

Coronavirus Disease - 2019

Pandemics Epidemiology: Societal Impacts and Strategic Response within South Korea

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Introduction

The novel coronavirus pandemic has swept across the globe, greatly affecting many countries' economies, governments, and people since the first reported case in Wuhan, China in 2019. The SARS-CoV-2 is a zoonotic virus, a disease that passes from animals to humans, that causes the coronavirus disease 2019, or COVID-19. Through natural selection and mutation, scientists believe that the coronavirus originated in horseshoe bats *Rhinolophus affinis*, and spilled over to humans through an intermediate host - the Malayan pangolin (Stevens, 2020).

By studying the RNA genome of the coronavirus scientists were able to match up most of its nucleotide sequence with the horseshoe bat coronavirus, but observed a drastic dissimilarity of the gene that codes for the spike protein. With further analysis, scientists determined that the specific region that codes for the spike protein matched with a region in the genome of a Malayan pangolin. This genome analysis has helped scientists hypothesize about the genetic history and emergence of SARS-CoV-2 which is crucial for future research and vaccine development across the globe. With the emergence of the coronavirus, nations across the world have taken different approaches to manage the pandemic.

South Korea has had a strong approach to the pandemic because of their history with viral respiratory illnesses. In 2015 they experienced the largest outbreak of MERS - or Middle East Respiratory Syndrome - outside of its origin in the Middle East ("2015 MERS outbreak", 2020; Song et al., 1994). After this outbreak, South Korea established safeguards to help prevent the same issues that they faced when containing and eliminating MERS. This helped them gain an advantage over the rest of the world when the novel coronavirus struck. Another advantage that the country had was their geography. While South Korea is located close to China, the origin

of this pandemic, they are separated by North Korea. North Korea stood as a buffer between the root of the outbreak, because they are a highly urbanized country with restrictive immigration laws. As a result, there has been limited transmission through North Korea, which has been very beneficial to the South Korean peninsula. South Korea's history and geographic location allowed them to control and contain the pandemic promptly.

The second largest coronavirus outbreak to occur outside of China was in the city of Daegu, South Korea (Bayer, 2020). South Korea is among the world's most densely populated countries, leading to cases being more clustered in comparison to other rural countries ("South Korea Population," 2020). However, South Koreans accept public health over personal privacy, and are more tolerant to government policies. They were also used to wearing masks to protect themselves against air pollution; therefore, they readily accepted mask regulations as opposed to other areas of the world. The cultural and legal environment allowed the country to reduce the number of cases without a great cultural shift.

The analysis of South Korea's response towards the pandemic includes observing the number of people that were infected with the coronavirus and mitigation efforts that were put in place to control the spread of the virus. Hospital resources were prioritized to the most severe cases in order to be used the most efficiently while treatment options are tested and vaccines are developed. While resources were being rationed, people had to social distance for their own safety, leading to social and economic repercussions. The coronavirus has altered South Koreans' day to day life, but the nation has implemented significant efforts to limit future impacts.

Infections Rates (*Cassidy Conte*)

The coronavirus pandemic began to impact South Korea in mid-January. Victor Cha, a senior advisor and Korean chair at the Center for Strategic and International Studies, found that South Korea's first official case of coronavirus was confirmed on January 20th, 2020 (Cha & Kim, 2020). This was the start of the rapid spread of coronavirus, and by February 20th, 2020 there were 53 daily cases (“South Korea”, 2020). By March 3rd, 2020 South Korea had 851 new cases, which was the peak of daily coronavirus cases in South Korea (“South Korea”, 2020). Matt Berger, a freelance reporter specializing in health and science, found that South Korea was able to reduce the rate of new daily cases to one tenth of the peak (Berger, 2020). On March 20th, 2020 South Korea had 87 new cases, which was approximately 10.2% of the peak (“South Korea”, 2020). From here the amount of daily cases continued to drop, and on April 20th, 2020 they had 13 new cases (“South Korea”, 2020). As of July 30th, 2020 South Korea had an overall total of 14,269 confirmed cases of COVID-19; 13,132 of these individuals recovered and 300 individuals died (“South Korea”, 2020). This calculates to a fatality rate of approximately 2.2%, meaning out of every hundred COVID-19 patients in South Korea, 98 people survived. This fatality rate is relatively low when compared to other countries.

In order to control the infection rate, South Korean officials took initiative to create a test. On January 27th South Korean officials told companies that a test for COVID-19 needed to be established. One week later the first test was approved (Berger, 2020). This rapid test approval allowed more individuals to be tested in South Korea than many other countries, such as the United States. By February 28th, 2020 the United States had successfully tested approximately

3,300 people, in contrast to South Korea who had tested 94,055 individuals (Berger, 2020). David Lee and Jaehong Lee, members of KAIST, a national research university, found that by February 28th, 2020 medical staff were able to conduct 15,000 tests per day. This was due to the wide availability of tests and low-contact screening clinics (Lee & Lee, 2020). The widely available testing allowed South Korean individuals who had the virus to take proper precautions and prevent others from getting infected.

