

History does not have to repeat itself (again): How to prepare for future pandemics

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Abstract:

The United States (US) response to the COVID-19 pandemic has led to unparalleled political, social, and economic turmoil. As zoonotic viruses begin to emerge more frequently, the United States must improve its strategies of handling pandemics in order to best protect and serve the wellbeing of its people. This report examines the US response in regards to their mitigation efforts, their management of hospital resources, the infection and mortality rates, the economic impact, and the progress of vaccine and treatment development. The US's response is then compared to those of countries that have successfully handled the COVID-19 pandemic. Specific methods to implement in order to improve the US's handling of a future pandemic are then outlined drawing from the strategies of these more successful countries. We concluded that the US's overall approach in mitigation, the most important step towards stemming any pandemic, was uncoordinated and ineffective due to many aspects, including political disarray and lack of enforcement. This along with bureaucratic conflicts between the public and private hospital system led to the disorganization of hospital resources. Both largely increased the infection and mortality rate of COVID-19 in the US. The mitigation efforts that were implemented then led to a rapid decline in the economy to which the federal government responded with multi-trillion dollar stimulus packages that did not meet the needs of the vulnerable populations. Although vaccine development efforts are going well, the US is spending and buying a lot more than other countries. We recommend as preparation for future pandemics, the US government must establish a government body dedicated to advising the president during a pandemic which can contribute to pooling and coordinating resources between different hospitals. Additionally, in order to reduce the economic impacts, the US should continue to supply benefits and cash relief to workers and businesses while tailoring financial support to target vulnerable populations and essential workers. In regards to vaccines and treatment, the US must increase funding for scientific research and continue its research into existing viruses so that vaccine development in future pandemics can keep up and take a more international minded approach in obtaining a vaccine.

Introduction:

When the first case was confirmed in the US on January 21, 2020, the U.S. was slow to react, leading to higher infection and death rates than other countries and bringing to light the many flaws in existing systems of government and hospital management. In the future, similar pandemics and epidemics will only become more commonplace as climate change increases the proximity of virus reservoirs such as bats and humans, ease of transportation facilitates the wildfire-like spread of such viruses, and demand for animal products increases the chances for genetic drift of such viruses. Thus we deem it absolutely critical that this pandemic be a wake up call to bring about the changes we urge for below. We will compare the United States' responses in regards to mitigation, hospital management and resources, infection and mortality rates, economic impact, and vaccines and treatment to those of the countries that have best reduced the

negative impact in each section. Thus, we may compare the US to different countries throughout the following report to find the most effective strategies the US can use in the future.

Mitigation (Madeleine and Sam):

Introduction:

Inconsistent politicized messages from national leadership speaks to a lack of US pandemic preparedness, undermining mitigation and science-based strategies. States were left to fend for themselves to overcome shortages of personal protection equipment (PPE) and testing supplies. Without consistent guidance and leadership from the federal government, states could not coordinate their shelter-in-place efforts; many states prematurely reopened, bowing to political pressure to restart the economy often with disastrous results. Critical lapses in pandemic preparedness resulted in the US leading the world with over 5.00 million confirmed cases as of early August 2020 (August 9, 2020, JHU).

Politics/Leadership:

Leadership is a crucial part of mitigation efforts since aspects of mitigation plans can decrease the R_0 value (contamination rate). Wearing masks and social distancing for instance are dependent on public cooperation (Murphy) but masks became politicized to the point where not wearing a mask represented support for the president, thereby directly working against efforts to reduce spread of the virus (Sorkin). In addition, rather than being supportive of public sources of scientific information, the president denounced Dr. Anthony Fauci, the nation's top infectious disease expert from the National Institute of Health (NIH) (Bellware) while US officials like Vice President Mike Pence and Senior Advisor Jared Kushner, who have no prior medical experience have been assigned to lead the nation's coronavirus fight.

Historically, the US had the President's Council of Advisors on Science and Technology (PCAST) previously made to the president on scientific matters. With the outbreak of the 2009 swine flu, the Obama administration focused PCAST on pandemic planning. This changed when the Trump administration refocused PCAST on technology for industries of the future, filling PCAST with business industry leaders. The opportunity for pandemic preparedness was lost in this transition of expertise and focus.

Another government organization that would have helped in pandemic preparedness was the National Security Council (NSC) In 2018, the Trump administration merged three directorates within the NSC: global health/biodefense (i.e. pandemic response), arms control/nonproliferation, and weapons of mass destruction/terrorism into one directorate. Rear Admiral Timothy Ziemer, the prior pandemic response directorate, left as part of this restructuring, which left no single senior level person in charge of pandemics (Sun). This effectively diffused pandemic priorities and hindered the ability to develop and promote a cohesive multi-step, science-based pandemic action plan (Kessler).

