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What the COVID-19 Pandemic has Taught Us About Future Health Standards

Brandon Bao[1] and Reto Asmis[#]

[1]Mission San Jose High School
[#]Advisor

ABSTRACT

The COVID-19 pandemic has been the greatest global health crisis of the 21st century, responsible for over six million deaths and half a billion cases in the past three years. Unfortunately, the world was unprepared for the pandemic and, as a result, struggled to respond to the outbreak with effective public health measures. In order to prepare for the next pandemic, this paper seeks to explore the effectiveness of many different public health policies. This paper examines whether implementing mask policies, social distancing, targeted lockdowns, efficient testing, and strict quarantining controls are the best tactics for combating the next virus outbreak. The burden caused by the next pandemic could be radically reduced if all of these policies are implemented strategically.

Introduction

On December 31st, 2019, the Chinese government contacted the World Health Organization (WHO) about severe pneumonia in Wuhan (Worobey et. al, 2022). Of the first 41 people hospitalized from this pneumonia of unknown etiology, 27 (≈66%) had been recently exposed directly to the Huanan Wholesale Seafood Market (Worobey et. al, 2022). The causative pathogen was identified as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which led to COVID-19 (Khan et al., 2020).

COVID-19, also known as coronavirus disease 2019, is an infectious disease that led to a global crisis that many were unprepared for. Coronaviruses are a diverse group of enveloped, single-stranded, positive-sense RNA viruses that have a wide-ranged tropism. The COVID-19 pandemic was the third recorded outbreak of a coronavirus, with the SARS-CoV-1 outbreak in 2002 and MERS-CoV in 2012. The first 425 cases of the Wuhan outbreak via direct contact tracing reported a basic reproduction number (R0) of 2.2, but in some cases could reach as high as 4.1-6.5 (Kuhl et. al, 2020). This means for each person infected with COVID-19, around five more people could have been infected. As of September 7th, 2022, there have been over 600 million confirmed cases, 6.4 million deaths, and 12.4 billion vaccine doses administered (WHO, 2022).

As a respiratory illness, COVID-19 spreads through respiratory droplets, which can enter the body through the nose, mouth, and eyes. It mainly spreads from person to person among those in close contact (within 6 feet or 2 meters). In addition, it can spread when a person is exposed to these viral droplets or aerosols that stay in the air for several minutes or hours, known as airborne transmission ("Coronavirus disease 2019 (COVID-19)", 2022, para. 3). Symptoms between each person can vary, but the most common include fever, cough, tiredness, and a loss of taste or smell. Other symptoms include shortness of breath or difficulty breathing, muscle aches, chills, sore throat, runny nose, headache, chest pain, etc. However, not all who are infected with COVID-19 develop symptoms. Pre-symptomatic or asymptomatic individuals can still spread the disease while not showing any signs of symptoms.

The particle size of SARS-CoV-2 ranges from 0.07 μm to 0.09 μm, making it very easy to enter the human body (Lee, 2020). The coronavirus attacks the human host by attaching its spike proteins (S-proteins)

to ACE2 (angiotensin-converting enzyme 2) receptors (Patel, 2020, para. 4). The ACE2 receptors that the virus binds to are most commonly expressed in the lungs (Ni et al, 2020). Then, the coronavirus begins to hijack the host cell's protein-making machinery to replicate itself and spread throughout the body (Patel, 2020, para. 4).

From the COVID-19 pandemic, it is well established that basic public health policies like mask mandates and social distancing are crucial to reducing disease spread. However, the effectiveness of each tactic is still relatively unclear in stopping the evolution of viruses during a pandemic. This paper answers the following question: which public health policies were the most effective at reducing or slowing the transmission of the COVID-19 virus during the spread of the pandemic? This research seeks to understand the relative importance of policies such as masking, quarantining, social distancing, lockdowns, vaccines, testing, and contact tracing.

Effectiveness is measured as the percentage of a specific public health policy that produces the desired result of preventing or slowing down the spread of COVID-19. In this paper, effectiveness is used to describe how many COVID-19 cases are being prevented. GDP, or gross domestic product, gives a basic understanding of a country's economy. The GDP of the U.S is used to correlate how the pandemic has affected the U.S economy.

Masking and Mask Mandates

Masks were one of the biggest factors in containing the spread of COVID-19. Before the pandemic, the majority of mask usage was from the health workforce. When the pandemic first emerged, many health officials in the U.S. discouraged the use of masks for fear of a shortage (Fazio, 2021). Now, nearly everyone wears masks whenever they step outside of their home to run errands. Masks have been proven to prevent a good portion of transmissions between humans, and now new technology has allowed people to develop suitable yet effective masks. Cloth masks are not only comfortable and easy to wear, but newly advanced material has allowed them to block upwards of 80% of droplets, with some on par with surgical masks (CDC, 2021). N95 masks are the most successful with a 95% effectiveness and are mainly used for first responders (CDC, 2021).