Although South Korea was ahead of other countries, they still have work to do. Jung Eun-Kyeong the head of the Korean Center of Disease Control and Prevention stated that the first wave of the coronavirus in South Korea lasted until late April (“Coronavirus: South Korea”, 2020). The number of daily coronavirus cases in South Korea from April 15th to May 25th varied from 6 to 32 cases per day (“South Korea”, 2020) This indicated that the first wave of the coronavirus was over. However, Juan Yeon-je, a journalist for Agence France-Presse, found that throughout June of 2020 South Korea saw daily cases increase to between 35 and 50 (Yeon-je, 2020). The consistency of high daily case numbers in June concerned the South Korean officials. The majority of these cases came from the metropolitan region of Seoul where nearly half of South Korea's population resides (Yeon-je, 2020). Jung-Eun-kyeong concluded that the spike in cases of COVID-19 was triggered by the May holiday where regulations were lax (Yeon-je, 2020). This led to a second wave of COVID-19 being declared in South Korea on June 22nd, 2020. (“Coronavirus: South Korea”, 2020). Since the declaration of the second wave, South Korea has implemented a multitude of regulations and resources to regain the control of the pandemic.

Hospital Resource Use and Future Models (*Amina Hasan*)

Although cases were still rapidly rising in other countries, South Korea was able to quickly and efficiently stunt the spread of COVID-19 without the lockdowns and economic shutdowns that other countries have been forced to implement (“Coronavirus: How Are Countries”, 2020). This is due to South Korea managing their hospital resources more effectively than other countries around the world as well as implementing widespread testing for the coronavirus. South Korea’s aggressive response to COVID-19 included establishing several safeguards and multiple policy changes to improve pandemic preparedness and response.

The government established an emergency response committee within days of the first case becoming known. This ensured that the number of new cases per day during the first month of the outbreak stayed between zero and two until a large cluster was identified in Daegu, a city of about 2.5 million people (“Emerging COVID-19 success”, 2020). After this cluster was identified, South Korea realized that their country had begun a steep uphill trend in COVID-19 cases and rushed to contain the spread. On February 21st, hospitals in Daegu reorganized their health care system as a whole, instead of operating as individuals. They created a four-step triage system, which designated 10 hospitals to COVID-19 patients only, ensuring critical, contagious patients were separated from the rest of the minor or non-COVID-19 related cases. This decreased the chances of infecting people without COVID-19 as well as greatly ensuring that PPE was allocated to specific areas to further maximize patient care. South Korea also swiftly recruited more health care officials - 2,392 total (Kim et al., 2020). Because of these measures, South Korea reached its peak of 909 daily cases early on in the year (“Emerging COVID-19

success”, 2020). After the peak, the number of daily cases decreased by 200 because of the implemented regulations (“Emerging COVID-19 success”, 2020; So, 2020). However, South Korea remained vigilant even after they overcame the worst of the pandemic. When another cluster was identified weeks after they experienced their peak, the country did not hesitate in shutting down their reopening to ensure that the number of cases did not rise again.

Throughout all of this, the South Korean government worked hand in hand with hospitals, ensuring that they had all the necessary equipment to contain this pandemic. The government increased the amount of negative pressure rooms in hospitals. These rooms are containment chambers that prevent airborne diseases from escaping and infecting others by filtering it before letting it outside the room (Husney, 2019). The government also ensured hospitals were stocked up on Personal Protection Equipment (PPE) before the peak of cases, allowing them to be prepared when cases rapidly rose (“Emerging COVID-19 success”, 2020). These precautions have led to less healthcare workers being infected. As of March 24th, only 1.8% of cases in the city of Daegu were healthcare workers, in contrast to over 9% in Italy - another hotspot for COVID-19 (Kim et al., 2020). It was crucial for health care workers to remain healthy and protected, in most hospitals shifts were monitored and limited to reduce fatigue and chances of medical errors, which helped South Korea contain and defeat the spread of the coronavirus.

Mask production was another factor of South Korea’s very effective pandemic response. Initially, the government implemented measures like exporting masks and penalizing hoarding amongst retailers (“Emerging COVID-19 success”, 2020). But when these measures became insufficient in mid-February, as cases were rapidly rising, the government implemented

emergency measures. This doubled daily mask production to an average of 10 million, with the government purchasing 80% of that and distributing it wisely (“Emerging COVID-19 success”, 2020). The significant efforts to protect healthcare workers as well as the general public raised spirits and encouraged cooperation with safety regulations.

After expanding equipment production, the country's focus then shifted towards creating more screening centers. Over 600 facilities were established, and by late March the country had performed over 300,000 tests (“Emerging COVID-19 success”, 2020). One particularly effective facility type - drive-through centers - allows three times as many samples to be collected without directly coming into contact with the patient. This diminishes the need for negative pressure rooms and allows them to be prioritized for critical COVID-19 patients (“Emerging COVID-19 success”, 2020). Phone-booth style centers were also highly effective, allowing health care workers to also evaluate symptoms and test people without coming into direct contact with them. Once cases began to fall, workers shifted to testing in positive pressure booths, minimizing the need for PPE and allowing medical supplies to be saved for hospitals.

Not only did South Korea have a surplus of tests, they also had a very high bed per capita ratio - 12.3 beds per 1,000 people - compared to other high-income countries (“Emerging COVID-19 success”, 2020). Other countries initially viewed this higher beds per capita as excessive and unnecessary, but it proved to increase capacity in hospitals which was effective during the pandemic. (“Emerging COVID-19 success”, 2020; Reynolds, 2020). As a result of South Korea’s effective management of hospital resources, their cases are falling daily, and this trend is predicted to continue with proper mitigation efforts that have been put in place due to past outbreaks.

