

Preparation for the Next Pandemic: A Study on Past Techniques Used During Pandemics

Tara Flynn¹, Mark Crowder[#], and Reto Asmis[#]

¹Indian Hills High School, Oakland, NJ, USA

[#]Advisor

ABSTRACT

When citizens of Wuhan, China started contracting Coronavirus Disease 2019 (COVID-19), it was inevitable that the disease was going to spread to the rest of the world, therefore resulting in a pandemic. This disease is caused by SARS-CoV-2 and was discovered for the first time in December of 2019. COVID-19 affects the lungs and has symptoms that are similar to the common cold, pneumonia, or the flu. Over 6 million people have died from COVID-19 and the number continues to rise. When there was first talk of the pandemic in the United States, it was said that the United States of America was the most prepared country in the world to tackle a pandemic. The United States ended up having one of the worst outcomes when COVID-19 struck and this was because of faulty planning. It is crucial to know information about COVID-19 before looking into what the United States did wrong. The research provided in the following study shows the lack of testing, bad mask mandates, poor public health funding, etc. Along with this, a plan is created on what to do if a pandemic were to hit the United States once again in the future and how to stop it before it wreaks havoc on the nation.

Introduction

COVID-19

SARS-CoV-2 is a virus that causes Coronavirus Disease 2019 (COVID-19). This virus attacks the respiratory system and lives in the bronchioles of the lungs (CDC, 2020). It is a new type of coronavirus that has many lineages which are closely related viruses with a common ancestor. COVID-19 is caused by the mutations of the original virus that usually lives in bats and pangolins. People are more susceptible to COVID-19 when they are in close proximity with someone infected which is why if someone is indoors, they have more of a chance to contract COVID-19 (CDC, 2022). Viruses are organisms that possess genetic material, but require a host for survival (i.e., they cannot survive for extended periods without infecting another organism). In the case of COVID-19, a host could be a person, but it has also been known to infect other animals such as deer, etc (CDC, 2022). The genetic material contained within viruses, otherwise known as their genome, is made up of either RNA or DNA (CDC, 2020). In the case of RNA viruses, their genomes are mostly single stranded, while the genomic material of DNA viruses is usually double stranded. It is also important to note that viruses are extremely small. They could range in size from between 20-800 nanometers. Viruses are different from bacteria. Unlike viruses, bacteria can be larger than 1000 nanometers. Also, unlike viruses, bacteria are considered living organisms and are single-celled. When someone is infected with bacteria, antibiotics such as penicillin can be successfully used to treat the infection, such as when a person has *Streptococcus pyogenes* (Strep Throat). Notably, antibiotics have no efficacy against viruses (CDC, 2020). In order to understand COVID-19, it is important to understand the viral life cycle, which differs for each viral species, though similarities can be found. A virus first goes through adsorption which happens when it gets in contact with host cell receptors. In the case of the COVID-19, these receptors are expressed in the lungs. The viral particles then fuse with the plasma

membrane. Once this step is complete, the protein coat of the virus separates from the genome and it is released into the host cell cytoplasm. Next, the viral RNA is then transcribed by the host cell transcriptional machinery, including RNA polymerases and other transcription factors. Next, these RNAs are translated into proteins that result in the production of fully functional viral particles. Viruses can infect a range of living organisms including insects, plants, humans, and even bacteria (CDC, 2020). There are many ways that viruses infect their host organisms. Some common ways are through ingestion, inoculation, inhalation, and sexual intercourse (CDC, 2020). Viruses can spread through blood or other bodily fluids such as saliva. This infection initiates an immune response that helps the organism to fight off the disease.

