SOUTH KOREA AND COVID-19

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Introduction

After the World Health Organization (WHO) declared COVID-19 as a pandemic, COVID-19 became the most-talked about topic in the world. The number of testings, cases, and deaths started to be matters that many people mention on a day-to-day basis. While we begin to get used to masks, social-distancing, online schools, and home offices, we continue to seek the ways we can stop this pandemic and return back to our normal.

While the number of cases were increasing significantly around the entire world, South Korea has flattened the curve on COVID-19 earlier than most of the countries. Although it became one of the first countries in which the first confirmed cases occurred, outside mainland China, the South Korean government took effective preventative measures to control the spread as early as possible. Thanks to these measures, in the first two weeks of March, new daily cases fell from 800 to fewer than 100, which assisted South Korea to stand out among other countries that experience COVID-19.

This paper focuses on the actions taken by South Korea during the pandemic, oversimplified in five different topics: infections and fatality rates, mitigation efforts, usage of technology, treatment and Vaccine Development, and Economy. This paper includes the distinctive approaches that South Korea has taken differently compared to the other countries with their consequences and effects, in each topic.

Infections and Fatality Rates (Tan Aydemir)

This section of this academic paper will focus on the infections and fatality rates in South Korea, as well as the potential causes for the fluctuations in the numbers, and current trends. Moreover, governmental regulations of the country to prevent the virus-spread will be further explored, with exhaustive information on the efficacy of these regulations.

Despite its considerably large population of 50 million people, South Korea, beginning from February when the first active COVID-19 case was announced, has been handling the situation quite efficiently, when compared to other countries, which have markedly fewer populations. By the beginning of September, South Korea was listed as the 71st country with the highest rates of fatality, which is a remarkable success, considering that the country implemented a strict quarantine that had lasted comparably shorter than other countries had done, even holding a national election in April, when corona-virus cases was swiftly climbing across the world.

According to various statistics and graphics, during the first encounter with the virus, the fatality and infection rates rose dramatically, in a period from early February to late March. One possible explanation for this rapid climb in numbers could be the potential tendency of citizens to catch common cold or flu, similar to countries in the Northern Hemisphere, when it was wintertime. According to a research by Professor Michael Ward, an epidemiologist at the Sydney School of Veterinary Science, COVID-19 is most likely a seasonal disease that "occurs in periods of lower humidity," as he expressed that "[they] found that lower humidity is the main driver [in Australia], rather than colder temperatures."(32) He explains that with less humidity comes smaller infectious aerosols, which could stay in the air for longer periods of time, thus, creating a greater chance for infection. This is presenting a logical explanation for the increase in the fatality rates and infections in South Korea from the start of March to May.

Another reason for this increase could be connected to the preparedness of public hospitals, and the lack of experience of medical doctors and hospital officials with the COVID-19. Even though South Korea raised the alert level to the highest on February 23, 2020 following a rapid surge in new infections in a single day, converting health centers into virus hospitals, adding extra beds and disinfecting the rooms took considerably longer. Yet, although the first numbers presented a problem for South Korea, its strict regulations, as well as strategies to track the infections through mobile phone applications, benefited the country in the next months, with other countries struggling to flatten the COVID-19 curve.

In terms of the case fatality rates by age, South Korea is analogous with other countries affected by this disease. While the numbers show that COVID-19 results in approximately 90 fatalities in 100,000 cases between ages 30 to 39, the same statistics demonstrate that almost 22 out of 100 cases for ages greater than 80 result in deaths. Thus, as with other countries, elderly people are more vulnerable to the disease than the younger for various potential reasons, including increased inflammation, in which bodily functions over-react to the invading cellular species.

As of the beginning of May, a number of articles, including the NEWS Medical, reported that the first wave had finished, while the crude mortality rate reduced to a 2.4%, As mentioned above, in

spite of its high population, South Korea was able to maintain this crude mortality rate, which was considerably higher in other countries with similar populations (10.8% in Italy by the start of April) (30). Still, it must not be overlooked that these numbers, in fact, do not represent the real scenario. The same news article stated that "low testing levels also cause a falsely elevated fatality rate as the asymptomatic and mildly symptomatic cases go mostly unreported and undiagnosed." Thus, as with other countries, there are markedly high numbers of cases that are not confirmed.