Lack of pandemic preparedness combined with lack of national unity in implementing science-based mitigation strategies resulted in the US having 58,947 confirmed cases per day. In contrast, Taiwan presently has no cases (August 1, 2020 Worldometer). The difference lies in Taiwan's leadership and preparedness: Taiwan's vice president who is leading the charge against COVID-19 is an epidemiologist, respected for his scholarly prowess and minimal political leanings (Hernández). Although Taiwan's political scene can be polarized at times, the high level of trust Taiwanese citizens had in their government's science-based approach united everyone to

be compliant in making social distancing, mask wearing, and contact tracing highly effective. In New Zealand, another country that has a low number of cases per day (August 1, 2020 Worldometer), Prime Minister Jacinda Ardern used a four-step lockdown plan, moving forward step by step in accordance with new scientific evidence. She gained public compliance through federal force (fine and imprisonment for breaking social distancing measures) as well as more personal chats with her citizens, acknowledging fears and encouraging empathy (Friedman). In both cases, pandemic preparedness combined with clear science-based leadership made a significant difference in the success of mitigation efforts.

Testing:

Lack of adequate testing also contributed to the government's inability to successfully provide uniform direction to the public. Towards the beginning of the pandemic, the CDC was charged with the responsibility of developing a test for COVID-19 (Bendix). Even though the United States did not receive the World Health Organization's test due to its large capability to produce their own, the WHO published the protocol developed by the German researchers who created their test so that any country could produce the same test (Azad). The US ultimately did not follow this protocol. Dr. Timothy Stenzel from the FDA observed that the CDC violated many of its standard laboratory practices and that absolutely nobody was in charge of the process of developing the test (Kaplan). 36 CDC labs found that the test gave them inconclusive results due to the presence of a third DNA strand not mandated in the WHO Protocol (Willman). Until the CDC created a new test, labs had to send samples to the CDC, which could cause a delay between testing and result confirmation of up to 48 hours. Initially, the CDC called to only test people who had traveled to China or had contact with an infected person whose case was confirmed (Washington Post Staff). It was only in February that the FDA began allowing other labs to begin developing their own tests. On March 6, the government sent out 700,000 tests, a number still severely short of the country's demand at the time (Shearman et al.). Lack of a "back-up" plan for testing and faulty laboratory practices left the US severely behind in formulating a response to the pandemic.

Even now, the US suffers a shortage and unequal distribution of testing. States like New York had to partner with private laboratories to acquire an adequate number of tests while states like Texas are only allowing people who are severely symptomatic to be tested, leading to a lack of full understanding of the spread of the virus in that state (Mervosh and Fernandez). Throughout the country, testing sites are concentrated in wealthier, majorly white neighborhoods. For example, in Dallas, there is a clear concentration of these testing centers in wealthier, white neighborhoods, while there are barely any in other areas (McMinn). However, Black and Latinx populations have rates of positive coronavirus tests nearly three times that of the caucasian population (Oppel). With people of color making up 75% of the essential worker population in the US and thus more vulnerable to being infected by this disease, communities of color should be prioritized more by the government for testing (Thorbecke).

Sheltering-in-Place:

With both a lack of leadership and strategy, the US scrambled to put together a plan with a mediocre team. Oftentimes, the federal government left much of the strategizing and decision-making up to each of the states, meaning that duration, severity, and timing of each stay-at-home order varied from state to state. California issued the first shelter-in-place order on

March 19 while South Carolina was the last state to do so on April 7 (Mervosh et. al). As of August 10, California has more successfully contained the virus's spread, with about 14,167 per million residents infected while South Carolina has about 19,506 per million residents infected (John Hopkins University). The early imposition of a shelter-in-place order allowed for California to control the spread of the novel coronavirus much earlier than South Carolina, contributing to the stark difference in their case rates .

In addition, these shelter in place orders were not being effectively enforced. In April, in the initial stages of the pandemic, 71% of people were socially isolating (Garrison). Lockdowns were met with harsh push-back by a significant portion of the population who claimed that this was a violation of their constitutional rights (Courtemanche). As of April 27, only 50% of the US population was staying at home, even though there were active shelter-in-place orders in all US states at that time (McMinn). This percentage has only decreased since then as states have begun to open again. As a result, the number of daily cases is at an all time high, averaging at about 57,500 as of August, as opposed to April, where the average was about 30,000 per day (Center for Systems Science and Engineering). Countries such as China and New Zealand on the other hand were able to keep the pandemic under control within 6 weeks through efforts including strict social distancing protocols as mentioned in the previous section, but the United States failed to control case risings over the long term as they failed to enforce their own guidelines (Levenson).

Face Masks:

As of June 23, only about two-thirds of American adults stated that they regularly wore masks (Igielnik). Mandating the public to wear face masks in the US has been, thus far, unsuccessful due to a multitude of factors. The CDC originally ensured the American people that they did not need to wear face masks. In April, the CDC then recommended that all people should wear some sort of face covering. This sudden change in direction so late into the pandemic led to a sense of confusion, especially as the country's leaders continued to provide conflicting advice about how to best act during the pandemic. Furthermore, the issue of enforcing PPE wearage has become a political issue as opposed to one of public health. Many argue that the government mandated PPE violates their liberty. Furthermore, government enforcement of PPE in public continuously has had little consequence if not complied with. As a result, the public does not have any incentive to actually follow the government's guidelines aside from protecting others. Americans who identify more with Republican ideals have also begun to refuse to wear face masks as a sign of support for the current president. A study by the PEW Research Center found that only 53% of Republicans wear facemasks at all times in public as opposed to the 76% of Democrats who wear masks at all times (Igielnik). New Zealand has found success in fighting the pandemic so it does not force its citizens to wear masks unless they are showing symptoms. Since the case count in New Zealand is so low, with only 24 active cases as of July 30, there is a low risk of spreading the virus. In the US, with a total of 2,369,320 active cases as of August 10, there is a much higher need for residents to wear PPE (John Hopkins University).