Symptoms

There are multiple symptoms in both children and adults. Some of the main symptoms are fever, cough that becomes productive, chest pain, new loss of taste or smell, changes in the skin such as discoloration, sore throat, nausea, vomiting, stomach pain, diarrhea, chills, muscle aches, fatigue, headaches, nasal congestion, and long term breathing problems (CDC, 2022). COVID-19 can lead to extreme complications in the future as well. It can lead to chronic kidney impairment and strokes (CDC, 2022). It can also lead to heart complications and Guillain-Barre syndrome which can cause temporary paralysis in the body. It can also lead to multisystem inflammatory syndrome in which the lungs, brain, eyes, brain, kidneys, and heart can get inflamed (CDC, 2022). COVID-19 can also cause blood clots within the heart muscles leading to damage. Another long term effect can be something known as Long COVID-19. With this the symptoms of the original disease still be present. Most symptoms that stay with Long COVID-19 are loss of taste, loss of smell, fatigue, brain fog, shortness of breath, cough, joint pain, and chest pain (CDC, 2022). 10% of people between the ages of 18 and 50 suffer from Long COVID-19 and 22% of people aged 70 and older who get COVID-19 suffer from long COVID-19 (CDC, 2022). There is still research being done to see if there are more or worsening long term effects of COVID-19 because it is still recent and it is unknown to doctors and society.

Treatments

There are some current drugs that are used to try to treat COVID-19. One of them could be Dexamethasone and this is an anti-inflammatory drug that is readily available and inexpensive (Mayo Clinic, 2022). Another drug that can be used is Tocilizumab which is already FDA-approved for autoimmune diseases. This, along Dexamethasone, can help adults and children who require oxygen, mechanical ventilation and/or a heart-lung bypass machine (Mayo Clinic, 2022). Another option is Remdesivir which is an antiviral drug that inhibits the RNA-dependent RNA polymerase of coronaviruses. Lopinavir-ritonavir is a drug that has no major reduction in mortality rates, but it decreases hospital stays (it is important to note that the results of this drug are inconclusive). Another medication that might work alongside Remdesivir is Baricitinib and it reduces the time of recovery from COVID-19 (Mayo Clinic, 2022). People can also use blood thinners to limit the effects of COVID-19-induced blood clots but this can be complex and can lead to future problems. These medications can aid while in a pandemic, but there is no cure for COVID-19. Hopefully by the time of the next Coronavirus pandemic, more information will be available and both an effective vaccine and cure will be present.

Immune System

The immune system is used to fight off infections caused by foreign antigens such as a virus. This critical defense mechanism is made up of organs, tissues and cells (Hopkins, 2021). Some of these include the white blood cells, lymph nodes, spleen, tonsils, adenoids, thymus, bone marrow, skin, mucous membranes, stomach, and bowel. When a foreign agent (i.e., an antigen) enters the body, immune cells recognize the foreign antigen and secrete cytokines to

signal to other immune cells to 1) proliferate, 2) produce cytokines, and 3) generate neutralizing antibodies (Hopkins, 2021). There are two major components of the human immune system which are a) the innate immune system and b) the adaptive immune system. The innate immune system is the first line of defense. This includes our skin, cough, tears, oils, stomach acid, and mucus, monocytes, eosinophils, dendritic cells, and macrophages (Hopkins, 2021). The adaptive immune system comes into play when it is trying to fight off an infection in an antigen-specific way. The innate immune system is immediate while the adaptive is not, but the adaptive immunity is long lasting, while the innate is not. This immune system has specific antibodies and cells that are able to fight off that specific pathogen in the future. This immunity can range for a different period for each virus ranging from weeks, to months, to years, to a lifetime (Hopkins, 2021). In order to be protected against these viruses people can decide to get vaccines.