So, when a rise in cases occurs during a pandemic, everyone above the age of 2 who is not physically impaired from face coverings must wear a mask that covers their nose and mouth in public transportation, indoor public areas, and at significant gathering events. A model that correlates community adherence and mask efficacy shows that even when the efficacy of the mask is at 50% if everyone in the area wears a mask, it would lead to disease containment (Howard et.al, 2021). Mask mandates should also be implemented until COVID-19 cases begin to drop at a gradual pace or there is a sufficient amount of vaccines administered in the area. Even though reaching 100% adherence to a mask mandate may be unachievable, studies have shown from 92 regions in six continents that a mean observed level of mask-wearing corresponded with a 19% decrease in reproduction number (Leech et al., 2022).

Social Distancing

Moreover, a social distancing policy of at least 6 feet between individuals should be recommended in all areas, especially around those who are sick. Practicing social distancing and wearing masks make it very difficult for COVID-19 to be transmitted between people. Studies from Raghu Kalluri and his colleagues at MD Anderson Cancer Center estimate that social distancing policies in 46 countries prevented more than 1.5 million cases of COVID-19 in a two-week period, which was a 65% reduction of cases during that time period (Boldt, 2020). More specifically, Germany, which limited the maximum number of people together in public spaces to 10 people, avoided 84% of the potential COVID-19 cases and 66% of the potential fatalities in a three-week period (Glogowsky, 2021). Like masks, social distancing policies can be lifted when it becomes safe to come into close contact with people for long periods of time. This can be achieved through herd immunity when 60-70%

of people in a given population are vaccinated, as estimated by scientists from Houston Methodist (McCallum, 2021).

Lockdowns: General v. Targeted

It is vital that the top health officials make sure to evaluate the consequences before engaging in a full lockdown. In the future, there should be an emphasis on targeted lockdowns. However, it is imperative that lockdowns are not widespread. A nationwide lockdown ultimately led to a peak unemployment rate of 14.8% in April 2020, the highest since the Great Depression (Amadeo, 2021). The U.S real gross domestic product also shrank at a record high of 31.4% in the second quarter of 2020 (Amadeo, 2021). Harvard Medical School researchers Dhillon & Karan (2020) suggest that places, where hospital beds, staff, and ICU capacities are strained, should impose lockdowns. Also, they mention better lockdowns should focus on restricting venues or scenarios where the widespread transmission can occur, like concerts, gyms, bars, etc. Targeted lockdowns can not only be implemented in specific locations but can also be used to restrict the movement of people of certain ages. For example, a study shows that if there is a temporary lockdown for people over 65 until a vaccine arrives, then such a measure can help young and middle-aged groups back into the economy by maintaining over 80% of the workforce, as well as reduce the economic damage from 24.8% to 12.3% of one year's GDP (Acemoglu et. al, 2020). Lockdowns are probably the most effective way of containing the virus but must be done cautiously and efficiently.

Early Testing

Testing is crucial as it is one of the only ways to know if an individual has the virus or not. Without testing, it would be impossible for the virus to be tracked. Testing is not only easy and quick, but it also saves lives, especially in communities that are affected the most. It's important to utilize aggressive and scalable deployment of testing resources in order to decrease the spread of a future virus (Benda et. al, 2021). One of the common tests for COVID-19 was the PCR test. The PCR test is a real-time reverse transcription polymerase chain reaction test to detect the presence of SARS-CoV-2 nucleic acid (Emery et. al, 2004). However, even though they are very accurate, the PCR test sample needs to be sent away to a laboratory for analysis, meaning it can take days for people to find out their results (Kent, 2021). On the other hand, there is an antigen "rapid" test, which is cheaper and detects certain proteins of COVID-19 in 20 minutes. At the beginning of a pandemic, tests may not be widely available, so it is crucial for health workers and government officials to test first, followed by the elderly, to make sure that there is a sufficient workforce to treat the infected. When tests start to become more readily available, there should be local test centers so people can quickly get tested. In early March 2020, South Korea had already opened up drive-through rapid testing centers and conducted 3,600 tests per million people compared to five per million in the U.S (Kuhn, 2020). It's critical that people who come into close contact with someone that is infected immediately take a PCR test in order to detect the presence of SARS-CoV-2 accurately. For those who are unsure whether or not they might be infected with COVID-19, taking a test once every 2 days can ensure that there are no signs of the virus when you develop symptoms (Barnhart, 2022).

