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RESEARCH NOTE

Lessons from Abroad: South Korea's Covid-19 Containment Model

THE NEW ZEALAND INITIATIVE

Leonard Hong with assistance from Joel Hernandez

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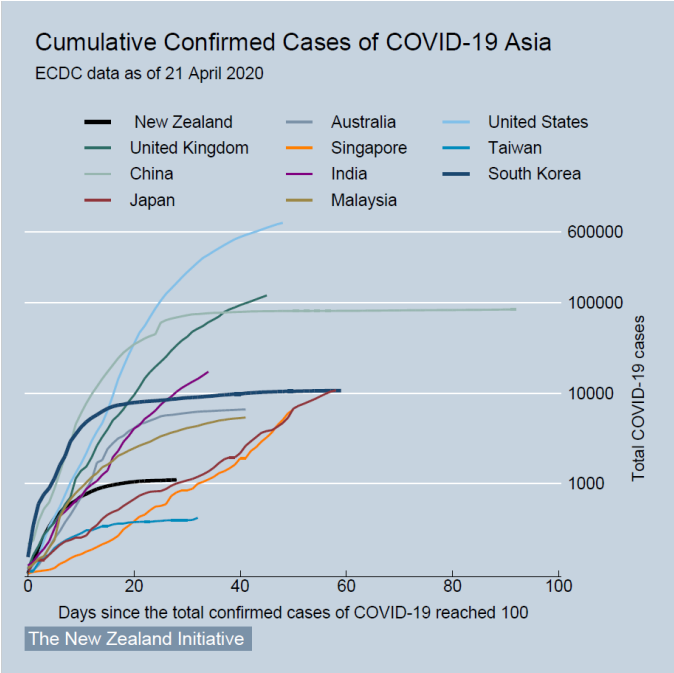
Introduction

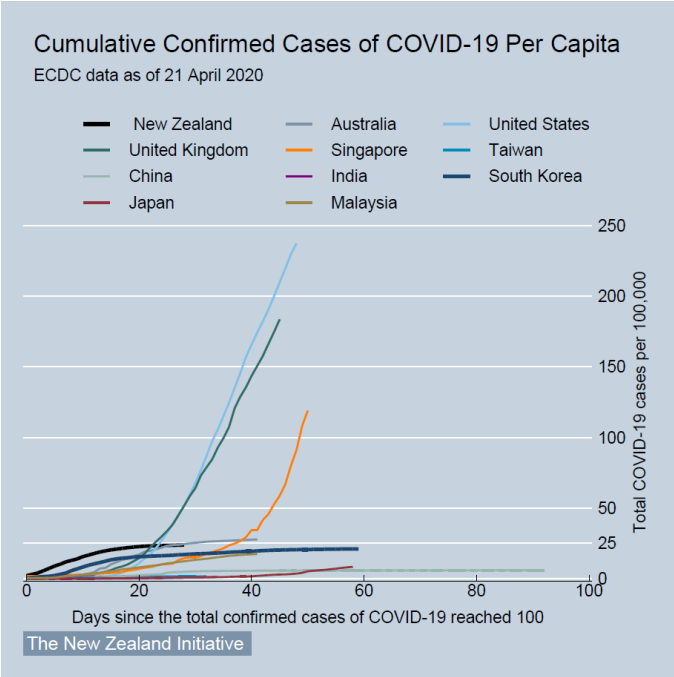
As the world struggles to contain Covid-19, many countries are at different stages of containment and mitigation since registering their first 100 cases. Some, like South Korea, are more than a month further ahead compared with New Zealand and could offer a good example of what might be expected as New Zealand transitions out of Alert Level 4 lockdown.

As of April 20, South Korea is 91 days into its Covid-19 response compared to New Zealand's 52 days. New Zealand appears to be on the same trajectory as South Korea measured by total cumulative cases and cumulative cases per capita (see figures 1 and 2). New Zealand has 29 cases per 100,000 people while South Korea has 20 cases per 100,000, showing that both are flattening their epidemiological curves.