Contact Tracing:

American leadership's incoherent action has also inhibited the US's efforts to set up an effective contact tracing system. While contact tracing has been a cornerstone of other countries' mitigation efforts, it has been one taking the backseat in that of the US. The American public has met contact tracing with substantial push back due to the lack of trust that the public has in

sharing their information with those they do not know. This has resulted in the government not allocating any money whatsoever specifically to fund contact tracing efforts; consequently, the \$3.7 billion minimum it would cost to train and pay 100,000 contact tracers (Aschwanden) is simply too high a cost for most local, state, and other agencies to handle.

Contact tracing has proven itself to be an integral part of mitigation in other places such as South Korea and Germany. In South Korea contact tracing was very effective because of its accuracy, utilizing GPS information, CCTV footage, and credit card transaction information in order to track down people who may have been possibly exposed (Kim). Germany has been using their Corona-Warn-App which tracks users relations to others and warns them if they may have been in contact with an infected person, as well as conversation (Deutsche Welle). The use of this app is completely optional but has been pretty widely accepted in the country, gaining almost 15 million downloads in the country of 83 million (DPA).

Reopening:

A study from the Brookings Institute shows a strong relationship between school districts' reopening with in-person learning and the county-level support for Trump in the 2016 election with little correlation with the county's per capita infection rate (Valant). If reopening decisions were science-based there would be a correlation between low infection rates and in-person learning and a correlation between high infection rates and remote-learning; the data shows neither of these correlations. In addition to this, state reopening plans have not been effective since many are prematurely reopening with plans that vary state by state. When Georgia allowed dine-in restaurants, and other businesses to open, researchers from the University of Maryland found over 62,000 people traveling to Georgia daily from surrounding states (UM). A study by the Massachusetts Institute of Technology found "contact patterns of people in a given region are significantly influenced by the policies and behaviors of people in other, sometimes distant regions"(Holtz). Without consistent policy implementation across states, people migrated and spread the virus from states with strict policies to states with less strict policies and greatly diminished the effects of the stricter policies.

In contrast, all of New Zealand was subjected to the strictest policy: only members of a household were permitted to gather with all citizens forbidden from carrying out nonessential activities. New Zealand was able to decrease its cases so that back-to-work plans finished 3 months after the lockdown with no cases present (Hobson).

Solutions:

Government leadership through pandemic preparedness is crucial to the effectiveness of mitigation efforts for future pandemics. Non-political government organizations focused on pandemic preparedness have to be restored so there is public faith in national leadership and science-based mitigation strategies. National leadership has to be prepared to provide effective policy guidance to states about mitigation and reopening so there is cohesiveness across the country and the general public receives clear consistent messages. Investments in infrastructure are necessary well in advance of a future pandemic. Best practices on social distancing need to be studied so compliance can be maximized. Research to anticipate developing tests and cures for potential future pathogens needs to continue and testing infrastructure needs to be improved so contact tracing can be effectively implemented. Backup plans should be put in place to anticipate different possible scenarios. Contract tracing expertise should be preserved for the future by

immediately training reserve contract tracing workers who can be called upon in case of emergency. PPE production should be brought back to the US as a national priority and subsidized as necessary to accelerate this process. Although the next pandemic will not be exactly the same as the current pandemic, the lessons learned from this pandemic should help the US develop the pandemic preparedness needed at all levels of government for quick effective action.

Hospital Resource and Management (Peter and Devon):

Introduction:

When the pandemic first hit countries, there was a worldwide lack of hospital resources. The U.S. in particular lacked conventional resources such as surgical masks, N-95 masks, and ventilators. This is detrimental for two major reasons: a lack of personal protection equipment increases the rate of infection among hospital workers and ventilators are necessary for critical stage patients. Yet, this does not include the nonconventional, but equally vital, assets such as information, trained hospital workers, and hospitals themselves. The lack of all of these resources means that it is quintessential that the U.S. not only increase production, but also ensure that hospitals are utilizing such resources properly.

Information:

Covid-19 is a large-scale disaster that the modern world has never seen. To combat an unprecedented pandemic requires immediate and adaptive change in hospitals (Bohmer). Yet, every measure that hospitals decide to take must depend on accurate, constantly-updating information. This information is regarding all the different facets of hospitals and medical care (Bohmer). Without it, practices like forecasts, inventory updating, and general treatment will fall apart, leaving the healthcare system without a clear plan to deal with the virus as the situation evolves. Uninformed actions from hospitals would only exacerbate the situation (Bohmer). A prime example of this was Taiwan's response to Covid-19. Taiwan officially activated its Central Epidemic Command Center, a branch within the NHCC, by Jan. 20 (Chen), which allowed coordination with various ministries to enact policies and strategies already in place. On Feb. 18, the government granted all hospitals, clinics and pharmacies access to patients' travel histories, which allowed them to enact contact tracing much more effectively. (Chen)

Inventory:

Supplies are not only constantly in flux, but also heavily interconnected. The use of one medical supply will most likely rely on multiple other supplies; a relevant example would be how testing kits rely on cotton swabs (Bohmer). If there is a lack of cotton swabs, producing more testing kits would not lead to an increase in testing. Due to these interdependencies, many times when a hospital changes one part of its system, another part is adversely affected, creating unintended effects. With Covid-19 creating a shortage of many resources such as masks, hospitals must be wary of unintentionally hurting different parts of their medical system when implementing measures specific to dealing with the pandemic.