Vaccines

A vaccine is usually made from a tiny part of a virus, most often the immunogenic antigen. Exposure to this antigen leads to the production of specific antibodies directed against it known as neutralizing antibodies. This response often leads to adaptive immunity to the antigen (WHO, 2021). Upon a secondary exposure, the antigen can be neutralized more quickly as a result of prior exposure.. When a sufficient population of people gets vaccinated they can create a herd immunity. If enough people are vaccinated against it, transmission is greatly reduced (WHO, 2021). Even if some people are not vaccinated, the herd immunity will protect them as well. It takes multiple different ingredients to make a vaccine successful which are the antigen, the adjuvant, the stabilizer, a surfactant, and a diluent. The antigen is the ingredient that creates the immune response. It can be made up of a protein or sugar from the virus or it could be a weakened version of the virus (WHO, 2021). The adjuvant improves the vaccine because it keeps it at the injection site for an extended period of time and it can stimulate the immune cells. In order to keep the chemicals from mixing and creating a reaction in a vaccine, the stabilizers are used (WHO, 2021). The surfactants keep the vaccine blended together instead of letting them separate (WHO, 2021). A diluent is a liquid that is put in to dilute the vaccine to correct the concentration (WHO, 2021). Water is usually used for this step. Two terms that many people commonly confuse are vaccine efficacy and vaccine effectiveness. Efficacy is how the vaccine performs in the most ideal situations such as cynical trials, while effectiveness is how it performs in large populations (WHO, 2021). Understanding this difference is crucial to properly interpreting how vaccines can be used to reduce COVID-19 transmission.

The Effect of What Went Wrong

Problems in America

The pandemic led to many problems in America. Not only did it cause fatality, it caused the economy to plummet. Many people lost their jobs and they were not able to bring in enough money for their families to secure a livable wage. Along with this, food insecurity became a larger topic during the pandemic because when people started to lose their jobs, they did not have a stable income to provide their families with the correct nutrients. People started to resort to food banks that did not have enough food due to the increased demand for healthy food.

U.S. Share of Population Working Full-time or Part-time: April 2011-2020

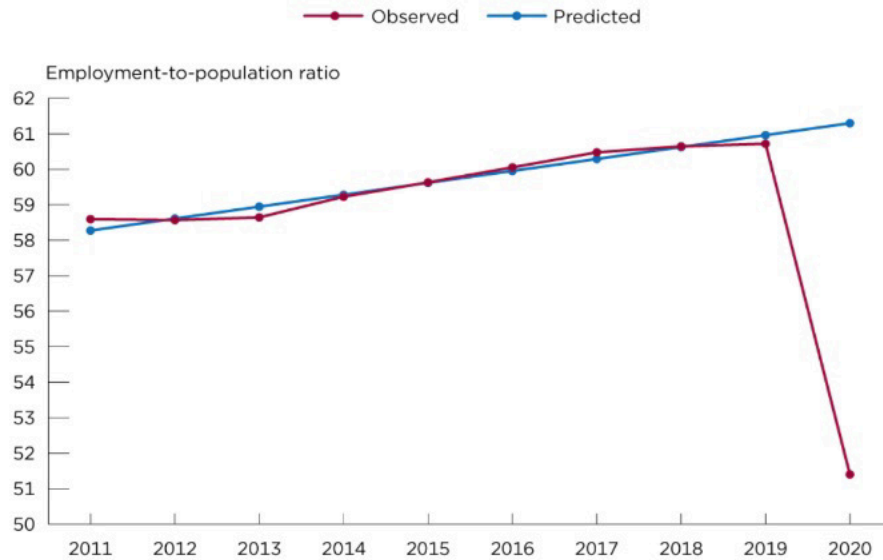


Figure 1. U.S. Share of Population Working Full-time or Part-time: April 2011-2020

Figure 1 above shows the US population of people working 16 years or older (Udalova, 2021). The blue line shows the predicted number of employment before the pandemic to population ratio and the red line shows the real employment to population ratio. From this chart it is evident that COVID-19 caused a deflation in jobs and it affected the world economically. Not only does it take an economic toll, it can take a mental and physical toll on families as well. Many people go to their jobs and see it as a safe place, and when the pandemic hit a lot of people lost that safe place that they had relied on for so long. With more people home, this can also lead to a crowded environment for families. Most people are not used to being home for such long periods of time which interferes with their day to day activities and can lead to a state of depression (WHO/Europe, 2022).

Problems in Low Income Communities

Not only did everyone suffer but people in low income communities were hit very hard. It was structural racism that led to health inequities. “Many people in Black and brown communities had already long suffered from high rates of underlying conditions such as obesity and diabetes as a result of inadequate health care, lack of access to nutritious foods and outdoor space, and higher exposure to pollution.” (Lewis, 2021) The pandemic made these situations worse because they do not have enough money to get the healthcare that they need and that they have been longing for before the pandemic was even a conversation within the United States. With being in a low income area a lot of conditions are already present and adding COVID-19 on top of it is not going to help and is detrimental to their society (Lewis, 2021).

