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An Analysis of the United States' Response
to Securing Personal Protective Equipment Amidst COVID-19

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ABSTRACT

The COVID-19 pandemic has exposed many underlying issues with the United States' emergency response plans, as well as the supply chain system for personal protective equipment. These downfalls resulted in detrimental human and economic loss across the entire nation. No state has been spared, and the United States' decision to act as fifty separate states, rather than one unified nation, has only aggravated the problem. At the end of this thesis, an analysis will be performed on New Zealand, a country that responded successfully to the pandemic through a universal and united strategy.

This thesis will begin with an overall look into the federal and state governments' roles in responding to national emergencies, as well as an overview on healthcare supply chain management in the United States. The thesis will then delve into the supply chain operations behind personal protective equipment, both before and during the pandemic. Next, the thesis will take a quick look at New Zealand's overall response to COVID-19, in order to consider key discrepancies between the response in the United States. Lastly, the thesis will conclude with recommendations on how to better improve the United States' response and outlook on the supply chain behind personal protective equipment. After careful analysis of the current state of emergency preparedness and supply chain management surrounding personal protective equipment, it is clear that the United States must make the necessary improvements to ensure the protection of the economy and health of the citizens. This analysis highlights the need for a more universal approach to emergency preparation and response, establishing a plan for an increase in domestic manufacturing of personal protective equipment, and shifting away from the just-in-time healthcare delivery system.

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Chapter 1

Introduction

Coronavirus disease 2019 (COVID-19) first emerged in Wuhan, China in December of 2019 (“About COVID-19,” 2020). Then, on March 11, 2020, the World Health Organization marked COVID-19 as a global pandemic (Ranney et al., 2020). In just a matter of months, the U.S. and many countries around the world were shut down and hundreds of thousands of people had already lost their lives. The U.S. was criticized by many for their ineffective response to the disease, and even months after the lockdown, the country is facing record breaking confirmed cases. Compared to other countries which are now almost returning back to their normal lives, the U.S. is struggling to find answers. Especially during such a heated and intense election year, current policies and procedures have been highly debated and the country is facing a severe split between how each side believes the government should respond to the pandemic.

In addition to political influences, the U.S. also faces the unique obstacle of balancing fifty individual states. Each state has its own governing body, with even smaller local governing bodies included within each state. This idea of a main government combined with regional governments, like state governments, is called federalism. Federalism is at the core of the U.S. Constitution, but it can have complications when it comes to a complex issue such as COVID-19. When compared to a unitary state like New Zealand, it is clear that federalism in the U.S. caused major issues when leaders tried to combat the pandemic.

Figure 1 below illustrates the countries that had the highest reported coronavirus cases as of May 17 of 2020 (Lee & Cher, 2020). This figure puts into perspective the severity of cases

and deaths in the U.S., within even just the first few months of the pandemic. As this report will later describe, there were many key issues regarding emergency planning and the equipment supply chain that correlated with the U.S.'s failure to combat COVID-19.