Short-Term Forecasting:

The pandemic has created a rapidly evolving situation in the United States where demand for resources is exploding and medical systems are swamped. Data on key statistics like infection rates and impact on nearby healthcare systems is being published and updated constantly;

hospitals should utilize such data to make rough yet sufficient forecasts on what the hospital needs that week (Guelich). Thus, hospitals would not only be equipped to better manage potentially-disastrous shortages, but would also have the chance to preemptively enact measures to mitigate such issues.

Pooling and Coordinating:

Managing the supplies that hospitals have is a given with the lack of resources that the pandemic is creating. However, individual hospitals must wrestle not only with their own needs, but also with those of hospitals that they were competing with before the pandemic and the suppliers of such resources. Dealing with these problems as individual hospitals is too inefficient with the breakneck pace that the virus is currently pushing hospitals at. Therefore, centralization of many hospitals into one inventory unit would reduce the requirements of each hospital to manage themselves and compete (Bohmer). Hospitals would not only share inventory, but also give each other vital information about their resources, how they have been using them and what trends they have each observed. Pooling should be taking place within the hospital at the very least; different departments cooperating would allow the hospital to act as a unit instead of many separated sectors (Bohmer). This same principle can be applied to inter-hospital coordination. Across different healthcare systems the obstacle of competing business plans exist, but within a hospital system this should be possible. Normally, competition between hospitals is healthy, but during a pandemic instead of competing, hospitals must prioritize efficiency in saving lives.

South Korea, specifically Daegu, has demonstrated pooling and coordinating to tremendous effect. South Korea initially experienced an enormous surge in COVID-19 patients; however, due to prompt governmental action on the hospital level, further spread was limited and mortality rates were much lower than those of other countries such as China and Italy, who were also hit at the beginning of the global outbreak (Kim). A modification of South Korea's hospitals into a triage system made this possible; COVID-19 patients were transported based on severity to different hospitals in the same region, which allowed each hospital along the chain to tailor their processes and resource usage for their specific treatment methods (Kim). Along with centralization of their hospitals came sharing resources. Both public and private hospitals were involved in this pooling, which saw assets (masks and beds along with nurses and doctors) being transferred between hospitals according to each one's needs (Oh).

Italy's healthcare system implemented similar policies. As one of the first countries hit by the full brunt of the coronavirus pandemic, Italy recorded 110,574 cases and 13,155 deaths from SARS-CoV-2 as of April 1, 2020 (Boccia). Initially a lack of beds, ICU units and other resources hurt their response, among other factors extraneous to healthcare, led to Italy's cases skyrocketing (Fiore). However, the innate cohesiveness of their health care system, which was state-run, allowed them to streamline their processes and act as a unit, thus then leading to Italy currently nearly beating the disease (Boccia).

Solutions:

Small actions such as taking inventory and forecasting a week or two into the future are being conducted by many hospitals in the United States. However, we need to enact more information sharing, pooling and coordinating policies; these measures are a recourse that many countries, which have already curbed their country's outbreaks, have implemented to great effect. In the likely event of a future pandemic, if our healthcare system is interested in optimization of

their treatment plans, further information sharing, pooling, and coordinating will be paramount to the success of our future generations' livelihood.

Infections and Mortality Rates (Michelle and WenWen):

Introduction (as of July 30, 2020):

The COVID-19 confirmed case ratio and death in the United States are all higher compared to those from Taiwan and New Zealand. Regarding preventative efforts for future possible pandemics, the United States should consider the successful mitigation efforts that have been proven to decrease COVID-19 cases set forth by the countries Taiwan and New Zealand. The table below compares the confirmed rates, recovered rates, and death rates of the US with those of New Zealand and Taiwan, two countries that have been successful at containing the pandemic. Studies have also found that the coronavirus has had a more severe, wide-spread effect on the lives of African Americans and Latinos in the United States. After taking information from 1,000 counties and the 64,000 infections among those countries, studies determined that African Americans and Latinxs are twice as likely to die from contracting the virus in comparison to Caucasians (New York Times).

Cases Per Million (In Relation to the Country)				
	Confirmed cases	Recovered cases	Deaths	Population
United States	13,528 cases /million	4284 cases/ million	438 case/ million	328.2 million
New Zealand	323.5 cases/ million	314.8 cases/ million	4.56 cases/ million	4.886 million
Taiwan	19.6 cases/ million	18.5 cases/ million	0.9 cases/ million	23.78 million

Vulnerable Citizens:

As vulnerability to the virus comes with increasing age, an important variable is the high number of the older population in the United States, 16.03% of 328.2 million people. In comparison, 14.36% of Taiwan’s population and 15.57% of New Zealand’s population are over the age of 65.