Mitigation Efforts (*Sai Deekshita Doma*)

South Korea was notably prepared for COVID-19 following the country's 2013 SARS outbreak and 2015 MERS outbreak. They established a given plan and accumulated resources for future national health complications. As of 2015, South Korea organized a centralized task force by administering full authority to the Korea Center of Disease Control and Prevention (Pardo & Lee, 2020). In addition, the country strengthened its healthcare system by limiting infection within the hospital setting and increasing the supply of PPE masks, surgical masks, ICUs, and negative pressure isolation rooms (Pardo & Lee, 2020). With the county's past mistakes taken into account, South Korea took significant measures within a week of the first reported case, effectively managing the spread of the pandemic.

Early Action

At the genesis of South Korea's coronavirus pandemic, the country immediately imposed emergency measures on Daegu, a highly populated city of 2.5 million. The virus spread quickly, mainly through churches, with more than 2,000 confirmed COVID-19 cases reported by February 29 and over 5,000 by March 7 ('Innovation in Care', 2020). As the virus began to spread, there was a significant concern about staff burnout, shortage in healthcare workers, and infection in the hospital setting. In order to manage this issue, South Korea worked towards reorganizing the health system on a regional level and limiting intervention on the hospital-level. The hospitals implemented a four-category risk-stratification system, from asymptomatic to mild, moderate, severe, and critical cases ('NEJM Catalyst Innovation', 2020). The severity of a patient's symptoms were assessed prior to the hospital visit in order to allow healthcare workers

to plan accordingly. This triage system allowed the hospitals to manage the intake of COVID-19 patients in an organized manner. All healthcare facilities rapidly expanded beds for isolation and recruited 3,009 healthcare workers ('NEJM Catalyst Innovation', 2020). In order to limit hospital infection, asymptomatic to mild COVID-19 cases were directed to community treatment centers where further screening took place. As COVID-19 began to spread from Daegu, this system became a standard across the country.

Widespread Testing

In the aftermath of the 2015 Middle East Respiratory Syndrome outbreak, South Korea observed that lack of testing resulted in a sizable infection rate. Within weeks of the Wuhan outbreak, “four Korean companies had manufactured tests from the World Health Organization recipe” resulting in a “system that could assess 10,000 people a day” (Engelberg, Song, & DePillis, 2020). According to Statista, as of July 24, 2020, South Korea has administered 1.5 million coronavirus tests. The extensive tests conducted in the early stages of the pandemic allowed South Korea to flatten the curve within a month of its peak in February. Our World in Data reports that as the pandemic escalated approximately 600 new testing centers were created in order to minimize contact with healthcare workers. In addition, South Korea instituted drive through testing centers where 10 people could be tested within an hour (Kuhn, 2020). Along with the testing, Public Relief Hospitals were established to separate between respiratory and non-respiratory patients in order to optimize testing efficiency (Center Disease Control, 2020). The extensive availability of testing kits took the strain away from the frontline workers and hospitals, ultimately regulating COVID-19.

Contact Tracing

The concept of telemedicine transformed South Korea's ability to manage COVID-19. South Korea's contact tracing program utilizes epidemiology and "new methods to track contacts by linking large data-bases (global positioning system, credit card transactions and closed-circuit television)" ('Contact Tracing During', 2020). The South Korean government mandated the installation of tracking apps, which Koreans readily accepted as they are prone to prioritize safety over privacy. The top two most successful apps, Corona 100m and Corona Map, "collects data from public government sources that alert users of any diagnosed COVID-19 patient within a 100-meter radius along with the patient's diagnosis date, nationality, age, gender, and prior location" (Huang, Sun, & Sui, 2020). These tracking apps help limit the amount of infection in certain areas and the amount of people infected from one COVID-19 patient. Quantifying SARS-CoV-2 allows for pandemic control and transparent transmission of information from the government to the citizens of South Korea.

Laws, Orders, and Travel Regulations

As South Korea transitioned from social distancing back to regular life, on May 6th relaxed regulations were imposed. The government made arrangements to encourage working from home. However, for those who were unable to work from home, businesses required facial masks, temperature checks, hand-sanitizing, and 2 meters of physical distance between individuals. World Aware reports that "authorities require people to wear masks to access public transport, including buses, taxis, and subway trains, as well as domestic and international airline passengers" ('Covid-19 Alert: South', 2020). In addition, the reopening of schools has been

highly regulated with a daily inspection system. The system has diagnostic and screening stations readily available to administer fever tests at least twice a day ('Ministry of Health', 2020). During educational activities, students physically distance and constantly disinfect. Regarding travel restrictions, as of April 1st, "the Republic of Korea's Ministry of Health and Welfare imposed a mandatory 14-day quarantine for all inbound passengers" ('U.S. Embassy & Consulate', 2020). The tightly regulated system along with the voluntary efforts of South Korean citizens has allowed the country to reduce the number of new cases significantly.

South Korean citizens have valued the governmental initiative to reduce COVID-19 impacts. They have willingly contributed to the distribution of their personal information as well as strictly adhered to the rules for the better of the nation. The South Korean government realized their mistakes of past outbreaks and put early measures into action. Widespread testing, drive-through testing centers, contact tracing, and strict reopening guidelines have successfully stabilized the spread of the coronavirus. With only 0.9% positive coronavirus tests out of the total number of tests conducted, South Korea's planned out regulations, national cooperation, and enforcement has been an example for managing a global pandemic.