Mortality Rates

All-Cause U.S. Mortality (per 10,000) and U.S. Employment-to-Population Ratio by Age: April 2020

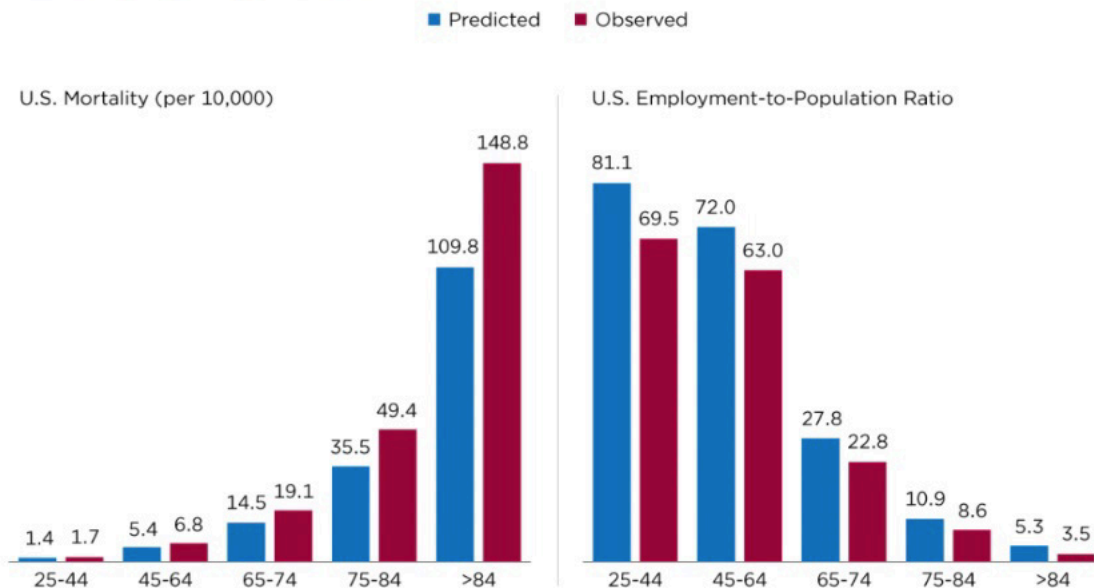


Figure 2. All-Cause U.S. Mortality (per 10,000) and U.S. Employment-to-Population Ratio by Age: April 2020

Figure 2 clearly shows how ineffective America's plans were at the start of the pandemic. Looking at the mortality for people over the age of 84, it skyrocketed with more than 39 thousand people dying from the original predicted numbers (Udalova, 2021). This is all because of flaws in how America planned for the pandemic, such as not listening to science and not having proper resources. The government knew that a better plan needed to be put in place in case of a pandemic and they decided not to change the failed plan because they thought their assistance was needed in other places of the government, when in reality a pandemic would strike not even a year later.

What Went Wrong with The United States Preparedness and What Can Be Done Better

Miscommunication

It was said that the United States was rated as the most prepared country when it came to a pandemic (Johnson, 2021). In reality, America had one of the worst outcomes when COVID-19 hit. America had three different plans that they could have put in place when they first heard that an epidemic was up and coming out of Wuhan, China (The direct origins of COVID-19 is a heavily debated topic with ideas ranging from it coming out of a lab, to somehow a bat could have been someone and they carried it back to civilization). In order to conquer the disease, there is a "Playbook for Early Response to High-Consequence Emerging Infectious Disease Threats and Biological Incidents" and it was passed from Former President Obama to Former President Trump. In this 69 page book, questions are about the upcoming pandemics in order to try to prepare for what is to come and how to stop it. It talks about the disease characteristics, epidemiology, and tracing capability (Johnson, 2021). Instead of looking into the book, a claim was made by Senate Majority Leader Mitch McConnell that Obama never gave Trump the book in order to plan for the pandemic. After the accusation was made, it was then found that the plan was published in 2016 by the US government to provide