Even though South Korea has been handling the current events well, with respect to other countries, a number of crucial incidents spread across the year have been leading the country to implement more stringent regulations, involving markedly stricter penalties and lock-downs. Although a variety of events causing rise in the infection rates have been announced, one of the major ones is super-spreading. An issue across the entire world, super-spreading plays an oversized role in the "transmission of the virus that caused the disease," in which one person infects a "disproportionate number of other individuals."(33). In a specific period of time from the first announcement of the COVID-19 in South Korea, various incidents were announced, especially across the crowded areas, including the entertainment districts and fresh food markets in and around Seoul.

A woman, who tested positive in early March, participated at the same church service as did 100 other people, which led to a swift increase in the virus cases, as the infected people had further spread the virus around the city of Seoul. Furthermore, based on the official news reports, approximately three hundred new COVID-19 cases were related to cluster infections in clubs at an entertainment district in Seoul. Anadolu Agency, a major Turkish News portal, stated that these infections had not only impacted those in this district, but also approximately 30 others "who were infected through secondary transmissions." Moreover, by the beginning of August, new reported cases of super-spreading caused distress across South Korea, eventually leading the country to take further immediate action. A news article by BBC announced that South Korea's Health Minister identified the country's recent condition as "very grave," administering stricter regulations, including the reduction of student attendance in kindergartens and primary-schools and the closure of the districts of entertainment.

In spite of the recent increase in numbers of the reported virus cases, South Korea has been successful in taking the disease under control better than other countries, specifically due to their excellent and far-reaching healthcare systems and sophisticated medical doctors around the nation.

Mitigation Efforts (Pelin Tiryaki)

After the COVID-19 pandemic has increased its influence over the world, the countries focused on mitigation efforts to reduce the projected effects of the pandemic. These efforts refer to pre-disaster planning over a medium or long time period and the disaster period.

Mitigation is the effort to reduce the loss of life and property by lessening the impact of disasters. The primary purpose of the mitigation efforts taken by the administrations is to maintain the

well-being of their societies. Effective mitigation requires an understanding of the local risks, addressing hard decisions, and investing innovative solutions for community's long term well-being. Without effective planned mitigation actions, societies jeopardize their safety, financial security, and self-reliance.

Coronavirus emerged in Wuhan, China in December 2019 and has now spread worldwide. Coronavirus spread to South Korea in late February 2020, and there was a rapid increase in the number of cases from the end of February to mid-March 2020. Because of the mitigation efforts of the Government of South Korea and the private sector, the spread of COVID-19 has been declining rapidly and only in a few cases until the end of August 2020 (16).

Upon the approval of their first case, South Korea instituted nationally coordinated strategies of mitigation. Since the first attempt was to take the spread of the virus under control, wearing a face mask in public seems to have been one of the major contributing factors. There were some countries where the use of face masks was discouraged, particularly in Europe. Despite this, the Government of South Korea strongly recommended that a face mask should be worn from the beginning (16).

From another perspective, there were several reasons why wearing a face mask has been easily accepted by the public in South Korea and why South Korea was faster than any other country to take under control the spread of the virus. In 2015, there was an outbreak of MERS-CoV (Middle East respiratory syndrome coronavirus) infection, with 186 cases and 38 fatalities in South Korea. The epidemic lasted for 2 months and the Government of South Korea quarantined 16,993 individuals 8 (20). The MERS-CoV outbreak strengthened public acceptance of wearing a face mask in the event of the unexpected threat of respiratory viral infections. Therefore, South Korea was actually pre-experienced of the pandemic period like a body defense mechanism which exposed the second time the same disaster. Therefore South Korea was relatively more adaptable to take precautions compared to the other countries who never experienced an epidemic before.

In South Korea, a 'trace, test and treat' program immediately was put in place. Members of the public were advised to avoid large gatherings and crowded places and to follow quarantine protocols, such as wearing a face mask, hand washing, and social distancing. These later became the new normals of all countries.

At the time the pandemic demonstrated its consequences, as the other countries South Korea has started to take actions against Coronavirus. Their approach was to learn how to live with it and continue on a regular basis of life in order to prevent themselves from pandemic's delimitative aspects. In this section, there would be three examples of mitigation efforts taken by South Korea chosen from among the many others.

1. Efforts for legislative election:

On 15 April 2020, South Korea held its 21st legislative election. They were " among the first countries to hold a national vote since the pandemic began"(5). This election had remarkable

points because South Korea presented itself as an epitomist to the world while bringing new precautions to maintain a confidential environment for voters.