Treatment and Vaccine Development (*Rishika Podarala*)

Vaccine Development

With the COVID-19 cases under control, South Korea has begun developing a vaccine for the coronavirus. As of now, the company Genexine in South Korea has begun its phase I/IIa trials for the coronavirus vaccine. The vaccine being tested has been approved by South Korea's Ministry of Food and Drug Safety, as declared by the CEO Young Chul Sung (Ho & Lee, 2020).

The vaccine that is currently being tested is a DNA vaccine, which means that the organism is injected with a gene that codes for a protein of the virus. This allows the organism's own cell functions to translate the gene into the protein, which prompts its immune system to respond to it (Biotech Primer, 2017). Once the protein is expressed, B-cells (produce and secrete antibodies) and T-cells (recognize viral antigens) launch an attack against what it thinks is the actual virus. After the B and T cells attack the cell the macrophages come in and eliminate the 'virus'. This creates active immunity within the organism which allows their immune system to be prepared in case it actually gets infected with the SARS-CoV-2 virus. In the case of the coronavirus, the protein in interest is the spike protein. This protein on the outside of the coronavirus is what allows the virus to enter and infect the cell. The spike protein is the ideal target for antibodies to attack the virus. However, there has been a discovery that there might be an o-linked glycan shield that essentially hides the spike protein so that it cannot be recognized by antibodies (Stevens, 2020). Despite these hypotheses, researchers have been able to make vaccines for the coronavirus. In addition to testing the DNA vaccine, researchers at the Korea Research Institute of Chemical Technology have used their knowledge from the previous SARS and MERS outbreaks and have found that the antibodies used to neutralize those viruses can also bind to SARS-CoV-2's spike protein (Arirang News, 2020). This could potentially give clues to develop another vaccine that can disable the SARS-CoV-2 virus, and prevent it from having access to human cells. It should be noted that this research was published in March, 2020 and given the constant change of information regarding the coronavirus, there may be newer, more updated information about using this technique.

Treatments

There have been many treatments that have been developed in response to COVID-19. A common global treatment is Remdesivir. There have been proven clinical examples of COVID-19 patients showing improvement after being treated with Remdesivir. In fact, U.S. news reports that one in three South Korean patients with COVID-19 have improved after this treatment (Reuters, 2020). The drug can help significantly reduce the recovery time, but still has not been approved as a vaccine as it has to be extensively researched and go through clinical trials. So far, there have been mixed results of its effectiveness from the Korean Centers for Disease Control and Prevention who have reported that 9 patients improved after the drug was given, 15 showed no change, and 3 patient's conditions worsened (Reuters, 2020). Another treatment that is being used is plasma transfusion. There have been successful case studies in South Korea of COVID-19 patients treated with plasma transfusion (Arirang News, 2020). The plasma treatment is where recovered COVID-19 patients donate their plasma with antibodies to fight against the disease. Their plasma is taken and given to current COVID-19 patients infected with the coronavirus, enabling their bodies to use the antibodies in the plasma to fight against the virus. Once the antibodies attach to the antigen, the macrophage comes in to engulf the virus - effectively eliminating it. Although this seems to be an effective treatment, plasma transfusion only gives the patient passive immunity. Thus, if the patient were to be infected again with the virus, their immune system would not have memory of the virus and would not be prepared to fight against it again.

Genome Mapping

In addition to researching possible vaccines and treatments for COVID-19, South Korean researchers have also effectively mapped the genome of SARS-CoV-2. Professors Kim V. Narry and Chang Hyesik at the Institute for Basic Science in South Korea have collaborated with the Institute of Health and Korean Centers for Disease Control and Prevention to map the SARS-CoV-2 RNA genome (Institute of Basic Science, 2020). This has proven to be very beneficial as researchers can now analyze the sequences and gather more information about where specific genes are located on the RNA genome. With this information, scientists can understand how the virus replicates and how it interacts with the human defense system in order to infect the cell. This advancement in understanding the virus and key structures - such as the receptor binding domain and polybasic cleavage site - will greatly help researchers develop vaccines and treatments.

Current Status

Currently, vaccine development has to successfully pass clinical trials. Scientists estimate that it will take another year, possibly to the end of 2021, to develop an effective vaccine. But, an increase in global cases has prompted the process of vaccine development to accelerate. Although time is of the essence, ensuring the safety of potential vaccines is crucial to avoid disease enhancement from vaccinations. After passing clinical trials the vaccine has to go through regulatory approval. Once approved, the virus has to be manufactured and distributed to the population. Fortunately, DNA vaccines can be manufactured in significantly less time compared to other vaccines, because they use an original strain from the virus's genome and

inject an attenuated form into the organism. Also, with the development of technology the vaccine can be rapidly manufactured. After manufacturing, the vaccine has to go through quality control checks to ensure that it is safe for the public, and then it can effectively be distributed throughout the population. In addition there has been a lot of government support and funding from organizations to help the development of the vaccine. In fact, the Bill and Melina Gates foundation has donated \$350 million towards coronavirus research, a large amount of it going directly to institutes in South Korea for COVID-19 vaccine development (Brown et al., 2020). The goal of the funding is to ensure that everyone has equal access to the vaccine, regardless of social or economic status. The development of effective vaccines and treatments is vital to avoid future economic and social impacts.