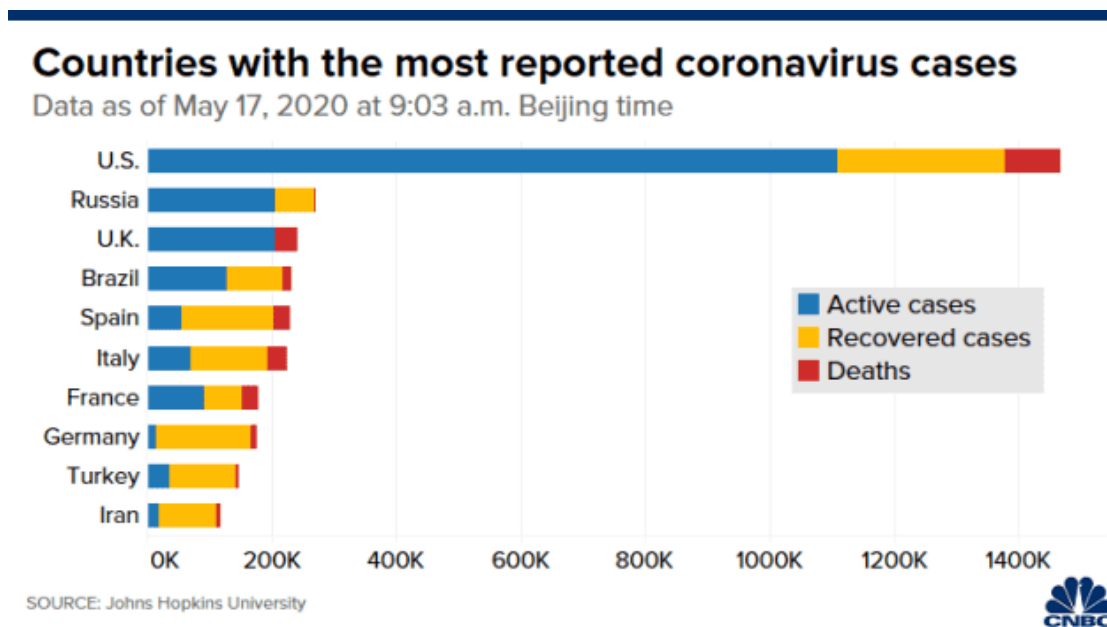


Figure 1. Countries with the most reported coronavirus cases

Source: “US, Italy and Spain have the most coronavirus cases. These charts show their infection curves” by Yen Nee Lee and Audrey Cher

This thesis seeks to provide an overview of the emergency plan in the U.S. prior to COVID-19, address how U.S. health care supply chains suffered because of that plan, and later provide recommendations for improved emergency planning and supply chain operations that would hopefully prevent future economic and human loss. This report will include an in-depth look at the personal protective equipment (PPE) supply chains, in order to identify what could have caused the shortage in supplies when the pandemic emerged. An analysis will then be performed regarding New Zealand’s response to COVID-19. New Zealand has experienced a successful outcome thus far. This insight will provide an inside look at the perspective of a

universal plan for action. The thesis will then conclude with recommendations for improved planning regarding healthcare supply chains and emergency planning.

Chapter 2

Background and Scope

The U.S. is unique in that it includes legislative and executive bodies that are acting at the federal, state, and local levels. Although the federal government is very powerful and controls many aspects of the country, each state has a lot of autonomy. When it comes to public health emergencies, states are granted the power to respond how they see fit. Each state is grounded on different values and political beliefs, which resulted in differing responses to this emergency. With each state's differing strategy to combat COVID-19, the country quickly became split and unsettled. There was no universal strategy or platform for states to unify around.

Federal Government

The Public Health Service Act, National Emergencies Act, Stafford Act, and the Defense Production Act all are statutes that allow the federal government to declare a national emergency and obtain funding and resources. In response to COVID-19, President Donald Trump utilized all of these statutes between January 31 and March 18 of 2020. He also announced that the Federal Emergency Management Agency (FEMA) would lead efforts to combat COVID-19. Before he announced this on March 19, response efforts were the responsibility of the Department of Health and Human Services.

Congress also has a role in responding to emergencies. They have the power to control the funding that is derived from tax revenue, and they can use this funding to improve the general welfare of citizens in the U.S. and to respond to public health crises. Congress has

utilized multiple laws throughout the pandemic to provide support for public health resources and the economy. They not only utilized existing laws, but also implemented some as well. For example, they passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act (Pub. L. No. 116-136). They also passed the Coronavirus Preparedness and Response Supplemental Appropriations Act (Pub. L. No. 116-123), which supported medical supply distribution, testing, and vaccine research and development by making \$8.3 billion available for the government to use (Price & Myers, 2020).

State Government

States also play an important role when responding to emergencies. The U.S. Constitution, through the Tenth Amendment, hands power over to the states for issues that were not already delegated to the federal government. States hold a lot of power, and each state is able to handle situations differently. Included in these powers that the states have are police powers, which gives each state the ability to choose how they respond to public health emergencies, such as the COVID-19 pandemic. For example, governors, state's health departments, and state's health agencies have the power to establish quarantines, as we have seen throughout the past year across many states (Price & Myers, 2020).