The National Election Commission (NEC) encouraged voters to vote early in order to "reduc[e] the number of voters expected to gather at the polling stations on election day" (28). As a result, over 12 million voters (26.7% of eligible voters and around 40% of overall turnout) cast their votes early (28).

The government ensured its citizen's safe voting environment. NEC adopted nationwide safeguards and precautions throughout its 14,330 polling places. Before accessing the polling station, poll workers checked each voter's temperature with a non-contact thermometer. The voters who had above 37.5 ℃ or displayed other respiratory symptoms redirected to special polling stations with heightened precautions. Face masks, social distancing, hand sanitizers, and gloves were all required; also, voters removed their gloves and discarded them into a disposal box (5). For the individuals unable to leave the hospital, such as nurses, COVID-19 patients, and self-isolation persons and the ones who have limited mobility, South Korea served "home voting application" between March 24-28 (28).

To communicate with the voters and maintain transparency, NEC live-streamed polling station activities on its eTV and national channels, both during early voting and on election day. In addition, South Korean health authorities have concluded that no COVID-19 transmissions occurred as a result of the parliamentary election (12).

2. Efforts for the Tourism Industry

Pandemic has affected many industries in all countries. South Korea is also one of the countries to promote domestic tourism to reduce the loss of this industry. Korea Tourism Organization has launched a digital campaign – #TakeMeBackToKorea which targets to keep Korea open to visit for travelers (23). Director of Korea Tourism Organization Jong Sool Kwon shares, "These are the most challenging times in the travel and tourism industry, but we are sure to recover and come back stronger than before" (23). After their limitation for borders has been bent for the foreign visitors, precautions are being taken such as limiting the maximum number of visitors to 1,000 people, requiring online reservations, and QR code entrance records (27). In this way, South Korea presents its norm and brings new ways to approach tourism with coronavirus. Since most scientists agree that the world will continue to leave with the consequences of Coronavirus minimum two years, South Korea's attempts to support this industry seems to have a long term contribution to its economy.

3. Efforts for Transportation

During the pandemic process, one of the emergent topics was precautions that were taken for the use of common areas such as inside of public buses. Prevent the spread of COVID-19, authorities in the capital Seoul have set up pilot ten glass-paneled bus stops that scan the temperature of passengers and refuse entry to anyone who has a fever (24). "Ten solar-powered shelters have been set up along major bus routes in the Seongdong district of the city's center, the

district government said in a statement" (24). These special bus stops have several innovative features to prevent COVID-19 infected people from spreading to others. They include "external thermal cameras and internal UV sterilizers" with air conditioning and therapeutic music (24). By installing these bus stops, the government of South Korea presents another approach to control the spread of coronavirus and to maintain the public's well-being.

The Technology South Korea Has Used to Flatten the Curve and Some Privacy Concerns (Beste Kuruefe)

As one of the few countries that has flattened the curve on COVID-19, South Korea has become a model for the rest of the world. Although there is no one factor to South Korea's success in dealing with COVID-19, the country's use of technology is definitely a key factor that sets it apart from many other countries.

While using technology to control the spread of coronavirus might sound exciting, loss of privacy, which is a potential trade-off, seems to worry some since most of the technology used by South Korea involves collection of residents' data.

The Technology South Korea Has Used to Flatten The Curve:

Although South Korea uses technology to deal with coronavirus in many areas, from facilitating hospitals to contact tracing, the technology that will be discussed in this paper can be examined in mainly two categories: the technology used for identifying infected people and protecting others from getting infected and the technology used for regulating the self-quarantine and easing the transition to social-distancing.

To be able to identify infected people and protect others from getting infected, South Korea developed a system that tracks the location of infected people. At first, patients go through an interview about the places they visited recently (4). The gaps that the patients did not mention are filled by collecting credit-card transaction data, mobile phone location logs, and surveillance camera footage (10). Once a person is infected, the places this person visited are shared with the public via government websites and cell broadcasting alerts, so that the residents can be cautious about not visiting the areas that the infected person had visited (4).