Economic Impacts (*Adeline Agnew*)

The current response of South Korea to the economic fluctuations due to the pandemic was influenced by previous economic recessions such as the Asian Financial Crisis in July of 1997-1998. As a result, South Korea had devalued their currency and a great deal of businesses had fallen. Because of such drastic economic impacts South Korea had to find ways to take control of their economic situation. Their previous experience of dealing with economic recessions allowed South Korea to bounce back from the effects of the coronavirus pandemic in 2020.

Initially, South Korea experienced major economic decline due to the pandemic. They reported a loss of 2.9 million won (South Korean currency) because the number of foreign travelers decreased by about 2 million people this year (So, 2020). Consequently, 60,000 people who work in the travel industry also lost their jobs (Stangarone, 2020), resulting in a massive decline in the tourism industry. Not only has South Korea's travel businesses been suffering, but manufacturing companies have also been impacted. One example is the mass production of vehicles like Hyundai motor companies. Hyundai had to stop the manufacturing of cars because they could not get the necessary parts from China due to the pandemic (Atiyeh, 2020). Also, people in their manufacturing buildings started to test positive for COVID-19 (Jin & Yang, 2020). This led them to have a 62% profit drop (Jun, 2020). Petroleum companies were also affected in South Korea, because of the low demand of oil during the pandemic (Kirk, 2020). Companies like SK Innovation have lost 440 billion won and Lotte Chemical said their company's net profit had gone down about 88.7% from last year because of COVID-19 (Korean Times, 2020; Yang & Lee, 2020). These major companies being affected led to the majority of economic decline.

In addition, small businesses were also being severely affected from the pandemic. Around 57,000 people who work in wholesale and retail companies have lost their jobs during the pandemic. Approximately 133,000 people working in the lodging and food industry have

also lost their jobs (Stangarone, 2020). Due to the loss in thousands of jobs, the government started providing a high number of stimulus checks to their citizens. The government has given 917 million won in unemployment benefits (Stangarone, 2020). They also provided 816 won per household with the exception of the richest 30% of South Koreans (South Korea, 2020). These are currently some of the many attempts being made by the South Korean government to try and stop the economy falling farther than it is. Their actions have also helped citizens and small businesses regain their financial footing.

Although many companies were failing, some companies in South Korea actually started gaining profits from the pandemic. For example, medical companies gained 40 million won from the mass exportation of tests in 2019, and as the number of cases continued to increase they gained 514.8 million won as of June 2020 (Stangarone, 2020). Medical supply companies are not the only ones profiting from the pandemic. South Korea's tech companies also started gaining profits because the use of tracking software increased. This tracking software allowed the government and citizens to see where someone had tested positive for COVID-19, and track where their location to control the spread of the virus.

South Korea has continued to work towards stabilizing their economy. The government is aware of how many people are unemployed and are working diligently to support these individuals. The South Korean government is making an effort to fund smaller businesses and

those who need financial support as well. These mandates and actions made by the government in response to the economy have greatly affected society as well.

Social Impacts (*Amber Jani*)

The coronavirus has impacted their society in several ways from the initial government interactions and protocols to their healthcare system. The government dealt with the effects of the pandemic and helped to reinforce the citizens's trust in the government. An example of how the government and citizens worked hand in hand is through their public health hotline. This system was created for someone to call if they were showing signs of COVID-19. Once they called, they were connected with an official who would assess the symptoms and provide an underlying evaluation by telephone. If suspected of infection, the patient is directed to a dedicated COVID-19 testing site. If tested positive for COVID-19 they'll receive medical care in a quarantined environment to stop further infection (Ahn, 2020). As a result of these precautionary measures, the rate of the spread of the virus and the mortality rate has slowly reduced. Due to the government taking accountability, this helped reinforce trust between the citizen and government. The understanding of the citizens and strong government leadership has helped greatly for the people of South Korea to build stronger relationships between everyone. That being said the people of South Korea willingly wore masks and understood the importance of self-quarantining.

Early and efficient responses by the government lead to better economic outcomes which in return helped positively impact the society. South Korea started practicing social distancing early and was quick to flatten the curve of people infected by the virus. The government took the virus seriously, prompting everyone else to take the virus seriously as well. The administration

worked fast and efficiently with the people, companies, and health care systems. Having a less impact on the economy improved the social well being of the citizens which in itself helped their mental health. Due to the massive effort taken by the government, several organizations improved their economic recovery. Additionally, South Korea worked closely with the private sector and built hundreds of high-capacity screening clinics to ensure an adequate supply of tests. South Korea's reaction to COVID-19 stands apart on the grounds that it was able to control the spike rapidly without shutting down organizations, giving stay-at-home requests, or enforcing stricter mandates. South Korea has demonstrated early accomplishments across three periods of the pandemic readiness and reaction structure: detection, containment, and treatment. From the start, dynamic in South Korea has been a joint effort between the legislature and mainstream researchers. (Ariadne Labs, 2020). These early steps to decrease the spread of the virus allowed South Korea to be a step ahead in diminishing the spread of COVID-19 and being better off to maintain social conditions.