As of May 13th, 9 individuals in the age group 0-17 died in the United States due to COVID-19. 601 individuals died in the 18-44 age group, 3413 individuals died in the 45-64 age group, 3788 age group died in the 65-74 age group, and 7419 individuals died in the 75+ years old age groups in the United States due to COVID-19. Distribution of death numbers when taking account age has shown that there is an increase in likelihood that older generations (75+ years old) in the population are more at risk, will be negatively impacted by the outbreak while in comparison to younger individuals ranging from 15-24 year olds.

Age Distribution (Percent of population)					
	0-14 years	15-24 years	25-54 years	55-64 years	65+ years

United States	18.62%	13.12%	39.29%	12.94%	16.03%
New Zealand	19.62%	13.16%	39.58%	12.06%	15.58%
Taiwan	12.68%	12.52%	46.08%	14.36%	14.36%

This table gives the percentages of age distribution between the ages of 0-14 years, 15-24 years, 25-54 years, 55-64 years, and 65+ years in the United States, Taiwan, and New Zealand. This gives more insight into the vulnerability of certain countries.

Another large factor is the percentage of individuals who are immunocompromised. These people can include genetic immunodeficiency patients, HIV patients, and those who use immunosuppressants. According to the ministry of health New Zealand, people who are immunocompromised should take extra safety measures such as avoiding ones who are have not been self isolating, staying at least two meters apart from strangers, avoiding contact with other immunocompromised individuals, and continuing to take immunosuppressive drugs. The CDC states that on top of regular safety measures, the immunocompromised individuals should continue with their past medication and treatment plan, have regular doctor appointments, and prepare an emergency supply of medication just in case of unexpected events.

How Can Responses Affect Rates?:

Taiwan's early acknowledgement of their high risk from their close proximity to coronavirus hot spots and country ties allowed them to maintain low infection and mortality rates. The country prevented any exportation of masks, partnered with large companies in hopes of maintaining adequate amounts of medical supplies, and began selling them at lower prices under healthcare systems, causing a boost in efficiency of its distribution. These actions ensured that Taiwan would have a steady quantity of medical supplies to tackle the outbreak. The Special Act, which was enacted on Feb 25. 2020 in Taiwan, allowed the government to control economic relief and discourage spreading misinformation. The Special Act also provided disease prevention compensation for those who must take care of vulnerable people at home or were unable to work. Punishments on the spread of false information including being fined for \$100,000 and imprisonment for three years.

New Zealand also took fast preventative efforts in response to the initial declaration of the outbreak by the World Health Organization (WHO). The government imposed a national lockdown and forced all citizens except essential workers to self-quarantine in their homes for two weeks. Officials also made sure that imported cases were taken care of and traced their contacts to prevent an increased rate of transmission. New Zealand also made commitments to their neighboring island countries in order to protect them from potential coronavirus outbreaks by closing their borders for 14 days and providing extra training for health staff within the country.

How the United States Can Learn:

After learning its lessons from the severe acute respiratory syndrome (SARS-CoV-1) that hit globally in 2003, Taiwan has done exceptionally well in this pandemic and the United States can learn from their experiences. The United States should fully enforce a travel ban in the next

pandemic as soon as possible. The United States also needs to take steps to ensure that all states maintain a good stockpile of medical supplies, which they currently lack. Equipment such as masks, personal protective equipment, and ventilators should always be in stock, as it may be too late to regain the supplies of these resources in the event in which another wave of COVID-19 hits or a new pandemic begins. The implementation of actions similar to the reaction response of Taiwan and New Zealand by the United States for future possible pandemics has a high chance of lowering both mortality and infection rates.

Furthermore, the United States should take the same control on the spread of inaccurate information through the media and broadcasts by enforcing harsh punishments, as seen in Taiwan's successful response. Historically, the US has forced all posts, broadcasts, and writing to pass through the Office of War Information during conflicts such as World War II in order to control the spread of inaccurate information among citizens. This sort of censorship by the government may be beneficial to controlling the spread of misinformation and minimizing panic and misaction per citizens.

Economic Impact (Iris and Xuanyi):

Introduction:

The failure of mitigation efforts by the United States government ultimately led to longer lasting economic impacts due to prolonged business and economic shutdowns. As of August 4, 2020, federal unemployment rates reached 14.7%, marking a record high since the Great Depression decades ago (Bureau of Labor Statistics) with over 1 million people applying for unemployment every week. Permanent job losses spiked, continuing to reach 2.9 million by June. Additionally, states that largely rely on tourism had much higher unemployment rates; Nevada recorded an unemployment rate of 25.3%, which is nearing the Great Depression's national rate of 25.6% (Lambert). Consumer spending, an important indicator of consumer confidence in the economy, also plummeted 6.6% in March, and a further 12.6% in April.

