdles; Vaccine doses go unused and trashed; CDC update vaccine allocation guidance; Elderly Los Angeles county residents report confusions and delays; GoodRx report documents vaccine deserts; Reports of racial disparities in vaccination rates; Incoming CDC Director Walensky to prioritize vaccine rollout; Amazon offers to help distribute vaccines; Health officials nationwide report limited vaccine supply; Moderna to develop booster shots to combat variants; US vaccine supply to increase by 50%
February	United States purchases 200 million Moderna, Pfizer vaccines; Polls show split by party line over vaccine update; Storm stall vaccine shipments, cancel immunization drives; Tennessee Department of Health Finds wasted vaccine doses; Los Angeles vaccine distribution program misused; 50 million COVID-19 vaccine doses administered; FDA grants EUA for J&J vaccine
March	Biden Says vaccines will be available for every US adult by May; Lack of pharmacies in rural America could impede rollout; Nearly half of Republican men will not get COVID-19 vaccines; White House to spend \$1.5 Billion on vaccine confidence campaign; Vaccine doses expected to reach 700 million by summer; Patients with blood cancer report vaccine hesitancy; Some states open vaccinations to all adults; Vaccine hesitancy drops
April	Vaccine rollout marred by racial inequities; CDC expands travel guidelines; racial disparities in COVID-19 incidence, Mortality in Montana; Study outlines COVID-19 blood clot risk; Half of all US adults have received 1 COVID-19 dose; States see drops in demand for COVID-19 vaccines; CDC eases mask restrictions for fully vaccinated individuals; Half of US states report drops in COVID-19 cases; CVS, Walgreens wasted more vaccine doses than most states Combined
May	FDA preparing to authorize Pfizer vaccine in adolescents; Teenagers respond well to COVID-19 vaccines; States with different vaccination rates; Heart problem investigated in vaccinated teens
June	Employers Can Require COVID-19 Vaccine

Note: AJMC Staff. A timeline of COVID-19 vaccine developments in 2020 and 2021. (2021, June 3). *American Journal of Managed Care*.

According to AJMC, “A Timeline of COVID-19 Developments in 2020 and 2021,” the United States has indeed focused heavily on developing and deploying COVID-19 vaccines instead of applying preventive measures such as facemask and social distance mandates in the earlier days of pandemic (see Table 2).

After the approval of EUA for Pfizer and Moderna in December 2020, the United States has funded and pushed available vaccinations to state, tribal, territorial, local partners, and other stakeholders. This is a typical push strategy where the United States government coordinates and negotiates with states and local and other partners to distribute COVID-19 vaccines, and this strategy is applicable and appropriate when vaccine supply is limited and in high demand. In the scope of distribution, the push strategy works at best when every distribution channel understands and implements the overall distribution strategies efficiently and effectively, and it requires clear and effective coordination and communication among distribution channels. For instance, the CDC’s falling short of their vaccination goal to give 20 million doses by the end of December 2020 (only about 2.8 million American people have received the initial dose out of 14 million distributed) is a good example of not executing a push strategy efficiently.

In January 2021, the public finds out more vaccine distribution related issues, e.g., states face significant rollout hurdles, vaccine doses go unused and trashed, elderly Los Angeles County residents report confusions and delays, GoodRx report documented vaccine deserts, and parts of the country report racial disparities in vaccination rates (AJMC Staff, 2021). AJMC Staff (2021) also noted the following distribution issues between February and May 2021: vaccine shipments stalled by storms, immunization drives cancelled, wasted vaccine doses found by Tennessee Department of Health, Los Angeles vaccine distribution program misused, rollout impeded by lack of pharmacies in rural America, COVID-19 vaccines refused to be taken by nearly half of republican men, vaccine rollout marred by racial inequities, vaccine doses wasted by CVS and Walgreens than most states combined, and different vaccination rates shown in different states.

The analysis of vaccine distribution timeline and issues above indicates that there was no particular problem directly associated with the physical distribution activities, e.g., transportation, warehousing and storage, inventory control, etc. However, there were many problems associated with issues such as wasting vaccine doses, inequity in vaccination rates, and limited access of technology and pharmacies, all of which could have been prevented, as these issues were similar to those of previous influenza pandemics and previous literature addressing these issues exist, as discussed in the next section.

4. Analysis and Results of COVID-19 Vaccine Distribution

Prior to the vaccine rollout, healthcare experts identified some issues and challenges of distributing COVID-19 vaccinations. According to Mills and Salisbury (2020), three major requirements must be met to be successful in distributing vaccination - “vaccine supplies (cold storage, distribution, syringes, needles), people to implement them (vaccinators, staff to document), and people to be vaccinated” -, and targeted and phased deployment of vaccination groups, e.g., healthcare workers, older adults, first responders, etc., should be identified prior to arrival of vaccinations. They also suggested that detailed distribution and implementation plans are necessary to make the vaccination campaign successful. Salmon, Opel, Dudley, Brewer, and Breiman (2021) also indicated that the major precautionary measures, especially addressing public concerns and effective communication plan, “unlocks the potential for high vaccine coverage; this is best achieved when science and values, not politics, inform public health” (p. 1).