Even though South Korea had such a positive impact on their economy and help from their government the mental health of South Korean's suffered greatly. South Korea currently has the 10th highest suicide rate in the world. Having stronger government response reduces the impact on the mental health of the citizens, but there are clear where people aren't completely immune to the mental distress that could occur. As a result of the coronavirus and stay at home orders there was an increased level of anxiety, depression, sleep disorders, and more. According to one study, 47.5% of Koreans said they experienced anxiety/depression because of COVID-19, which led the government to expand the help of psychological support (Hyunbong Parka and Soyoung Yu, 2020). The daily life of South Koreans has completely flipped. Churches were

advised to shut down, students were forced to sit at a distance for exams to reduce contact, and lunch was no longer a place to socialize because protective screens have been put up in different facilities. This lack of contact and daily life changes have greatly affected the mental health of all citizens. As concerns about the virus increased, people minimized contact with others by refraining from outside activities, public transportation, and social gatherings. There have been several negative and positive effects on people since their daily lives have changed due to the pandemic.

The most common places that people may get infected by COVID-19 are nursing homes, jails and prisons, places of residency, workplaces, airplanes, and cruise ships. The Korea Biomedical Review, met with two public health doctors, Choi Se-jin and Jeon Hyeong-jin, in Daegu. They were sent to Daegu Correctional Institution and Daegu Detention Center for medical support to help stop the spread of the virus in the prisons starting in March. Their job was to operate the isolated examination rooms and protect inmates from any additional COVID-19 outbreaks within the prison and the detention center. The jail in Daegu has 2,200 people, including inmates and staff, and the detention center has 900. The two institutions require more prudent disease control because just one new case could spark group infections easily. When several prisoners are locked up in a cell, stress builds up, and it leads to increased fights and incidents. “I was concerned about possible violence, but I had to limit their activities in such a dire situation,” Choi, vice president of the Korean Association of Public Health Doctors, said (Report from Daegu, 2020). “To prevent an incident, I have no other option but to explain the situation to inmates well. Luckily, they are also in an alert state, and there was no big trouble until now,” (Report from Daegu, 2020). Prisoners were required to cancel outdoor

recreational activities and social distance from other prisoners. This has a negative effect on prisoners' well being and mental health due to them having less and less contact with others.

In short, COVID-19 has impacted people of all different social groups psychologically, politically, and culturally. It affected people in places of residency, workplaces, jails and prisons, nursing homes, and more. The government, several organizations, and citizens of South Korea have been working together to help flatten the curve of the virus. The citizens of South Korea had a great change in their daily lives due to quarantining, social distancing, and closing of public transportation, and community and entertainment gatherings. These changes affected their mental health through an increase in anxiety, depression, sleep disorders, and more. While having to deal with the uncertainty of the virus it brought families and communities together. Individuals display their duty to make a difference by investing or donating money, volunteering, and working hard to help improve the mental and physical well-being of those who are in need, and to help their community thrive again.

Conclusion

The coronavirus pandemic emerged in China, and the first case was discovered in South Korea in January 2020. South Korea immediately took action, developing their first coronavirus test in February 2020. With the government's quick and efficient response, the infection rate was reduced by one tenth of the peak (Berger, 2020). Learning from previous outbreaks, many mitigation efforts were implemented early on. These plans entailed preparing the healthcare system by increasing supplies of masks, creating more isolation spaces, and developing contact tracing technology. Hospitals implemented a four step triage system which ensured that all

critical COVID-19 patients were in a separate hospital to those with minor COVID-19 cases or uninfected patients. South Korea's efforts were very effective in limiting the amount of cases and spread of the virus.

Even though South Korea was quick to contain the pandemic, their economy and society were greatly affected. Prior to this pandemic, South Korea had already experienced a financial crisis which prepared them to give stimulus checks to small and large businesses as well as households during the COVID-19 pandemic. South Korea's prior preparation allowed their economy to bounce back from an economic crisis quickly during the pandemic. Along with economic impacts, the coronavirus had significant social impacts. The government worked with their citizens and several organizations to help improve the outcome and spread of the virus. Even though they made mandates which helped the country greatly, the citizens' mental health suffered with issues like anxiety, depression, suicide, and more. The citizens worked with their community by volunteering and donating to help improve the mental and physical well being of everyone.

Although infection rates have been controlled, South Korea experienced a second wave on June 22, 2020. Currently, vaccine development efforts are in progress in South Korea to work toward herd immunity. There are also many treatments that are being used to help people with COVID-19 recovery. While the pandemic is a continuing global concern, there are hopes that a vaccine will be approved in 2021.

References

2015 MERS outbreak in Republic of Korea. (2020, April 13). Retrieved August 16, 2020, from <http://www.who.int/westernpacific/emergencies/2015-mers-outbreak>

2020 coronavirus pandemic in South Korea. (2020, May 12). Retrieved August 15, 2020, from https://en.wikipedia.org/wiki/2020_coronavirus_pandemic_in_South_Korea

A. (Director). (2020, March 04). South Korean discover neutralizing antibodies for COVID-19 [Video file]. Retrieved 2020, from www.youtube.com/watch?v=j1vFHJxGLuY

Ahn, M. (2020, April 13). Combating COVID-19: Lessons from South Korea. Retrieved August 15, 2020, from <http://www.brookings.edu/blog/techtank/2020/04/13/combating-covid-19-lessons-from-south-korea/>