The information of the infected person shared with the public can include details, such as the times of his or her visits to specific locations, or whether the person was wearing a mask or not, thanks to the recordings of CCTV cameras. Here is an example of publicly shared information about a patient's location track:
"Before being diagnosed, patient #10422 visited the Hanaro supermarket in Yangjae township on March 23 from 11:32 p.m. to 12:30 a.m. The patient was accompanied by their spouse, both wearing masks and using their own car for transportation. On March 27, the pair visited the Yangjae flower market from 4:52 p.m. to 5:18 p.m., again wearing masks. They then had dinner at the Brooklyn The Burger Joint at Shinsegae Centum Mall from 6:42 p.m. to 7:10 p.m."

To be able to regulate self-quarantine, two apps are developed: "Self-Quarantine Safety Protection App" and "Self-Diagnosis App." All inbound travelers must download one of the two apps to their smartphone to check their health status and record any symptom that they show for two weeks in their self-quarantine.

Another type of app developed during pandemic shows the places residents can buy masks nearby. During the first months of the pandemic, the rate of production of masks was not enough for the demand for masks of the residents. There could be long lines in front of stores that sell masks, or stores could run out of masks, which could cause panic among residents (15). The app that shows the stores that residents can buy a mask is developed to address this problem.

To be able to ease the transition to social-distancing, some private corporations took initiative. A remote-work software provider offered free use of their remote meeting solution, RemoteMeeting, for three months. Another startup provided its remote teaching service, which has functions such as asking questions, taking notes, giving feedback, or conducting surveys, to schools for free (25).

Some Privacy Concerns:

Although the information shared with the public about infected people through government websites is quite detailed, it is not personal. For example, specific case numbers assigned to each patient, such as "#10422", suggest anonymity (10).

Regarding the concern of the content of the data shared with the public, Goh Jae-young, an official at the Korea Centers for Disease Control Prevention, says that "[they] share with the public only places where there was close contact or infections could have spread - like where there are many people, where the patient was known to have not worn a mask", emphasising that they do not reveal every place a patient had been (14).

Seon Kui Lee, who is the director of the Division of Risk Assessment and International Cooperation at Korean Centers for Disease Control & Prevention, also states that they "have a very strong privacy policy in Korea", and they used the information they gathered from patients only for "protecting the public." Kui highlights that the only purpose of the information gathered from the patients is "epidemiological investigation" (15).

However, there is still a possibility that the information shared with the public can be used for wrong purposes, or causing infected people to be identified. For instance, internet searches done by the patient's case number can include related queries such as, "personal details", "face", "photo", "family" (14), or two infected people who are having an extramarital affair can be spotted by matching their location records (10). Also, some users make jokes, such as "people cheating on their spouses are known to be keeping a low profile these days," about the location-tracking system on social media sites.

Another aspect of sharing information about the places infected people had visited is that revealing the name of a specific store that a patient had been could lead the store to close for a certain time, causing financial loss for the store owner (14).

Even though these kinds of examples show that loss of privacy can be a trade-off when data-based technology is used, it is worth noting that the same technology also helped South Korea save a lot of lives.

Economic Impacts (Aylin Alkaş)

South Korea has been one of the quintessence countries by means of the economical improvements it has gone through. It is famous for its distinct rise from one of the poorest countries in the world to a country with a developed and stable economy. Right now, it is ranked the 12th most strong economy in the world. We might see the effect of this change, in the history of South Korea during the global financial crisis. Not just they maintained their systematic approach, but they also experienced an economic peak. This success lies behind many economical and political factors. One of which is the developed relations with many countries. Since the elections that took place in 2017, South Korea has been trying to improve its terms with North Korea. "The Korean-peninsula remains one of the most protracted and volatile conflict zones in the word. President Moon Jae-in has pushed the denuclearization and the 'peace economy' concept as the cornerstones of its North Korea policy."(2) Since then, the South has been offering economic benefits, which includes massive infrastructure projects. However, the fact that all economic activity is constrained by the international sanctions to protect the international law in South Korea, has caused the questioning of dismissed diplomatic actions and human rights, especially during the Covid-19.

Export Led Country:

Started in the early 1960s-government policy shifted from import substitution towards export orientation. Level of economics development is positively correlated with the growth of trade with foreign countries within comparative advantage adjustment. Following that, the industrial policy which includes only the exports of the products of the labor intensive Light Industries (LI), shifted to the development of high-value added Heavy and chemical Industry (HCI). (18) This can be considered as one of the main turning points, by means of economic policies. The government chose iron and steel, non-ferrous metal, shipbuilding, electronics and chemical industries as the most important HCI.(18) The fact that they took a big step compared to the other countries at that time, initiated many other improvements. In the following years, with the global technological advancements, South Korea switched to the production and export of the technology-based machines and products. Which was again a huge step, considering the rapid increase of need in this particular area.