Early in the pandemic, Covid-19 cases in South Korea sharply increased, peaking at 909 new cases after 41 days. But as of April 20, South Korea only has 2385 active cases and 8042 recoveries from a total of 10,674 confirmed cases. It also has a low case fatality rate (CFR) of 0.2% or 236 deaths. Italy, Spain, the US, and New Zealand have CFRs of 13.2%, 10.3%, 5.3% and 0.8%, respectively.

Figure 1. (Left graph) - Cumulative confirmed cases of Covid-19 per capita since confirmed cases reached 100 – (data is from the European Centre for Disease Prevention and Control).[1] Figure 2: (right graph) Cumulative confirmed cases of Covid-19 total. [Black = New Zealand; Blue = South Korea]





Leonard Hong is a Research Assistant with The New Zealand Initiative.

Although the South Korean government failed to stop the initial transmission of the virus from overseas, it speedily dealt with the first Shincheonji's clusters in Daegu while maintaining an open economy, effective border controls, high-level diagnostic testing, strict enforcement of Covid-19 rules, efficient contact tracing and government transparency. It even avoided a national lockdown by giving local governments the authority to shut only parts of their districts.

The effectiveness of these policies was boosted by public solidarity, civil compliance, the prominent use of face masks and the widely understood lessons of previous virus outbreaks.

This report outlines seven key examples of South Korea's pandemic approach:

1. Open domestic economy
2. Special immigration procedures and external restrictions
    - Initial mistakes
    - Temperature monitoring and border protection measures
    - Foreign bans on South Korea
3. Test, test, test
    - Private and public sector testing infrastructure
    - Drive-through testing and other innovations
    - Centralised Public Healthcare System
    - Exports of test kits
4. Quarantine requirements
5. Enforcement of covid-19 rules
    - Types of punishments: national and foreign
    - Deportations and actions taken
    - Electronic wristbands
    - Government measures
    - Disinfection and fumigation of public spaces
6. Contact tracing: the importance of technology
    - Citizens' initiatives
    - Government actions
7. Competent and transparent government
    - Open dialogue
    - Data availability
    - Disinfection and fumigation of public spaces
8. Other containment measures
    - Public solidarity and civil compliance
    - Prominent use of masks by South Koreans
    - Lessons learned from MERS 2015.

1. Open Domestic Economy

South Korea is one of the few countries the IMF predicts will avoid a heavy recession this year. According to Chang Yong Rhee, Director of the IMF's Asia and Pacific Department, South Korea's economy is only expected to contract 1.2% over 2020, the smallest estimated contraction.[2] This compares with contractions of 5.9% for the US, 7.2% for New Zealand and 7.0% for Germany.[3]

By having an early testing regime with a rapid contact tracing system, it clamped down on Covid-19 without enforcing a lockdown. Given the high level of supply chain interconnectedness of South Korea's economy, many businesses have gone into liquidation since the crisis began but others were cushioned from the worst economic shocks by fiscal stimulus measures. President Moon Jae-In said tracing the virus early gave South Korea the breathing space to "maintain the indispensable flow of country-to-country economic exchanges" and "flatten the curve." For New Zealand, a lockdown was necessary since its public health infrastructure was unprepared.

2. Special Immigration Procedures and External Restrictions

Initial mistakes

In contrast to many other countries, South Korea did not enact a specific travel ban on China, a decision that was condemned by the Korean Medical Association.[4] Instead, it *only* imposed a travel ban on foreign nationals who had visited China's Hubei province.[5] This mistake resulted in South Korea's initial virus outbreak, caused by a public gathering at a super church related to the Shincheonji cult group. A "super-spreader" called Patient 31 from this cult is said to be responsible for a set of 5212 Covid-19 cases (48.8%).
By contrast, New Zealand blocked all Chinese arrivals four days after its first case was discovered.[6] However, South Korea quickly acknowledged its mistakes and began vigilant surveillance and management of all arrivals.