Atiyeh, C. (2020, July 08). Coronavirus Forces Hyundai, Others to Shut Down Korea and China Factories. Retrieved August 15, 2020, from <http://www.caranddriver.com/news/a30767235/coronavirus-hyundai-china-korea-factory-shutdowns/>

B. (Director). (2017, July 11). DNA vaccines [Video file]. Retrieved from www.youtube.com/watch?v=BOQ0XsxF02w

Brown, K., Chang, E., & Bloomberg. (2020, August 05). Bill Gates lays out a possible timeline for a 'stop-gap' COVID vaccine. Retrieved August 16, 2020, from <https://fortune.com/2020/08/05/bill-gates-vaccine-covid-coronavirus-stop-gap-timeline/>

CHA, V. D., & DUMOND, M. (2017, July 01). THE KOREAN PIVOT. Retrieved 2020, from https://www.jstor.org/stable/resrep23175.9?seq=3#metadata_info_tab_contents

Cobban, J. (1994, January 01). Exporting Planning: The Work of Thomas Karsten in Colonial Indonesia. Retrieved August 16, 2020, from https://link.springer.com/chapter/10.1007/978-94-011-1002-0_16

Coronavirus: How Are Countries Responding to the Economic Crisis? (n.d.). Retrieved August 16, 2020, from <http://www.cfr.org/backgrounder/coronavirus-how-are-countries-responding-economic-crisis>

COVID-19 Alert: South Korea Tightens Restrictions in Greater Seoul as of June 15. (2020, June 15). Retrieved August 16, 2020, from <http://www.worldaware.com/COVID-19-alert-south-korea-tightens-restrictions-greater-seoul-june-15>

Eco health. (2016, October 11). Retrieved August 16, 2020, from <http://www.ecohealthalliance.org/programs>

Feng, E., Kuhn, A., & Dwyer, C. (2020, May 13). In South Korea And China, Loosening Restrictions Brings Coronavirus Resurgence. Retrieved August 15, 2020, from <http://www.npr.org/sections/coronavirus-live-updates/2020/05/13/855117276/south-korea-and-china-see-covid-19-resurgence-after-easing-restrictions>

Fisher, M., & Sang-Hun, C. (2020, March 23). How South Korea flattened the curve. Retrieved 2020, from <https://library.umsu.ac.ir/uploads/385.pdf>

Hays, J. (n.d.). ASIAN FINANCIAL CRISIS IN 1997-98 IN SOUTH KOREA AND INDONESIA. Retrieved August 15, 2020, from <http://factsanddetails.com/asian/cat62/sub408/item2558.html>

He, L. (2020, April 23). South Korea's economy just recorded its worst contraction since the Great Recession because of the coronavirus pandemic. Retrieved August 15, 2020, from <http://www.cnn.com/2020/04/22/economy/south-korea-economy-coronavirus/index.html>

Ho, D., & Lee, G. (2020, July 07). South Korea's Genexine begins phase I/IIa trials for COVID-19 vaccine. Retrieved August 16, 2020, from <http://www.bioworld.com/articles/435995-south-koreas-genexine-begins-phase-iiia-trials-for-covid-19-vaccine>

Hospital Isolation Rooms. (n.d.). Retrieved August 16, 2020, from <http://www.uofmhealth.org/health-library/abo4381>

How South Korea Weathered the 2008 Financial Crisis Articles. (n.d.). Retrieved August 15, 2020, from http://www.globalasia.org/v8no1/feature/how-south-korea-weathered-the-2008-financial-crisis_shalendra-d-sharma

Hyundai Motor halts work at factory after worker tests positive for coronavirus. (2020, February 28). Retrieved August 15, 2020, from <http://www.reuters.com/article/us-china-health-southkorea-hyundai-motor-idUSKCN20M08>

Jun, K. (2020, July 23). Hyundai Motor profit drops 62%. Retrieved August 15, 2020, from <http://www.marketwatch.com/story/hyundai-motor-profit-drops-62-2020-07-23>

June-Ho Kim, M., Julia Ah-Reum An, M., Pok-kee Min, M., Asaf Bitton, M., & Atul A. Gawande, M. (n.d.). June-Ho Kim. Retrieved August 16, 2020, from <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0159>

Kirk, D. (2020, May 14). COVID-19 Hitting South Korea Hard As Economy Contracts And Exports Tumble. Retrieved August 15, 2020, from <https://www.forbes.com/sites/donaldkirk/2020/05/13/covid-19-hitting-south-korea-hard-as-economy-contracts-and-exports-tumble/>

Kwon, J., & Jeong, S. (2020, May 29). Hundreds of South Korea schools close again after reopening. Retrieved August 16, 2020, from <http://www.cnn.com/2020/05/29/asia/south-korea-coronavirus-shuts-down-again-intl/index.html>

Lee Labs, B. (2020, March 24). Origins of SARS Covid 2 part 1. Retrieved <https://leelabvirus.host/covid19/origins-part1>

One in Three South Korean COVID-19 Patients Improve With Remdesivir. (n.d.). Retrieved August 16, 2020, from <http://www.usnews.com/news/top-news/articles/2020-07-13/one-in-three-south-korean-COVID-19-patients-improve-with-remdesivir>

Park, H., & Yu, S. (2020). Mental healthcare policies in South Korea during the COVID-19 epidemic. *Health Policy and Technology*. <https://doi.org/10.1016/j.hlpt.2020.06.006>