The increased power of production within the country, led South Korea to systemize and fund the production process. In 1995, the government decided to come up with a Capital Goods Industries Promotion Plan. The aim was to simply promote high-value added capital goods industry while also supporting and funding the production of newly developed technologies, and

establishing them as the main continent of the export industry. With this plan, they had to strengthen the market mechanism, thus the production level has increased significantly in the international level. Getting on an international level caused some basic changes in the territorial applications; such as providing tax and financial incentives. Considering the limited geographical size, increasing labor force and limited natural resources South Korea hasn't any other choice rather than focusing on technological developments. Out of the 52 million population, 24.8 million people are considered in the labor force. Additionally, the main industries (electronics, telecommunications, automobile production, chemicals, shipbuilding, steel) represent 35.1% of the GDP and employs 24.8% of the workforce. (18)

Years	real GDP growthrate (percent)	export values (US$ billions)	exports/GDP (percent)
1962-1966	8	1	7.7
1967-1971	9.7	3	13.7
1972-1976	8.4	22	27.8
1977-1981	6.1	77	31.5
1982-1986	8.7	141	34.4
1987-1991	9.2	307	32.1
1992-1996	7	510	28.7
1997-2001	4.3	734	42.8
2002-2006	4.8	1,239	31.2
2007-2009	2.5	1,186	42.2

Graph

COVID-19:

As was mentioned in the "Fatality Rates" section, South Korea first reported confirmed cases in early February with an average number of 500 new cases each day. The implemented comprehensive testing and tracking system, allowed Korea to contaminate the virus and decrease the case number to an average of 100 cases daily, while also minimizing the mobility restrictions.

Even though we can see that South Korea has done a significantly better job than most of the countries while controlling the spread of virus from the results, it would be impractical to assume that their stable economy didn't get affected, or it was easy to deal with the consequences. During February, after the first outbreak of the Covid-19 in South Korea, The Ministry of Trade, Industry and Energy announced that "Korea's exports in February rebounded and increased 4.5 percent from a year earlier to USD 41.3 billion. Imports inched up 1.4 percent to $37.2 billion. The trade balance stood at a surplus of $4.1 billion, remaining positive for 97 straight months."(29) Considering that most of the countries were not at a "dangerous" level by means of cases back at that time and there were less countries reported cases compared to now, with the exports of medical products and especially masks South Korea has peaked in the trade market. Despite all of that, the upcoming months were presenting an uncertainty, especially considering the falling demand of the wide range of products from China and the rising need of medical products in South Korea itself.

But despite what was happening in the world, Korea had to take actions on a national level to keep the wheels turning. Therefore on March 13, "The Ministry announced on April 13 that Korean exports of information and communications technology (ICT) goods in March increased 1.1 percent year-on-year to USD 16.0 billion. Imports inched up 2.7 percent to $9.4 billion, and the trade balance stood at a surplus of $6.6 billion. (29) Following that, on March 17 the National Assembly passed the 1st supplementary budget of 2020. This budget included a KRW 0.8 trillion decline in revenue, with a KRW 10.9 trillion spending on disease prevention and treatment, loans and support for businesses, households and local economies in general. After that, there was a second and third supplementary budget. On July 14, the government announced a new policy package called the Korean New Deal. This package was planned to transform the economy from a fast follower to a leader, in the private sector. This would come with building a carbon-dependent economy to a green-economy, and becoming more inclusive in these areas.