Temperature monitoring and border protection measures

Before the pandemic, Incheon International Airport had instituted temperature monitoring systems such as ear thermometers and *ThermoDetector* cameras checking all incoming passengers in a designated isolation ward.[7] After the first confirmed case on January 20, new Special Immigration Procedures were set up requiring new arrivals to fill out health questionnaires after which those identified with Covid-19 symptoms were put into monitored 14-day quarantine and tested.[8]

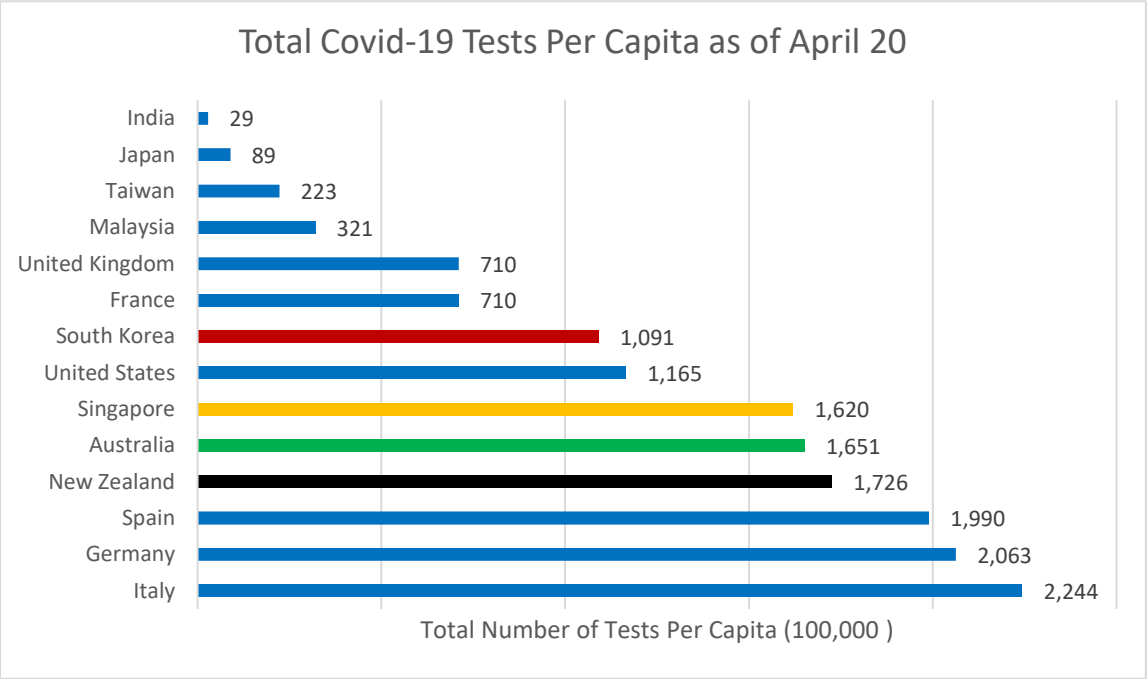
On February 2, all inbound travellers from China and returning citizens who showed coronavirus symptoms had to be tested. This requirement expanded on March 23 to all inbound travellers from Europe regardless of symptoms.[9] Two days later all travellers from the US were required to undergo testing at South Korea's border as well.[10] In addition, it has suspended all visa-free entry for Chinese nationals and anyone traveling from China to South Korea.[11]