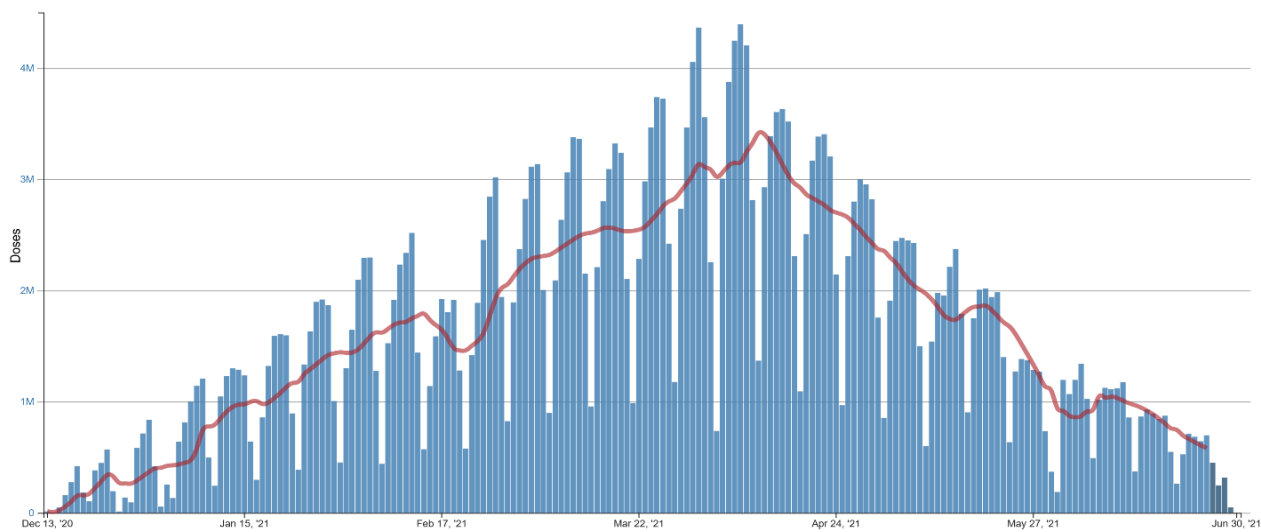
In terms of vaccine equity and fair vaccine distribution, the study of Groom, Cheek, and Bryan (2006) have found that inequity of the vaccine coverage exist when there is vaccine shortage; therefore, both implementation and distribution policies, guidelines, and strategies must be explored, examined, and identified. “Strategies must identify to ensure more equitable distribution of vaccines during the shortages at the national, state, tribal, and local levels” (p. 4). Clark, Fredricks, Woc-Colburn, Bottazzi, and Weatherhead (2021) also suggest that both federal and state government vaccine distribution strategies and policies should be carefully drafted to make vaccine available for hard-to-reach populations, including new immigrants to the United States. “As national vaccine allocation, distribution, and communication plans are made, it is important to include creative, inclusive approaches to equitable vaccine access based on input from representatives of immigrant communities” (p. 580). Araz, Galvani, and Meyers (2011) have analyzed a bi-criteria comparison of the four vaccine distribution policies during an influenza pandemic for the state of Arizona, and their findings suggest, “effective distribution policies reduce the rate of pandemic influenza transmission” (p. 175).

These literatures clearly show that those vaccine distribution issues will arise if the government does not develop detailed and sound distribution and implementation plans: “A multifaceted and thorough engagement and communication plan that is responsive to the concerns and values of different groups must be swiftly yet carefully implemented in a coordinated manner by federal, state, and local governments” (Salmon et al., 2021,

p. 1). The goal of the United States COVID-19 vaccination campaign was to deliver COVID 19 vaccines to the arms of the American people and achieve herd immunity, e.g., vaccinate 70% adults in the United States by July 4, 2021. As of June 2021, 46.7% American people (about 155 million) are fully vaccinated with 54.4% (about 181

million) being vaccinated at least one dose, and the statistics indicates that the United States would not reach its goal of vaccinating 70% adults by the given deadline. Figure 1 shows that vaccination rates peaked in early April and sharply declined since, averaging 3 million shots per day in early April to less than 1 million shots in June.

Daily Count of Total Doses Administered and Reported to the CDC by Date Administered, United States



Note: Centers for Disease Control and Prevention (as of June 29)

Figure 1: COVID-19 Vaccine Doses Are Being Administered Each Day in the United States.