The package included three components: digital economy, green technology, and social safety net. According to this plan, the total of KRW 67.7 trillion will be invested by 2022, and in return a total of KRW 160 trillion will be won. Most important among them, a total of 1.9 million jobs will be created.(22) If this happens, these actions will be turning points for South Korea. Because despite the low unemployment rate, the number of irregular workers is very high. This is a thread for not just the future of the country, but also the social ties and inequalities.
This might not seem as a priority during the pandemic, but South Korea took these into action considering the country's future. This was more of an investment for them. Their advantage was their stable economy, thus they had the chance to worry about their future. As expected, the initial effect was great. "The Ministry of Trade, Industry and Energy announced on August 13 that Korean information and communications technology industry's export growth in July posted a year-on-year growth of 3.3 percent to USD 15.0 billion. Imports inched up 1.2 percent to $9.9 billion, and the trade balance stood at a surplus of $5.1 billion."(29)

South also kept up with its work on the international level. In April, they took a wise step and decided to merge forces with the USA. The USA's place during the pandemic, both politically and economically, is a questionable topic; but considering its power, it has been beneficial for South Korea. "The Bank of Korea opened a bilateral swap line with the U.S. Federal Reserve for $60 billion."(22)The aim was to find a resource for the funding of the improvements that were planned to be made in the private sector, while also making future investment both politically and economically for the benefit of the country. This plan included three main steps:

1. Raising the cap on foreign exchange forward positions to 50% of capital for domestic banks (it was previously 40%), and 250 percent for foreign-owned banks (it was 200% previously). (22)
2. Temporarily suspending the 0.1% tax on short-term non-deposit foreign exchange liabilities of financial institutions.(22)
3. Temporarily reducing the minimum foreign exchange liquidity coverage ratio for banks to 70% (it was 80% previously). The Bank of Korea has also announced a facility for non-bank financial institutions to engage in repos to receive foreign exchange from the Bank of Korea, to be implemented by end-september. (22)

Treatment and Vaccine Development (Berin Pınar)

Treatment Efforts:

Although South Korea's success is mainly due to their advanced contact tracing technologies, hospitals and treatment centers have successfully monitored the patients and provided intensive care for the ones who needed it.

Keeping in mind that there is no effective antiviral treatment for COVID-19, early recognition of patients at high risk is important for providing necessary interventions at the right time. Therefore South Korean hospitals used a combination of the three scoring systems for the prediction of the patients with higher risks, which include the Systemic Inflammatory Response Syndrome (SIRS) score, the quick Sequential Organ Failure Assessment (qSOFA) criteria, and The National Early Warning Score (NEWS). Scoring systems like such predict the clinical outcomes of COVID-19 patients.

Systemic Inflammatory Response Syndrome (SIRS) score is a scoring system that consists of four variables: body temperature, heart rate, respiration rate, and white-blood-cell number (17). The quick Sequential Organ Failure Assessment (qSOFA) criteria is relatively new compared to SIRS, which assesses respiratory rate, Glasgow Coma Scale, and systolic blood pressure (17). It is better than SIRS for predicting in-hospital mortality rate, however inferior to NEWS for predicting clinical deterioration.The National Early Warning Score (NEWS) system assigns a score of 0-3 to seven parameters which include: pulse oximetry, oxygen rate, pulse rate, systolic blood pressure, respiration rate, temperature, and central nervous system status (13). It is the system used by most of the South Korean hospitals during COVID-19 pandemic due to its significantly accurate prediction of the infected patients' responses to the treatments.

In a retrospective observational study done by Korea Research Institute of Bioscience and Biotechnology and Yeungnam University, 110 patients with SARS-CoV-2 infection who were hospitalized at Yeungnam University Medical Center from February 19, 2020 to March 26, 2020 the effectiveness of three scoring systems was monitored (13).
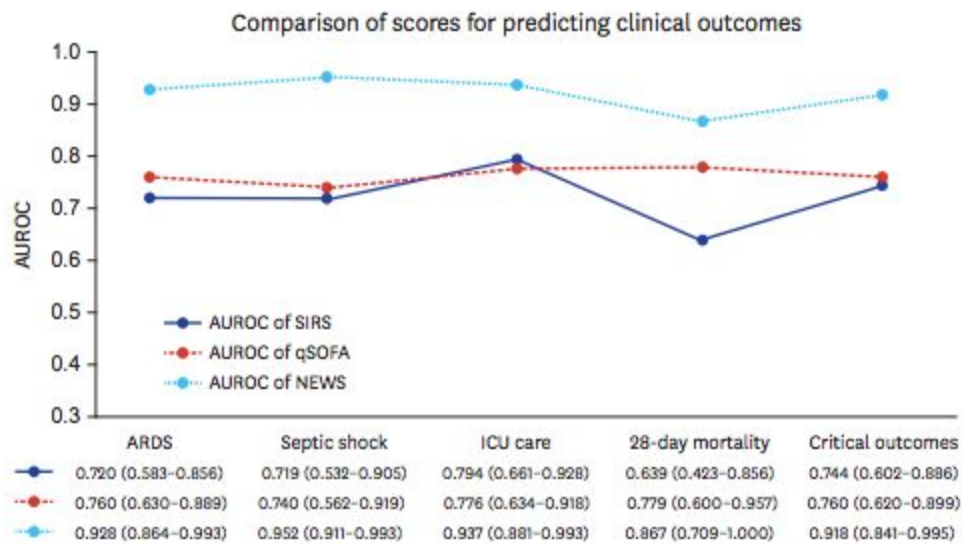
Fig. 1. Comparison of SIRS, qSOFA, and NEWS for predicting clinical outcomes of COVID-19.
AUROC = Area under a receiver operating characteristic, ICU = intensive care unit, NEWS = National EarlyWarning Score, qSOFA = Quick Sepsis-related Organ Failure Assessment, SIRS = Systemic Inflammatory Response Syndrome.