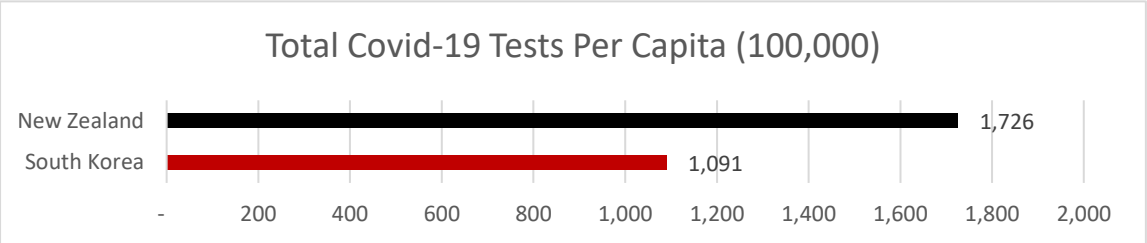
Foreign bans on South Korea

Conversely, starting with Israel on February 24, a total of 179 countries have imposed entry bans or strict quarantine procedures for travellers from South Korea.[12] New Zealand banned all non-residents from entering our country on March 20.[13]

3. Test, Test, Test

Figure 3: Total Covid-19 Tests Per Capita as of April 20.[14]





Part of the reason for South Korea's effective stamping out of Covid-19 was the early government coordination in producing a Covid-19 test kit which is used to test large numbers of people to identify infection hotspots, along with widely encouraging social distancing.

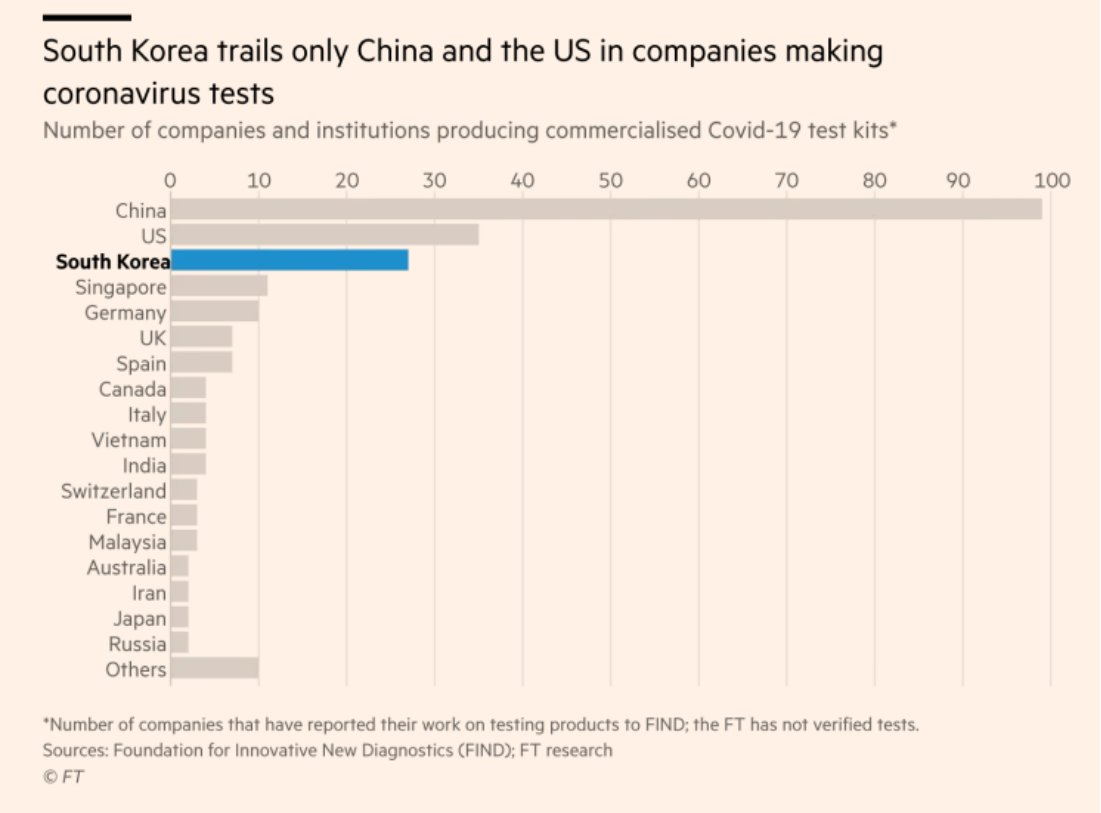
Private and public sector testing infrastructure