Current status (as of August 4th, 2020):

The current status of the United States economy shows a major 32.9% drop in gross domestic product (GDP) during the second quarter of the fiscal year (April 1st to June 30th), which is the sharpest economic contraction in modern history. There has been hope for a V-shaped recovery where the economy falls into sharp decline, but then recovers and grows very quickly. Unfortunately, 12,000 more people have applied for unemployment benefits in the week ending July 25th compared to the previous week, meaning that a V-shaped recovery is unlikely. Experts have temporarily categorized the current economy as a W-shaped recovery in which growth begins to rise again, only to decline into recession once more (Rodeck).

Recently, there have been progressing trends of recovery from the economic recession caused by the COVID-19 pandemic. The federal unemployment rate, an important indicator of the strength of the economy, declined by 2.2 % points to 11.1% as of June 30th, 2020 (Bureau of Labor Statistics). However, it is still much higher than the 50-year historic low of 3.5% in February. Additionally, persons on temporary layoffs decreased by 4.8 million in June 2020 (Lambert). Despite the general trend, unemployment rates in the United States contained wide disparities among different races (Lambert). Whereas white workers had a national average unemployment rate of 10.1%, Hispanic workers had an unemployment rate of 14.5%, and the unemployment rate for Black workers was even higher at 15.4%. The drastic increase in unemployment can be

attributed to the gradual reopening of the economy in several states. It is also likely that the uptick of 8.2% in consumer spending in May, following a drop of 6.6% and 12.6% in March and April, respectively, contributed to economic recovery (Bureau of Labor Statistics). However, it is notable that resuming normal economic activity prematurely may lead to either a resurgence of cases in the first wave of the COVID-19 pandemic, or a second wave in areas that were thought to have successfully mitigated the virus. As mentioned previously in the “Back to Work” portion of the mitigation section, reopening states, businesses, and other areas with a potential for public gatherings have caused cases to climb. Evidence of a potential second wave has been seen in countries (many of which have resumed large parts of economic activity) that were largely regarded to have tamed the virus already, such as Japan, China, and Vietnam (Vaughan). The massive contraction in the second quarter’s GDP demonstrates that premature reopenings have caused the economy to drop once more after the slow recovery in April and May.

Current Government Action:

In response to the increased rates of unemployment and the economic recession, the United States has implemented several policies to reduce the economic impact. Some of the key policies implemented as of July 30, 2020 are the Coronavirus Aid, Relief and Economic Security Act (CARES Act), Paycheck Protection Program and Health Care Enhancement Act, and Families First Coronavirus Response Act. The CARES Act, passed on March 27th, 2020, provides an estimate of \$2.3 trillion ($\approx 11\%$ of GDP) to provide assistance for American workers, families, and small businesses, payments to governments, and also act to preserve jobs in industries adversely impacted by COVID-19.

The Paycheck Protection Program and Health Care Enhancement Act allocated \$484 billion of funding to supplement key programs from the CARES Act, and also added \$25 billion for the HHS Public Health and Social for necessary research, testing, and equipment. The Coronavirus Preparedness and Response Supplemental Appropriation ACT and Families First Coronavirus Response Act together provide approximately 1% GDP for testing, small business exemption, supply assistant, et cetera. These policies all provided a short-term relief and boost to the economy, but progress on the reopening of the economy still differs across all 50 states.

Unfortunately, policies such as the CARES Act provide no benefits for the majority of the homeless population, undocumented immigrants, and the disabled. Because the United States operates under a mixed public and private healthcare system, 27.5 million people (8.5% of the population) still do not have access to healthcare, and thus are more vulnerable to dying from the virus. For instance, Lissandra Villa of Time magazine estimates that six million undocumented immigrants are categorized as essential workers, yet do not have any healthcare coverage. All this exponentially increases their risks of contracting and spreading the virus (Scheyer) leading to further economic loss because even if hospital resources and management were sufficient, the coronavirus would still be able to continue spreading among the uninsured populations.

Model Countries’ Economic Responses:

Notable countries that have successfully contained the first wave of COVID-19 have provided a variety of government services to financially aid their constituents. For instance, the Chinese government injected a relief package of RMB 4.2 trillion, or 4.1% of the country’s GDP, which can be split into three major categories: supporting production of medical equipment; unemployment insurance and tax relief targeted toward workers; and liquidity injections into the

financial market. The temporary cash flow relief to workers included accelerating payments of unemployment insurance benefits extended to migrant workers and social safety nets.

Similar to China's flow of temporary cash relief, the government of the Republic of Korea funded an emergency relief payment program of KRW 14.3 trillion (\$12.03 billion USD) for transfers to households (International Monetary Fund). Since there are 15,887,128 households in Korea, that amounts to around KRW 900,100 per household (\$756.91 USD).

The Japanese government passed their Emergency Economic Package against COVID-19, which contained ¥117.1 trillion, or 21.1% of the country's 2019 GDP, to develop preventive measures against the spread of infection, protect businesses and employment, and rebuild a resilient economic structure. Notably, Japan included cash handouts to individual and affected firms, as well as the deferral of tax payments and social security contributions. In July, Japan passed the second fiscal year 2020 draft supplementary budget, which allocated ¥31.8 trillion specifically to coronavirus. Of that, ¥2.9 trillion (roughly 9.39% of the budget) is directed toward strengthening medical frontlines through financial grants, distributing personal protective equipment, and funding research into vaccines.