Illustrated by the graph above, area under Receiver Operating Characteristic (ROC) curves was used to compare three scoring systems, and it was found that for predicting 28-day mortality, ARDS, septic shock, ICU care, and critical outcomes, NEWS was superior to both of the systems.

As pneumonia caused by SARS-CoV-2 infection is the leading cause of death for the patients with the infection, early detection is life-saving. By relying on NEWS which allows careful monitoring by determining patients who will develop critical symptoms.

Vaccine Development:

In contrast with their rapid response to the COVID-19 pandemic, South Korea's attempt to develop a vaccine was slower compared to many countries such as the United Kingdom. By giving the vaccine to 40 healthy volunteers on June 19, Genexine became the first company to start phase 1 trials. In the production of their vaccine, the South Korea based biotechnology company used Hyleukin-7 platform technology to enhance the immune responses by increasing T-cell production (1).

Hyleukin-7 is a homodimeric Interleukin-7 (IL-7) based T-cell growth factor (8). In Hyleukin-7 platform technology, IL-7 is engineered for more stable structure and long lasting factor for T-cell production. Since the end-goal of the technology is to induce persistent immune response, engineered IL-7 are hybridized with IgD and IgG4 fragments (8). With IgD's ability to maximize biological activity and IgG4's unexposed junction site that prevents antibody-dependent cellular cytotoxicity, this hybridization provides a non-cytolytic and non-immunogenic carrier (21).

In addition, IgD reinforces Fc fusion proteins that preventI virus specific antibodies to facilitate virus entry into the host cell via Fc receptor pathway (1). As a result, it hinders the occurrence of Antibody-dependent enhancement (ADE). Although the appearance of ADE in SARS-CoV-2 has not yet been certainly identified, it was observed in MERSCoV and SARS-CoV in vitro (1). Therefore, it is possible that this vaccine can prevent the entry of the virus and stop the progress of infection.

With such vaccine, Genexine has reported the improved vaccine efficacy showing the accumulation of pulmonary T cells in influenza A virus, however for COVID-19, there are no official results since the phase1 trial has not been concluded yet.

Conclusion

As with the infection and fatality rates in South Korea, their success compared to other countries of similar populations can be tied to their greatly improved health-care systems, as well as stringent regulations to prevent transmission. Though the country was afflicted from various incidents of super-spreading in popular districts around the capital city, their labor to limit people from visiting those places benefited the country in the long run, as they were able to keep the numbers fixed at a base. Even though South Korea was among the first nations to experience a peak in the COVID-19 curve, it most likely resulted from the lack of prior experience with the virus and the unpreparedness of medical centres. Still, though the country proved to be successful in preventing numbers from being escalated until recently, following months will be crucial, considering that the temperatures will decrease as South Korea enters wintertime.

In terms of mitigation efforts, the Government of South Korea presented itself as a prominent country with the precautions taken by authorities to reduce the effect of COVID-19 from the first case detected. During the pandemic process, South Korea brought innovative and reliable solutions against the Coronavirus's detrimental effects on it. South Korea is the country that adapts ideally to the new world after the coronavirus with innovations to maintain the flow of the pre-coronavirus conventional world.