A week after its first case on January 20, South Korean government officials met with 20 medical companies[A] to request the development of a new Covid-19 polymerase chain reaction (PCR) test.[15] To make it easier for the public to take these tests, the government also allowed pharmacies to check patients' travel histories through a patient status checking system.[16]

On February 7, the government approved new PCR kits capable of producing results in six hours with the capacity to test up to 4200 people each day.[17] Currently, five South Korean biotech companies have been granted government approval for selling test kits — combined, it produces about 135,000 kits each day.[18]

[A] The first company approved for the test kit was Kogene Biotech Co Ltd with government approval on February 4. Seegene Inc began developing their test kit in January 16 before the first case, and got their products approved on February 12. These sets of testing innovations from medical companies helped South Korea reduce the number of new cases over a matter of weeks, serving as a model for other countries grappling with the pandemic.

Figure 4: **Number of Companies and Institutions producing commercialised Covid-19 test kits.**[19]



Public sector innovation also played a significant role in enhancing testing capacity. On April 9, Daegu scientists at Daegu Gyeongbuk Institute of Science and Technology (DGIS) developed a new test kit that produces results in 20 minutes.[20]

South Korea's liberal testing regime allowed anyone with symptoms to test for Covid-19 and for doctors to conduct tests on anyone they believe may have contracted the virus, including those who have not recently travelled overseas.[21]

Drive-through testing and other innovations

Local governments and medical institutions also developed a drive-through testing system, the first of which was set up at Kyungpook National University Hospital on February 23. This efficient system takes only 10 minutes to complete, and as of April 20, 50 drive-through testing facilities are operational in 633 testing sites which has led to much higher testing numbers.[22]

In addition to public health investments, the Korea Centers for Disease Control and Prevention (KCDC) already planned to implement drive-through clinics as part of the country's national security preparations for rapid, large-scale medicine distribution.

The H Plus Yangji Hospital in Seoul also introduced a one-person "walk-through" testing booth called the Safe Assessment and Fast Evaluation Technical (SAFETY) which separates doctors and patients to reduce the risk of infection. [23] Incheon International Airport is operating sixteen outdoor walk-through booths to test short-term asymptomatic visitors from Europe.[24]

Another innovation by Seoul National University Boramae Medical Center was the "Glove-Wall" system in which medical personnel put their hands into gloves attached to a clear acrylic wall to interact with a patient standing on the other side.[25]

High volume of testing

On April 20, South Korea reached the maximum capacity to conduct 20,000 PCR tests per day.[26] It has also tested a total of 559,109 people (1091 tests per 100,000), one of the highest in the world.[27] New Zealand has tested 83,224 people (1726 tests per 100,000) as of April 20.

With early innovation on testing technology, a high-cadence testing system, isolation of patients and strong quarantine enforcement, South Korea now has a recovery rate of 70% and more recoveries than active cases.[28] The number of recovered Covid-19 patients surpassed active cases on March 28. *Figures 2 and 3* show similarly positive trends in New Zealand.[29]

Centralised Public Healthcare System

An important strength for the South Korean and other Asian governments is their centralised, top-down public healthcare systems. South Korea's testing and contact tracing data is part of a single coordinated system under the KCDC and the Korea Ministry of Health and Welfare. By contrast, New Zealand's public health response is largely the responsibility of various District Health Boards and regional public health units, each with different resources, information systems and interpretations of guidelines.