Healthcare Supply Chain Overview

Healthcare in the U.S. typically operates off a just-in-time delivery system, which many believe to be a contributing factor to the shortage of PPE during the pandemic. With a just-in-

time delivery system, distributors usually maintain a thirty to ninety-day supply at one time. This system of delivery allows healthcare organizations to minimize inventory and holding costs. Prior to the start of the pandemic, domestic passenger flights were a common way to deliver medical equipment and supplies. Now, due to a decrease in the number of flights, there have been severe hinderances in flights and increases in cost (“COVID-19 Related Goods,” 2020). The just-in-time delivery system has proven successful in the past, but the current pandemic highlighted some major issues with the system.

Chapter 3

Personal Protective Equipment Distribution

Issues with the supply chain and distribution of personal protective equipment (PPE), such as gloves, medical masks, goggles, and N95 respirators, created supply shortages that increased the rate of the disease and deaths in the U.S. This is not the first time that the U.S. has struggled with PPE supplies. The Human Immunodeficiency Virus, the 9/11 attack, and the Ebola Virus all exposed the lack of an efficient PPE supply chain in the U.S., but the COVID-19 pandemic proved that this country has not yet learned from previous mistakes. COVID-19 is highly transmissible and severe, so the shortage in PPE was extremely detrimental. According to the National Nurses United, eighty-seven percent of nurses had to reuse a single-use N95 respirator or disposable mask. Additionally, twenty-seven percent of nurses said that they did not have the proper PPE when they were exposed to patients with COVID-19. As of only July 28, 2020, there were 342 healthcare professionals who died from COVID-19, according to Medscape (Cohen & Rodgers, 2020). When healthcare professionals do not have proper PPE, they are at a thirty percent greater risk of being infected, according to Dr. Andrew T. Chan and his colleagues at Harvard Medical School (Mendoza & Linderman, 2020).

In the U.S., the emergency stockpile had twelve million N95 respirators in the beginning of March of 2020. According to Dr. Prakash Mirchandani from the University of Pittsburgh, this stockpile was too small, as illustrated through studying opportunity cost. The U.S.'s capacity to manufacture respirators is insubstantial; it would take the U.S. over four months to obtain 300 million respirators. Throughout the pandemic, this capacity has grown. However, demand has still steadily increased which, as mentioned earlier, has forced healthcare providers to reuse the

masks. All levels of government and hospital systems have been fighting one another for PPE due to the insignificant stockpile we entered into the pandemic with (Mirchandani, 2020).

It is important to note where the supply chain process for PPE starts because the manufacturing origin illustrates the major issue the U.S. faced when trying to collect PPE. China is the leading exporter of PPE in the global market. China is known for very low-cost production and good quality goods (Cohen & Rodgers, 2020). China produced half of the surgical masks that were supplied in the world, prior to the COVID-19 outbreak (Burki, 2020).

With hospitals and healthcare providers prioritizing low costs and inventories, they seek out the producers that offer the lowest price, like China. While China is the leading exporter, the U.S. is the leading importer of PPE (Cohen & Rodgers, 2020). This was clearly an issue for the U.S. when China was the first country hit hard by COVID-19. PPE supply in China was already interrupted by Chinese New Year, on January 25, 2020. In the past, this holiday has interrupted supply production by ten to fourteen days. Due to many people gathering for the holiday, many cases emerged throughout China, and many people were not able to go back to the factory to work due to new emergency health policies that were in place (Burki, 2020).

Now, not only was production rapidly decreasing, but also domestic demand was rapidly increasing in China as well. Due to their increased need for PPE, China had to put restrictions on their exports. Other countries were forced to do the same, and restrictions internationally quickly exacerbated the problem. Prices for surgical masks, N95 respirators, and surgical gowns were increasing at concerning rates, while countries like the UK and U.S. were in significantly low supply of all PPE. Competition for PPE around the entire world became competitive, but even nations were internally competing. For example, there were reports of states in the U.S. bidding against one another for PPE supplies. The Director-General of the World Health Organization,

Tedros Adhanom Ghebreyesus, said at the end of March of 2020, “The chronic global shortage of personal protective equipment is now one of the most urgent threats to our collective ability to save lives” (Burki, 2020).

The U.S.’s Reliance on Foreign Imports

Many people point to the U.S.’s reliance on foreign imports for PPE as a main reason for their struggle with supplies. The PPE shortage in the U.S. has highlighted the issues with the supply chain process. These issues need to be immediately addressed and analyzed in order for the U.S. to avoid similar complications in the future.