a response to a high-consequence emerging disease threat anywhere in the world (Johnson, 2021). There is also “The National Biodefense Strategy” which is a list of goals to follow if an epidemic or pandemic ever struck the United States. There were 5 main goals in the “The National Biodefense Strategy” which were to “Enable risk awareness to inform decision-making across the biodefense enterprise, ensure biodefense enterprise capabilities to prevent bioincidents, ensure biodefense enterprise preparedness to reduce the impacts of bioincidents, rapidly respond to limit the impacts of bioincidents, and facilitate recovery to restore the community, the economy, and the environment after a bioincident” (Public Health Emergency, 2018). When the government started to downplay the pandemic, these goals went out the window. There were two other plans in place called “Pandemic Crisis Action Plan” and “Biological Incident Annex”, and both were found to be flawed when the government had a pandemic preparedness experiment only four months before there were traces of COVID-19 in the United States. In order to plan for the next pandemic, the current president of the United States should review these crucial documents in order to conquer. Knowing the plans can help the President and the government stay prepared and also have a background in what happens during an emergency such as a pandemic.

Listening to Science

Another way to prepare for the next pandemic is to listen to science. During this time COVID-19 became very political. This was detrimental to society because they would just believe what their political leader said instead of listening to the facts about the virus (Johnson, 2021). When it was first said that the virus was not real by Former President Trump people believed it because someone in power was telling them that and it ended up causing our country to be divided during the pandemic. Some people listened to what the doctors were saying while other people decided to follow what their personal political party was saying. In order to create better circumstances for the next pandemic, it would be important for not just the people of the United States, but the government officials to listen to doctors as well. Listening to the science behind a virus is the best way to approach a pandemic because it gives the true facts such as the mortality rate and case numbers (Johnson, 2021). Hopefully, by listening to doctors and scientists, during the next pandemic the mortality rates will be lower than they were during the COVID-19 outbreak.

Public Health Funding

Our public health system had been preparing for failure from the start. It has always been underfunded. In 2002 the system had a whopping \$1.4 billion, but by 2020 it had dropped to \$675 million (Johnson, 2021). Because of the money decrease 50,000 public health jobs were lost (Johnson, 2021). The authors of “Holding The Line on Biodefense” stated “Devastation could be vast and swift, and local resources would be very quickly depleted. The thousands of state, local, tribal and territorial governments that are the backbone of our nation will have to fend for themselves for far too long until federal assets arrive and Congress can provide emergency supplemental funding.” (Johnson, 2021) When their funding started to go down they started to run out of resources to help people, even if it wasn’t for a pandemic (Udalova, 2021). Having money for the CDC and just public health in general can help. It can go towards helping people that are in hospitals as well as protecting the public from upcoming and existing diseases or viruses. Past studies have shown how underfunding our health officials has been detrimental to not only Americans, but to the world (Udalova, 2021). Because our public health could not do much with an insufficient budget, they were in a position where they were trying to help the people with the resources they had, which were minimal. The money that they were using was going into trying to find a vaccine and cure for COVID-19 and even then they couldn’t come up with the proper materials because they did not have enough money for it. By creating funding for the public health system, there can be a plan in place for when the next pandemic does reign high, so hopefully the United States citizens won’t have to spend a lot of money on coming up with a doctoral system. This also caused a lack in personal gear that people could use to help themselves through the pandemic without contracting COVID-19.