Pardo, R. P., & Lee, J. H. (2020, May 07). Retrieved 2020, from https://www.korea-chair.eu/wp-content/uploads/2020/05/KFVUB_Policy-Brief-2020-07.pdf

Reynolds, E. (2020, May 26). The world sacrificed its elderly in the race to protect hospitals. The result was a catastrophe in care homes. Retrieved August 16, 2020, from <http://www.cnn.com/2020/05/26/world/elderly-care-homes-coronavirus-intl/index.html>

Roser, M., Ritchie, H., Ortiz-Ospina, E., & Hasell, J. (2020, March 04). Coronavirus Pandemic (COVID-19) - Statistics and Research. Retrieved August 15, 2020, from <https://ourworldindata.org/coronavirus>

S Korea to pay cash to families, plans extra budget relief. (n.d.). Retrieved August 15, 2020, from <http://www.google.com/amp/s/www.aljazeera.com/amp/ajimpact/korea-pay-cash-families-plans-extra-budget-relief-200330044104832.html>

Shepherd, L. (2020, June 11). South Korean Workplaces Grapple with COVID-19. Retrieved August 16, 2020, from <http://www.shrm.org/resourcesandtools/hr-topics/global-hr/pages/coronavirus-south-korean-workplaces.aspx>

Shin, H. (2020, March 19). South Korea pledges \$39 billion emergency funding for small businesses. Retrieved August 15, 2020, from <http://www.reuters.com/article/us-health-coronavirus-southkorea-toll-idUSKBN216066>

So, W. (2020, July 24). South Korea: Coronavirus tests. Retrieved August 16, 2020, from <http://www.statista.com/statistics/1102818/south-korea-COVID-19-test-total-number/>

So, W. (2020, May 25). South Korea: Economic impact of coronavirus outbreak on tourism 2020. Retrieved August 15, 2020, from <http://www.statista.com/statistics/1092579/south-korea-economic-impact-of-wuhan-virus-outbreak-on-tourism/>

South Korea announces \$29 billion third stimulus budget to fight coronavirus crisis. (n.d.).

Retrieved August 15, 2020, from

<http://www.google.com/amp/s/www.cnbc.com/amp/2020/06/03/south-korea-announces-29-billion-third-stimulus-budget-to-fight-virus.html>

South Korea GDP Growth Rate 1960-2020 Data: 2021-2022 Forecast: Calendar. (n.d.).

Retrieved August 15, 2020, from <https://tradingeconomics.com/south-korea/gdp-growth>

South Korea Population 2020 (Live). (n.d.). Retrieved August 16, 2020, from

<https://worldpopulationreview.com/countries/south-korea-population>

Staff, S. (2020, April 09). New coronavirus (SARS-CoV-2) mapped out. Retrieved August 16,

2020, from <https://phys.org/news/2020-04-coronavirus-sars-cov-.html>

Stangarone, T. (2020, August 03). COVID-19 Pushes South Korea Into Recession. Retrieved

August 15, 2020, from

<https://thediplomat.com/2020/08/covid-19-pushes-south-korea-into-recession/>

Stephen Engelberg, L. (n.d.). How South Korea Scaled Coronavirus Testing While the U.S. Fell

Dangerously Behind. Retrieved August 16, 2020, from

<http://www.propublica.org/article/how-south-korea-scaled-coronavirus-testing-while-the-us-fell-dangerously-behind>

Stevens, C. (2020, March 27). The Origins of SARS-CoV-2: Part 2. Retrieved August 16, 2020,

from <https://leelabvirus.host/covid19/origins-part2>

These are the 6 largest coronavirus outbreaks outside of China. (2020, August 13). Retrieved August 16, 2020, from <http://www.cbsnews.com/news/coronavirus-largest-outbreaks-outside-china-south-korea-diamond-princess-italy-japan-iran-singapore-today-2020-02-26/>

This is a guest post from researchers at the Ariadne Labs as part of the Exemplars in Global Health platform. Ariadne Labs is a joint center for health systems innovation at Brigham and Women's Hospital and Harvard T.H. Chan School of Public Health. (n.d.). Emerging COVID-19 success story: South Korea learned the lessons of MERS. Retrieved August 16, 2020, from <https://ourworldindata.org/covid-exemplar-south-korea>

U.S. Mission Korea | August 6, 2020. (2020, August 10). COVID-19 Information. Retrieved August 16, 2020, from <https://kr.usembassy.gov/022420-covid-19-information/>

Vaccine to in the pandemic? [Video file]. (2020). Retrieved from <https://www.youtube.com/watch?v=S1l6BchEoZM>

Yang, H. (2020, July 07). Samsung Electronics flags second-quarter profit jump on solid chip demand, one-off gains from Apple. Retrieved August 15, 2020, from <http://www.reuters.com/article/us-samsung-elec-results-idUSKBN247326>

Yang, H. (2020, July 29). South Korean refiners post record first-half losses on plunge in oil price, demand. Retrieved August 15, 2020, from <http://www.reuters.com/article/us-sk-innovation-results-idUSKCN24U1CK>

[Report from Daegu] Doctors guard prisons against COVID-19. (2020, March 18). Retrieved August 15, 2020, from <http://www.koreabiomed.com/news/articleView.html?idxno=7750>