Moving Forward:

The United States should focus on addressing the needs of low-income communities and communities of color who are the most vulnerable to both the health-related and economic impacts of the virus. As mentioned previously, there is a wide racial unemployment gap which affects the livelihoods of Black and Hispanic Americans who are also dying at twice the rate of white Americans due to COVID-19. This makes it a priority for the government to aid their specific needs. Specific policies to address this should focus on three major sections: increasing financial support of food stamp programs, increasing financial support of renters, and aid to state governments who have more jurisdiction over policies related to local healthcare, public health measures, and budget reallocation for the aforementioned areas (Lempinen).

It is essential for mitigation efforts of COVID-19 to continue. Some may falsely draw a dichotomy between prioritizing economic recovery and prioritizing public health, when in reality, they are very closely intertwined. The crucial role that this plays in the United States' economic recovery demonstrates the need for the task force and stronger mitigation efforts, as described in the mitigation section. The improvement of robust public health services will boost efforts to eradicate the virus, thus accelerating economic improvement while simultaneously keeping United States constituents safe. The United States needs to allocate far more money directly specifically toward supporting the healthcare system and workers. As Japan's national budget demonstrates, 10% of the budget specifically toward supporting healthcare would be beneficial toward mitigating COVID-19. Another critical action the United States must take is to specify where the funds will be reallocated at the local level. For instance, Japan's budget reallocation specifies that the funding should go to the Emergency Comprehensive Support Grant For Novel Coronavirus Disease. This ensures maximum transparency and efficiency in stimulating and incentivizing mitigation efforts.

Additionally, the flow of temporary cash relief toward unemployed workers as well as small and big businesses should be continued. 156 top economists from various universities throughout the United States have suggested that the federal government must continue the cash relief in the form of stimulus checks and extended unemployment benefits (Wang). This direct

cash flow is critical to boosting consumer spending, which in turn buoys businesses and keeps the economy from further contracting.

Vaccines and Treatment (Ivan and Trent):

Vaccines:

The US' lack of strong leadership and strategy in mitigation has led to hospitals across the country being overwhelmed with increasing case numbers everyday; hence the development and manufacturing of a vaccine is even more crucial.

In general, vaccines often take years to develop and license due to the long periods of time spent in clinical testing (testing on human populations) and low chances of success. These clinical trials take long periods of time due to the need for long-term data (to determine any side-effects and safety issues), interim data analysis, and manufacturing checks (Lurie et al). During pandemics like COVID-19 however, the processes are largely sped up through the shortening or combining of phases and the concurrent large-scale "at-risk" manufacturing of the vaccine with the clinical trials (Lurie et al). The US has provided more than \$8 billion in funding for the research, development, and production of vaccines, helping to speed up the process so that numerous vaccines are already in their third phases of trials.

This overall advanced movement towards a vaccine is also due to our experience and knowledge of coronaviruses with the 2003 outbreak of SARS-CoV-1 and the 2012 MERS outbreak. Companies that have received funding for vaccine development such as Novavax and Oxford University have also been working on vaccines for SARS-1 and MERS so researchers knew to focus on the spike (S) protein of the novel coronavirus. Improvements in the technology of vaccine production and development have also sped up the process. There are now easier to produce and safer vaccines such as genetic (mRNA and DNA) vaccines as opposed to classic vaccines (Hubaud). It is worth to note that no genetic vaccine has yet been fully developed and approved by the FDA for use.

Treatment:

A treatment on the other hand, most likely an antiviral drug, works to reduce mortality rates, prevent infection and reinfection, and decrease recovery time. Developing treatments to existing viruses even though they have not caused a pandemic is important for the early stages of a pandemic. Whereas vaccines are difficult and costly to stockpile, antiviral drugs are able to be held in large amounts to combat early stages of a pandemic.

The FDA has formed the Coronavirus Treatment Acceleration Program (CTAP), where possible treatments and testing are examined faster to get treatments out as soon as possible. They have cleared remdesivir for emergency treatment after supporting trials and revoked emergency use authorization (EUA) of hydroxychloroquine and chloroquine on April 10. If the program had started earlier, then more treatments can be examined at an expedited rate, increasing the likelihood of a larger arsenal of treatments, thus helping combat the pandemic further.

The US invested 450 million in coronavirus treatment testing as of July 7. The money went to Regeneron, a pharmaceutical company who is testing an antibody antiviral cocktail that provides antibodies of the virus. It also aims to help prevent infection of the virus by binding to it and blocking entrance and infection of cells. By containing two different antibodies to two different COVID-19 variations, the treatment aims to prevent viral "escape," where a secondary strain evades the antibodies in a person, and becomes the primary infection of the body. The test

of the drug's prevention capabilities paired with the NIH on July 6 is in Phase III of clinical testing. On July 30, the White House signaled an investment into convalescent plasma therapy supported by HHS and the Red Cross, including increasing donations and accessibility of treatments. The research of plasma therapy has been accepted into CTAP.