South Korea is the first country which held legislative elections; they demonstrated to the world how with the effective precautions without any loss of life a country can hold nationwide selection. They integrated technology successfully with the "home voting application" for the ones who have mobility problems. South Korea also serves as a model for the tourism industry as one of the prior countries which opens its border to visitors with the technology integrated precautions. In addition to those mitigation efforts, to maintain the citizens well being in the country, they benefited from the governments and private sector's support in the technological aspects. Since in pandemic times non-contact technology serves as an essential key for all the world, South Korea solved this problem more successfully than any other country with the apps and innovative devices. *Smart bus stops* are only one example from many others.

Mitigation efforts in South Korea are firstly focused on controlling the spread of virus and reducing the loss of life then supporting other industries. If maintaining society's well being is the key point of mitigation efforts, it can be concluded that South Korea passed the exam successfully in its first step. However, further consequences will determine in the long term

whether South Korea would be successful.

In terms of use of technology, South Korea developed a location-tracking system by interviewing patients and filling the gaps with credit-card transaction data, mobile phone location logs, and surveillance camera footage, which enabled South Korea to identify infected people and prevent others from getting infected."Self-Quarantine Safety Protection App" and "Self-Diagnosis App" helped South Korea regulate the self-quarantine of all inbound travelers. Some private corporations took initiative and assisted South Korea to ease the transition to social distancing by offering free use of their remote meeting solution and remote teaching service.

Although technological steps taken by South Korea are widely praised most of the time, many people expressed their concerns about their privacy since the technology used by South Korea involved collection of residents' data. There were some cases where infected people were identified by the location-tracking data the government shared with the public, or where a name of a specific store is revealed and caused the store owner a financial loss.

Regarding the concern of the content of the data shared with the public, officials like Goh Jae-young and Seon Kui Lee emphasized that they are carrying out the location-tracking process deliberately, highlighting that they ensure the privacy of the patients. Therefore, one can say that the method of using technology to deal with COVID-19 was overall successful.

Another underlying factor of success was South Korea's use of scoring systems to predict the clinical outcomes of the patients. The key scoring system, which was the primary system that was used, was The National Early Warning Score (NEWS). With its accuracy in predicting mortality rate, septic shock, the need of ICU care, ARDS, and critical outcomes, the system allowed hospital staff to respond to rapidly changing conditions of the patients. For a disease with no proven treatment,Calculation of the NEWS at the time of hospital admission for the use of early detection to avoid pneumonia is vital.

With Genexine being the only company to start phase 1 trials, South Korea has just entered the vaccine development race among countries. Although the efficacy of the vaccine on SARS-CoV-2 infection has not been proven yet, Hyleukin-7 platform technology indicates that it is a strong vaccine candidate.

Considering the relatively high population density, 51 million people and relatively less land and source, South Korea has always known how to invest in their strong sides and meet the deficits that came with their weak sides. We have seen them doing so especially during the 2009 financial crisis, and this time we are seeing this during the Covid-19. Even though they faced some challenges by thinking about the future of the technologies, and seeing this worldwide regression more like an advantage to step up their game, they have managed to figure out what is best for their economy and their nation. During the Covid-19, since most of the countries came with the export-import restrictions, it was a difficult task for the export-led countries to keep up with their work. But luckily, their switch to the chemical industries before was an advantage and something South Korea was good at for many years. They managed to keep their state in the export market among the countries, and didn't go through major challenges with that advantage. Meanwhile, at the national level, they took some risky decisions. Since they came up with

different policies while dealing with the virus earlier, they managed to not spend an excess amount of money for the support plans, and managed to balance the future spending and support spending together. It was risky, by means not being able to predict the upcoming affects and changes that they might go through. But right now, according to Asia Fund Managers, "South Korea's economy is expected to be an economy that will dominate the 21st century." (2)While keeping things at the optimal level nationwide, their secure but effective strategy in their relationships with the other countries has helped them to get a significant amount of support while also making strong connections through their help to other countries. Overall, South Korea's stable economy that kept developing since the 20th century, was their advantage to keep making investments on their future rather than their present like the rest of the world.

This research paper focused on the infection and fatality rates, mitigation efforts, the technology utilized for monitoring the virus-spread, economic impacts of the virus in South Korea, and its endeavours in vaccine development and treatments of the infected. By concentrating their efforts into preventative methods, South Korea utilized an innovative approach to monitor the spread of the novel COVID-19. With their advanced technology, trace, teast, and treatment programs rendered South Korea capable of taking control of the spread of virus and maintaining its citizens' well being.

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