There are many valid reasons for both importing and exporting PPE. For example, many countries import PPE because it minimizes costs. However, during an emergency, such as a pandemic, issues with importing PPE can have human and economic consequences. If the U.S. starts to increase domestic production of PPE, they could potentially encounter uncertainties with public health and national security (Bai et al., 2020). It is important to consider all of the associated benefits and disadvantages to both importing and domestically manufacturing PPE.

The Journal of General Internal Medicine recently found that 3M, Honeywell International, and MSA Safety are the three largest manufacturers of PPE in the U.S. As of July of 2020, these three manufacturers had not yet disclosed supply chain information. In their reports shared with the Food and Drug Administration, they only provided information regarding the locations of their manufacturing facilities. There was no information regarding the overall depth of their production or supply chain operations. Congress has introduced bills to increase

transparency and reporting among these supply chain operations. However, there are many stakeholders at play, so these efforts could be hard to prove successful (Bai et al., 2020).

PPE in the U.S. During the Pandemic

During President George W. Bush's presidency, the Strategic National Stockpile was created. This was meant to support states and healthcare organizations with healthcare equipment during emergencies; however, the stockpile was not adequately stocked when COVID-19 started. When COVID-19 first made its way into the U.S., the masks in the stockpile had not been restocked since 2009 and many were expired. The lack of focus and concern regarding the stockpile prior to the COVID-19 pandemic were likely a result of insufficient funding. There have even been recent cuts in funding for restocking the stockpile (Finkenstadt et al., 2020). The funding clearly is not enough to allow the stockpile to operate efficiently and be of use when it is necessary. For example, the budget for the Strategic National Stockpile in 2019 was \$745 million; however, the team managing the stockpile requested a budget that was \$1 million over what they were provided with. Although officials managing the stockpile have made improvements since the pandemic started, such as adding supplies and increasing their supply chain knowledge, these changes were not able to make up for the gaps in the system prior to the pandemic (Evstatieva, 2020). As mentioned earlier, many of these supplies are imported from China, so restocking the stockpile is not something that can be done overnight.

Additionally, the responsibility and management of the Strategic National Stockpile was put into the hands of a small group of individuals within the U.S. Department of Health and Human Services, which is a department of medical professionals. Another concerning fact is that

there have been no updates on the inventory-management systems that the stockpile operates on since 2004 (Finkenstadt et al., 2020). The previous director of the Strategic National Stockpile, Greg Burel, believes that the entire supply chain for critical equipment needs to be redone (Evstatieva, 2020).

Role of the Government

As mentioned earlier in the Federal Government section, the President of the U.S. can utilize the Defense Production Act. This act allows the President to require the production of certain necessary items by U.S. manufacturers. This act could have solved some of the major issues with the Strategic National Stockpile, but President Trump did not frequently utilize his authority under the act. States were left alone to solve the issues left behind by the federal government. Each state dealt with this in their own way, and each state and governor were left to implement their own, individual supply chain systems. For example, California and Oregon found warehouses to lease where they established stockpiles for their states. California worked with vendors to bring in gloves and N95 respirators, and California, as an individual state, now has more N95s supplies than the entire Strategic National Stockpile does. California has successfully managed their supply chain on their own; however, many other states are struggling and have to use whatever the national stockpile can provide for them (Evstatieva, 2020).