In addition to testing, maintaining an intense surveillance system is necessary to contain the virus during the early stages of a pandemic. Hong Kong, a densely populated city with over 11 million people, managed only to record 4 deaths, while the U.S 7-day average deaths were well over 2,000 people (WHO, 2022). How was this possible? This difference was due to the strict border control and quarantining the Hong Kong government implemented early during the pandemic. Hong Kong banned all non-residents and residents who arrived after traveling abroad had to undergo a strict 14-day quarantine (Saiidi, 2020). However, since the U.S

is such a big country, all airports would need to conduct a regimen similar to Hong Kong's. In Canada, travel exposure accounted for 26% of COVID-19 cases (Statistics Canada, 2020). Thus, when anyone flies into the U.S, regardless of citizenship, they must go through a 14-day quarantine (which corresponds to the upper limit of SARS-CoV-2 incubation time), as well as a negative COVID-19 test after the quarantine and enter the country with no infection risk. This strict procedure could eventually graduate to screening, temperature checks, and rapid tests as governments see a decrease in risk.

Contact Tracing and Vaccines

Contact tracing systems would need to be very efficient and reliable to identify people who have been in contact with an infected individual. In local areas, the only measures of contact tracing experienced are through connections or notifications from school districts. In order for us to effectively contact trace, there should be a national system, such as a contact tracing app. One innovative contact tracing app is NOVID, an anonymous app that traces the distances and locations of users by implementing Bluetooth and ultrasound technology. It is the only app that explicitly shows the distance between cases. Nonetheless, the potential of the app can only be reached if it is implemented on a national scale.

The COVID-19 pandemic showed how the pharmaceutical side of the equation could really achieve such great feats in such little time. For a vaccine, the time it takes to develop, test, and release to the public is usually 10-15 years ("Vaccine Development, Testing, and Regulation", 2018). Since COVID-19 was a global crisis, many pharmaceutical companies invested in developing the vaccine, resulting in its successful production and dissemination in under a year (Solis-Moreira, 2021). The mRNA vaccine was the first vaccine to be administered to humans. The BNT162b2 (Pfizer) vaccine is an mRNA vaccine that relies on the viral SARS-CoV-2 genetic information to produce viral spike proteins in the host, thus eliciting an immune response that produces neutralizing antibodies. With an efficacy of 90% for kids and over 94% for teens and older, the vaccine is still the most effective way of combating COVID-19 (Klein et. al, 2022). Ultimately, the speed of vaccine development could alter the direction of any future pandemic.

Conclusion

So why does this all matter? The International Monetary Fund (IMF) estimates that the median global GDP dropped by 3.9% from 2019 to 2020, the worst economic downturn since the Great Depression (Oum et al., 2022). There have been 4.2 million more jobs in October 2021 than in February 2020 ("Tracking the COVID-19 Economy's Effects on Food, Housing, and Employment Hardships", 2022). Approximately 75% of newly emerging infectious diseases (EIDs) are zoonoses that result from various anthropogenic, genetic, ecologic, socioeconomic, and climatic factors (Gebreyes et al., 2014). COVID-19 is one of many zoonotic diseases that causes much harm to the world. Therefore, it is essential that governments invest billions of more dollars toward implementing these public health measures/policies. Moreover, 80% of COVID-19 deaths have been among older adults (Farrell et. al, 2020). Many long-term care facilities have been especially and disproportionately impacted by COVID-19. In September 2021, one in four hospitals reported over 95% of ICU beds occupied, with states such as Alabama having no more room for patients (Smart, 2021). The government must allocate more resources toward ensuring critical patients are being taken care of by enhancing funding for intensive care unit (ICU) beds, mechanical ventilator capacity, and hospital personnel.

People around the world have learned so much about what steps must be taken to prepare for the next pandemic. This research paper found that although some of the currently implemented policies are very beneficial toward the spread of the pandemic, there still are many improvements that can be made for a future pandemic. Also, policies such as targeted lockdowns and stronger contact tracing systems are factors that play

a crucial factor in reducing the duration of a pandemic. It is essential that everyone learns from their previous mistakes and make the right decisions to reduce the likelihood of future zoonotic viral outbreaks. The government must fight the virus by promptly implementing targeted lockdowns, quarantining, and testing to mitigate early transmission. It is important that there is trust between the citizens and health officials, or else the potential of contact tracing apps and science-based measures like masks and social distancing cannot be reached. Health organizations must also allocate more of the budget toward the healthcare industry to make sure that patients can be treated properly and develop research data to develop a vaccine in no time.

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