The definition of distribution this paper developed based on historical and practical perspectives go beyond the concept and scope of physical distribution and includes “managing and coordinating all transactional activities that are directly associated with the movement of goods to achieve customer satisfaction and organizational goals”. It seems the distribution strategy developed by the United States was focusing heavily on the basic tenets of physical distribution, i.e., transportation, warehousing, inventory control, and large-venue mass-vaccination sites (Goralnick, Kaufmann, & Gawande, 2021). This strategy and its implementation could be viewed as appropriate and successful; however, those vaccine distribution issues identified here are directly associated with other distribution tenets that are not included in the concept of physical distribution, such as inward and outward communication, information, and customer satisfaction.

For inward and outward communication, the point of origin, which is the United States government in this case, must have effectively and continuously communicated with the final consumers, the American public, and promoted the safety and effectiveness of COVID-19 vaccines, the benefits of getting vaccinated, and one’s duties of social responsibility. Effective and continuous inward and

outward communication minimizes confusion and noise and improves customer satisfaction. For instance, it was a little too late to minimize confusion and noise, especially the anti-vaccine messages and vaccine conspiracy theories, by the time the Biden administration decided to spend \$1.5 billion on vaccine confidence/public relations campaign on March 15, 2021, (AJMC Staff, 2021). The United States should have spent more time and money on vaccine confidence/public relations campaign much earlier to improve awareness and effectiveness of the vaccines. Furthermore, the United States only applied the push strategy, that is, there was no process for a continuous improvement in the distribution process. For example, either providing feedback to improve vaccination process was not available to the public, or provided feedback was not analyzed for improvement, e.g., the AJMC’s timeline shows the issues of vaccine deserts continued since January of 2021.

In terms of information, sharing most updated and accurate information, such as vaccine distribution allocations and vaccination sites, their contact information, and vaccine availability, could have prevented and reduced wasting of vaccine doses, vaccine deserts, and vaccine inequity. Furthermore, information about safety and

effectiveness of vaccines and the benefits of being fully vaccinated were confusing. For instance, CDC promoted safety and effectiveness of vaccines throughout the pandemic but failed to timely advance the major benefit of being fully vaccinated, e.g., the announcement that people who are fully vaccinated can resume their daily activities without wearing masks and social distancing was made in May 2021 instead of earlier in the year.

Finally, the vaccine distribution strategy, which relied heavily on technology-based customer service for the entire public, created confusions and delays. For instance, the internet-based vaccine administration system, including vaccination locations, availability, and appointments, was only useful for those who have access to internet and know how to navigate. Many senior citizens and those who live in rural areas either did not have access to or knowledge of the technology or were in a vaccine desert that did not have vaccination sites. In January 2021, Amazon offered to help distribute COVID-19 vaccines using their information technology and communication, distribution, and operation capabilities. While delivering mass vaccination doses to states and local partners would have been simple and straightforward for Amazon, given its world class distribution systems, technology, network, and capabilities (Hahn, Youn, & Kim, 2018), Amazon would still be limited to help those who do not have access to technology or are living in vaccine deserts.

5. Conclusions

Every country in the world was impacted by the COVID-19 pandemic, and it seems the only way out of this pandemic was to develop, distribute, and vaccinate COVID-19 vaccines effectively and efficiently. The United States began its vaccination campaign in the middle of December 2020, and approximately 47% of its population has been fully vaccinated by the end of June 2021, whereas only 11% worldwide. This paper analyzed distribution strategy of COVID-19 vaccines that the United States developed and implemented based on the historical and practical definition of distribution. The United States' vaccine distribution strategy was appropriate and successful if one views the strategy based on the concept and scope of physical distribution only. Physical distribution generally focuses on packaging and material handling, order processing, transportation, inventory, warehousing, etc.; whereas, distribution encompasses physical distribution activities as well as other activities, including inward and outward communication, information, customer satisfaction and achieving organizational goals. Therefore, the United States' vaccine distribution strategy was short of meeting the concept and scope of distribution.

The countries that are currently developing or implementing COVID-19 vaccine distribution strategy should analyze and learn from the United States' distribution strategy and its implementation. Countries should identify and apply all the distribution activities in addition to those of physical distribution, especially inward and outward communication, information, and customer satisfaction to achieve the country's vaccination goal, which is to develop and implement sound vaccine distribution strategies to achieve herd immunity. To prevent confusion, wasting of vaccine doses, vaccine inequity, and vaccine deserts to improve customer satisfaction that leads to achieving herd immunity, the United States COVID-19 vaccine distribution strategy should have included (1) communicating early, continuously, and effectively with the states, local partners, and the public; (2) sharing and informing the most updated and accurate information, such as vaccine distribution allocations, vaccination sites and their contact information, vaccine availability, and the benefits of being fully vaccinated; (3) identifying and using local conventional health care sites, such as public health clinics, local pharmacies, hospitals, and pop-up clinics, to be the point of obtaining vaccine information and vaccine administration in addition to using internet and cell phone based technology; and (4) utilizing nontechnology based customer support services, such as existing postal service and its networks, local broadcasting companies and newspapers, and community services to help inform and guide the public, especially those who do not have adequate technology or live in vaccine deserts.

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