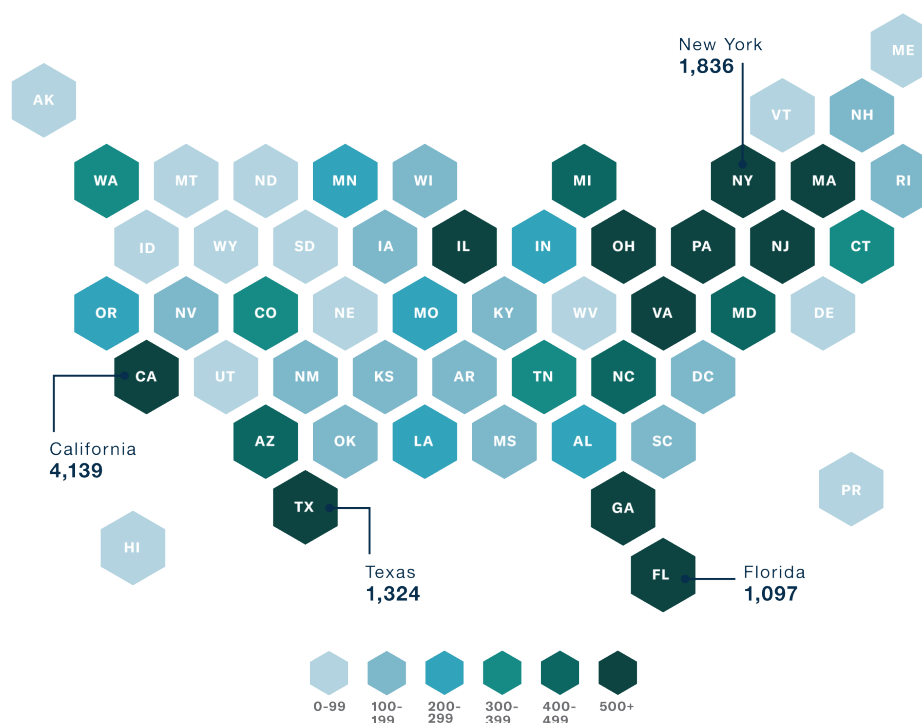


Figure 2. State breakdown of PPE requests to Get Us PPE

Source: “PPE Shortage Index indicates the PPE crisis continues” by Get Us PPE

Get Us PPE is the largest national organization that helps provide PPE to frontline healthcare workers. It is a nonprofit organization that was founded by emergency physicians in March of 2020. As illustrated above in Figure 2 by Get Us PPE, every state requested some kind of help regarding PPE supply. The map shows the breakdown of each state and the number of requests that Get Us PPE has received between March 2020 and January 2021. The shaded blue and green colors at the bottom identify the number of requests for each state. Even a year after the pandemic started, in February 2021, forty-four states still were requesting PPE (“PPE Shortage,” 2021).

Biden Administration's Approach

When President Biden took office, his administration quickly started to transform the federal government's approach to combatting COVID-19. Early on, his administration made it clear that they believed the Defense Production Act should be more actively utilized in order to increase production of PPE. The president of the American Medical Association, Susan R. Bailey, MD., said that she hopes the Biden Administration's new plan "will quickly fix the supply chain issues that have plagued the U.S. for many months—providing health care professionals with the PPE they need to protect themselves," while also protecting patients and families. This administration has used executive actions to create a public health workforce plan, advance the collection of COVID-19 data and information, and create a pandemic testing board. President Biden also appointed a COVID-19 response coordinator, Jeffrey Zients (O'Reilly, 2021). It appears as though the new administration is starting to look forward with a research-based approach to both analyzing and preparing for future emergencies similar to COVID-19.

Chapter 4

Country Comparison

New Zealand was consistently making headlines over the past year for their success at handling COVID-19 cases. After the Severe Acute Respiratory Syndrome outbreak in 2006, New Zealand’s Ministry of Health (the Ministry) and district health boards (DHBs) came together to create an emergency response plan, which included creating a national reserve of PPE (Ryan, 2020). This section will outline New Zealand’s general strategy to the COVID-19 pandemic, as well as its approach to the distribution of PPE. New Zealand’s success in handling COVID-19 makes it an ideal country to analyze and compare to the U.S.