Figure 5: Total Covid-19 Tests in South Korea.[30]

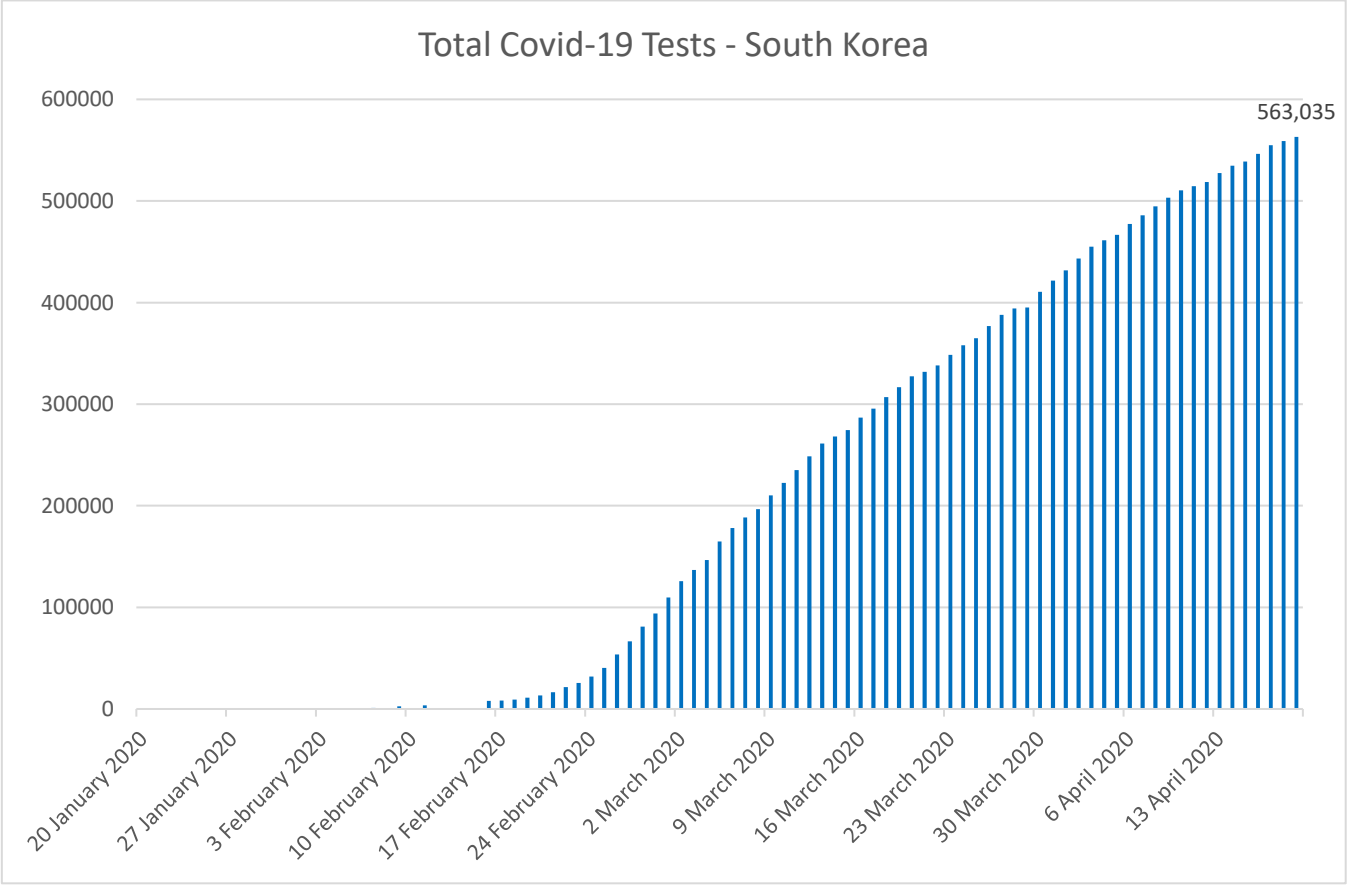


Figure 6: Daily Covid-19 Tests in South Korea.[31]