Cost of Vaccines and Drugs:

As of July 31, 2020, the United States has spent over \$8 billion funds out of the \$10 billion set aside by Congress into 9 different vaccines. This is \$24 per capita on vaccines for the coronavirus pandemic alone in comparison to the \$6 per capita spent on vaccines for the Swine flu in 2009. Other successful countries such as Germany, New Zealand, and South Korea are spending \$812 million (\$10 per capita), \$37 million (\$8 per capita), and \$93 million (\$2 per capita) respectively, all remarkably less than the US.

At this point, the US seems to be spending its money on 9 different vaccines that are all at high risk. According to Operation Warp Speed, funding is coming from a collection of Departments under Human and Health Services as well as the Department of Defense. Although the US may have the capacity to spend a lot on vaccine development, we want to point out that this seemingly desperate spending of funds into vaccines should not ever have to happen again as it is highly unsustainable—only 17% of vaccines that make it to clinical trials successfully reach licensing and widespread use (GAVI). Furthermore, treatments are often overpriced. Although the government can interfere in pricing (Cornell), it has never done so and will likely not do so in the future. This issue is already occurring with the COVID-19 vaccine; the US has spent five times more per dose than Britain in securing vaccines from AstraZeneca (GEN). This is also an issue with drugs that the US is looking to use in fighting the pandemic. Gilead has set the price of remdesivir at \$520 per dose in the U.S. whereas other developed countries are being charged only \$390 per dose. The estimated average cost to produce each dose is \$9. These elevated costs pose a dangerous accessibility issue to low income communities and BIPOCs—the very individuals that are most at risk for COVID-19.

Thus in funding for vaccines, these contracts should be created so that the government can interfere in price. Although vaccine development and manufacturing is costly, this should not be an additional burden to the American people as our taxpayer money is already being used to support the development of these vaccines.

Funding for Research:

Interestingly, a few recent studies have suggested that antibodies formed from an immune response to SARS-1 (whose S protein shares 80% amino acid similarity) can be used in treatments or vaccines to combat SARS-CoV-2 (Pinto et al). However, there is still no full vaccine for either SARS-1 or MERS, most likely since neither had large market size, meaning no pharmaceutical company would profit from the development and production of said vaccines.

Therefore, research into vaccines and treatments should receive more government funding and should continue even after most outbreaks have subsided. If the United States government had been able to push for these vaccines, then they could have initially been used as a temporary treatment. As of 2017, 70% of R&D funding in the United States is provided by businesses according to the National Science Foundation whereas the government provides only 22% of R&D funds, explaining the reason why such vaccines for MERS and SARS-1 have yet to reach completion. With countries such as China increasing spending on scientific research (China spent

\$445 billion whereas the US spent \$485 billion in scientific research according to the OECD), and the UK increasing funding for science research after the coronavirus (from \$10.6 billion to \$25.9 billion), it is clear that the US must step up its game in funding for scientific research to ensure that the US is prepared in research when then next pandemic strikes.

What future viruses may emerge are uncertain, but increasing spending on scientific research to support a well researched arsenal of knowledge on existing viruses regardless of fatality and area of effect will ensure that our response to future pandemics on the vaccine and treatment side will be able to keep up.

Conclusion:

The United States' response to the COVID-19 pandemic has been characterized by lack of care and organization. Supply shortages, testing delays, political squabbles, and even social distancing failure on an individual level are symptoms of fundamental inadequacies with the American government's course of action during the pandemic. Guidelines for citizens to follow are fickle, as inconsistencies between legislation of different States created a patchwork response that is overtly inadequate. Plagued by detrimental delays of action, a failure to provide clear direction to the citizens, as well as lack of communication and cooperation at the local, state, and national levels, the U.S. is currently far from recovery. Epidemics and pandemics similar to that of COVID-19 will only become more regular in the future, and if the United States is interested in preserving the health of their citizens and economy, it is in the country's best interest to learn profusely from their failures in the current outbreak.

Furthermore, the U.S. has been among the worst in the world in terms of coronavirus deaths per million. As of August 4, 2020, a handful of countries like Taiwan, New Zealand, and Germany are already near to beating the virus, while the United States is still recording some of its highest cases per day. The concise and thorough response of such countries are what allowed for them to begin containing and minimizing the effects of the pandemic.

In Taiwan, the government quickly put strict travel and social measures into place and set up the Central Epidemic Command Center. In the future, the US could improve their imposition of their policies, such as social distancing guidelines and shelter-in-place orders, as well as take more meaningful action earlier on in order to the limit the rapidness with which the virus infects the US population. On the other hand, New Zealand found immense success in the transparency with which it carried out its response to the virus and the strength with which it enforced its mitigation policies. The US could improve upon their response to future pandemics by providing the public with more updates about their situation, better enforcing the guidelines that they put into place, and giving the public clear directions on how to alter their lifestyle to best limit the spread of the virus, endorsed by all parts of the US government. Germany's approach to containing the spread of the virus was successful largely due to the great cooperation between its government, residents, and scientists. The US must also provide a united front, especially among political leaders, in their actions to fight the spread of future pandemics.

If the United States were to change only a little or nothing substantial about their pandemic strategy, during future outbreaks we would see similar or worse (depending on how severe the virus will be) deaths and economic decline. The ineptitudes of the American government's strategy is evidenced by the country's consistently high coronavirus-related death and infection rates, and such inadequacy must be fixed if the country is to pull through the next pandemic.

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