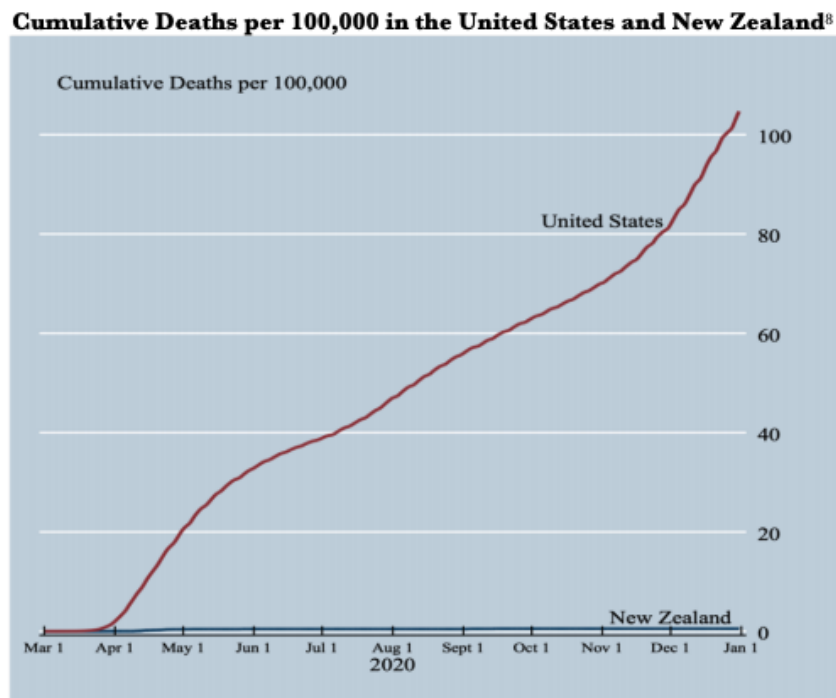


Figure 3. Cumulative Deaths per 100,000 in the United States and New Zealand

Source: “Why America’s Response to the Covid-19 Pandemic Failed: Lessons From New Zealand’s Success” by Richard Parker

As illustrated above in Figure 3, New Zealand was extremely more successful compared to the U.S. in regard to saving lives. This figure compares cumulative deaths per 100,000 people from March 1 of 2020 to January 1 of 2021. It is important to compare the successes of New Zealand to the downfalls of the U.S. when considering recommendations for improving emergency plans and PPE supply chain management.

Overall Approach

New Zealand's approach to COVID-19 started as a mitigation approach. In February of 2020, they enacted its pandemic influenza plan, along with policies restricting people from entering the country. Then, in the middle of March, New Zealand realized they were not prepared to the level that they needed to be. Leaders came together and used information backed by science to transition into a national elimination strategy. On March 26, there was a lockdown across the entire country. This lasted for seven weeks, and at the beginning of May the country was no longer facing any spread of COVID-19. After the elimination strategy had ended, the only concern was people who were entering from outside the country. People entering had to go into quarantine or isolation for fourteen days, as enforced by the government. In August of 2020, New Zealand was almost back to normal, and their economy was performing in ways it was before COVID-19 hit. According to a team from The New England Journal of Medicine, the government's ability to act fast and utilize science-based research was extremely beneficial. There was also a consistent theme and emphasis on unity, which Prime Minister Jacinda Arden established among all the citizens. This unified approach encouraged trust and cohesion, resulting in adherence to all policies that were put in place (Baker et al., 2020).

PPE Distribution

In New Zealand in February of 2020, there were issues identified with the PPE stock, similar to those seen in the U.S. with the national reserve. The Ministry and DHBs in New Zealand had not collaborated prior to the pandemic, so there were many uncertainties around the stock of PPE. There was also no system in place to forecast demand, and items in the reserve had expired. PPE was procured by the DHBs either individually or regionally, which caused problems as restrictions arose internationally for PPE when COVID-19 hit. However, New Zealand immediately created a new and centralized procurement system right around the time they were in lockdown (Ryan, 2020).

The country established a national registry for PPE. This registry was live and constantly updated, working to find manufacturers. Additionally, smaller, local businesses stepped in to produce supplies and work with partners in China to bring in more PPE (Parker, 2020). With the combination of immediate action by New Zealand's leaders and efficient supply management, the country was able to meet the needs of their citizens and healthcare workers. This in return kept COVID-19 rates low as well (Parker, 2021).

Chapter 5

Recommendations and Conclusion

The data and information outlined above provide an overview and basis for the key elements that drove vulnerability surrounding supply chain and overall planning for the U.S. as it relates to COVID-19. The research points towards a need for immediate action by federal and state officials, manufacturers, and supply chain professionals. In order to avoid issues like this from occurring in the future, it is crucial that U.S. officials amend current legislation to unify the nation's emergency response plans, increase domestic manufacturing of PPE, and the move away from just-in-time delivery systems in healthcare.