Effective Testing

The United States was also very behind with screening for the pandemic in the beginning. In China they were testing people in airports domestically and internationally an entire two weeks before America started to (Johnson, 2021). This was just another example of a flaw in the plan because they saw that other countries were screening and decided not to. On March 13, 2020, COVID-19 was finally declared a national emergency. Although this was helpful, it could have been too late for America. Researchers at Columbia University's Mailman School of Public Health think that if the measures were taken a week earlier than 36,000 deaths might have been prevented (Johnson, 2021). When this came out Former President Trump dismissed the study saying that it was just a jab against him. It was by late March that people started to use the "Pandemic Playbook" that had been there from the beginning. Our government also took a step back after Minnesota, Virginia, and Michigan put stay-at-home orders into place (Johnson, 2021). There were tweets sent out saying to "liberate" these states in order to try to have the orders lifted. This caused chaos because at this point people in America would start to not take the upcoming pandemic seriously. We also lacked testing centers (Johnson, 2021). South Korea started giving a diagnostic kit on February 23, 2020 and the United States did not have anything like that until two weeks later and only in New York City and Seattle. "The U.S. accounts for less than 5% of the world's population, but more than 25% of total COVID-19 cases reported across the globe." (Johnson, 2021) America was so behind and it was evident because even Nigeria, a third world country, had a Coronavirus Group an entire month before they had their first case of COVID-19.

Mask Mandates

Finally, after being weeks into the pandemic globally Former President Trump established an executive order saying that people who have been to China in the past 14 days could not enter the United States. Although this was a step in the right direction, COVID-19 had already entered America and was ready to reign large. After this, Trump admitted that he wanted to downplay the virus to avoid causing a panic within the United States (Johnson, 2021). This was detrimental to the country because no one knew who to believe at that point. This started to make the American people have distrust in the government. There were also very limited supplies of personal protective equipment. This ranged from gowns, to masks, to gloves, and to face shields. Even then, some people decided that they didn't need any personal protective gear. Former President Trump stated that he would not partake in wearing a mask, so it led other people to think that they did not need to wear masks and it was taking away their rights as Americans (Johnson, 2021). Our government did not make masks mandatory after they knew a pandemic was going to happen in America. When a mask mandate was put into place guidelines were also very shaky. It was said that wearing cloth masks was the best option to stay safe and stop the spread of COVID-19, but it was recently found that the cloth ones are the masks that are the least effective. Wearing surgical masks is better, but because Americans were fed that information at first, they trusted that it was true. The government needs to make sure that the mask mandates are clearer and more effective. On hot days they lifted the mask mandates in school for just that one day, then proceeded to tell students that they needed to start wearing masks again the day after. This does not help with solidifying the idea of wearing them because they start to think that they are unnecessary in any situation and not just on a hot day. Using information from the past of knowing that there was an insufficient number of masks at the beginning of the pandemic helps the United States plan for the next one (Johnson, 2021). When talk of a pandemic comes up, mask production should start immediately. Even if there is not a lot of information on the virus or disease at hand, it is still good to have the protection of a mask. There were many mixed messages from the pandemic that not one knew what to do, what to wear, or what to think anymore.

Conclusion

A better plan should and needs to be put in place when talk of a pandemic arises. The first thing that people should do is listen to what science is telling them. America will not be successful in planning for another pandemic if they do not take the time to think about what science and doctors have said from the current pandemic. Our public health also needs a lot of improvement. When funding was taken away, the results were detrimental and everyone suffered because it then led to a lack of materials and funding was mainly spent on a vaccine (Johnson, 2021). Along with this, the government needs to listen to what doctoral advice is being given. We will not succeed through a pandemic as a country if we don't understand the sciences behind a disease or virus. People need to stop just listening to the government when it comes to a pandemic. When they only take into consideration one side, the people end up suffering. We saw this through people only listening to their political party and hurting the United States by not wearing masks and thinking that the pandemic did not truly exist. Testing should also be a leading factor when an epidemic or pandemic breaks out. Testing is a great way to keep track of the virus as well as keep it contained so people know when to stay home while they are positive with COVID-19. Mask mandates also need to be improved. When the mandate originally came into place, they were dismissed by many because the president stated that they were not necessary. This was a huge problem for America because this also led to people not believing in science and what was proven to be true about the COVID-19 pandemic. If another pandemic does strike the United States, it is important to go back and review what was done wrong so history doesn't repeat itself and hopefully America will be in better standings.

Acknowledgments

I would like to thank my advisors for their insight on this project.

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