The U.S. should amend current legislation and adjust current emergency plans to establish a universal strategy. Although the governmental structure of New Zealand and the U.S. greatly differ, New Zealand's unified approach proved successful in minimizing loss across the nation. The U.S. should take advantage of their federal platform to unite the country and take on future pandemics or public health crises as an undivided front. When each state is acting in their own best interest, it is hard to achieve the best result as a nation—which can eventually further hinder the entire process towards recovery and unity. States have varying political and ideological beliefs; however, state and federal officials can utilize their power and collaborative working environment to reach an agreement on the best plan for improvement. New Zealand's use of a centralized procurement system and live, national registry for PPE also proved to be an efficient means for a nation-wide supply chain strategy. The U.S. has the ability to implement something similar to this with their Strategic National Stockpile. Although it was not properly

funded or exploited in the past year, this stockpile could be the ideal opportunity to consolidate resources and provide adequate supplies to each state. With the appropriate allocation of funding, a stronger focus on the Strategic National Stockpile could be an equitable and powerful step toward a centralized emergency response plan in the U.S. If the government exhibits a serious effort to unify and attend to its country's needs, this could also encourage trust and adherence, as illustrated throughout the pandemic in New Zealand.

A lot of the research also illustrates the importance of increasing the domestic production of PPE in the U.S. because of the unreliability of China's exportation. When the U.S. depends heavily on foreign imports, they become exposed to vulnerability and uncertainty among the people—thus leading to unpredictable loss. Prior to the COVID-19 outbreak, the U.S. relied on imports for eighty-five percent of their supply of surgical masks (“COVID-19 Related Goods,” 2020). China was the leading exporter, as mentioned earlier in this thesis (“COVID-19 Related Goods,” 2020). Domestic producers in the U.S. provided about fifteen percent of the market for surgical masks in 2019, but this production has increased in the past year and still suggests that there is too much of a reliance on foreign exports (“COVID-19 Related Goods,” 2020). When there is an issue that could result in the loss of lives, it should be the nation's top priority to minimize and prevent human loss at all costs. The Defense Production Act is a way for the executive branch to encourage the production of necessary PPE by U.S. manufacturers, which at the same time would address some of the concerns with the Strategic National Stockpile by increasing the inventory levels. Although the initial costs to increase domestic production would be substantial, the long-term results would be instrumental to both the economy and public health in the U.S. It is also important to note the importance of transparency when it comes to supply chain operations. As aforementioned in this thesis, many of the top PPE manufacturers in

the U.S. have failed to share important information regarding their supply chain systems. This information could provide extensive, critical insight for government officials and supply chain professionals. It is essential that legislation is either amended or established to force transparency in this industry, as it is required in many other industries.

Finally, in order to avoid major setbacks with respect to providing care and services, healthcare organizations should shift away from the just-in-time delivery system model. This system encourages stockouts during times of extreme demand, such as the COVID-19 pandemic. These are times when the country's public health is at high risk, and the current delivery system does not do anything to prepare or protect healthcare organizations during these times. Now that the country is aware of the destructive susceptibilities of the U.S. healthcare system, it is time to implement a new ordering and delivery strategy. Although holding costs could increase with this change, loss of life and potential issues in supply that are capable of occurring in the future would ultimately be avoided. With supply chain and healthcare professionals working together to transition toward an inventory model that no longer discourages a minor surplus, the U.S. healthcare system could make major advancements. This could require additional warehouses or adjustments in the layout of hospitals and service providers, but in the long term it would result in substantial benefits.

The healthcare system in the U.S. has always been seen by other nations as complex and ineffective considering the high costs and budgets. However, the COVID-19 pandemic truly highlighted how sensitive the system really is. If the U.S. prioritizes emergency planning and healthcare supply chain operations, the economy and many lives could be spared if another emergency like COVID-19 is ever dealt to the world. It is never too late to start planning ahead, and it is critical that the U.S. learns from its mistakes this past year.

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Expected Graduation: May 2021

Honors and Awards:

Schreyer Honors College
Dean's List – 7/7 semesters
Beta Gamma Sigma International Business Honor Society
The President's Freshman Award
Panhellenic Sorority Woman of the Year

Memberships/Activities:

Pi Beta Phi Sorority
THON Donor and Alumni Relations Chair
Penn State THON Dancer Relations Committee
Administrative Assistant
Penn State Panhellenic Executive Council
Vice President of Programming

Professional Experience:

Thomas Jefferson University Hospital
Center of Operational Resource Efficiency Intern
Berks County Court House
Intern for the Honorable Judge Jeffrey Sprecher
CVS Pharmacy
Pharmacy Technician