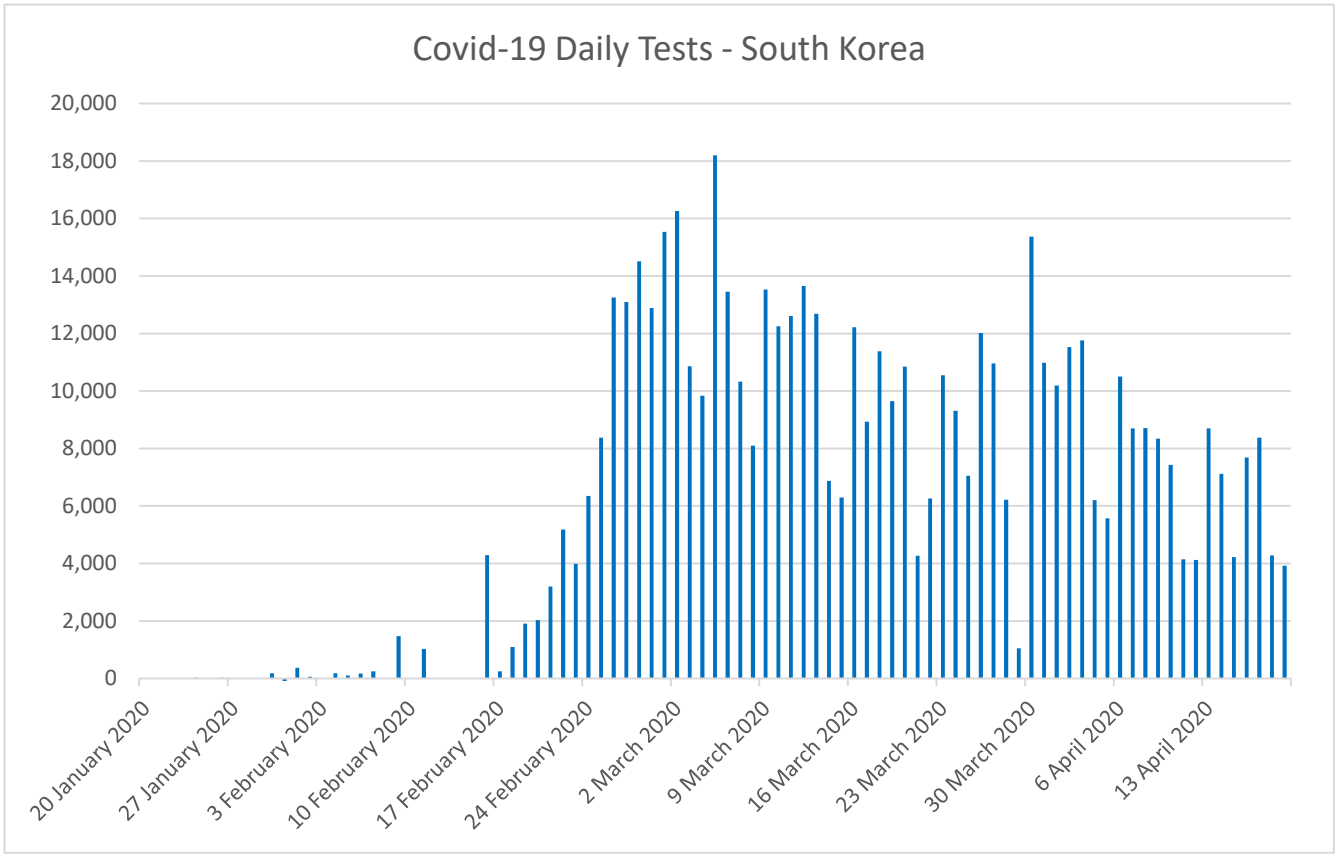


Figure 7: Total Tests in New Zealand.[32]

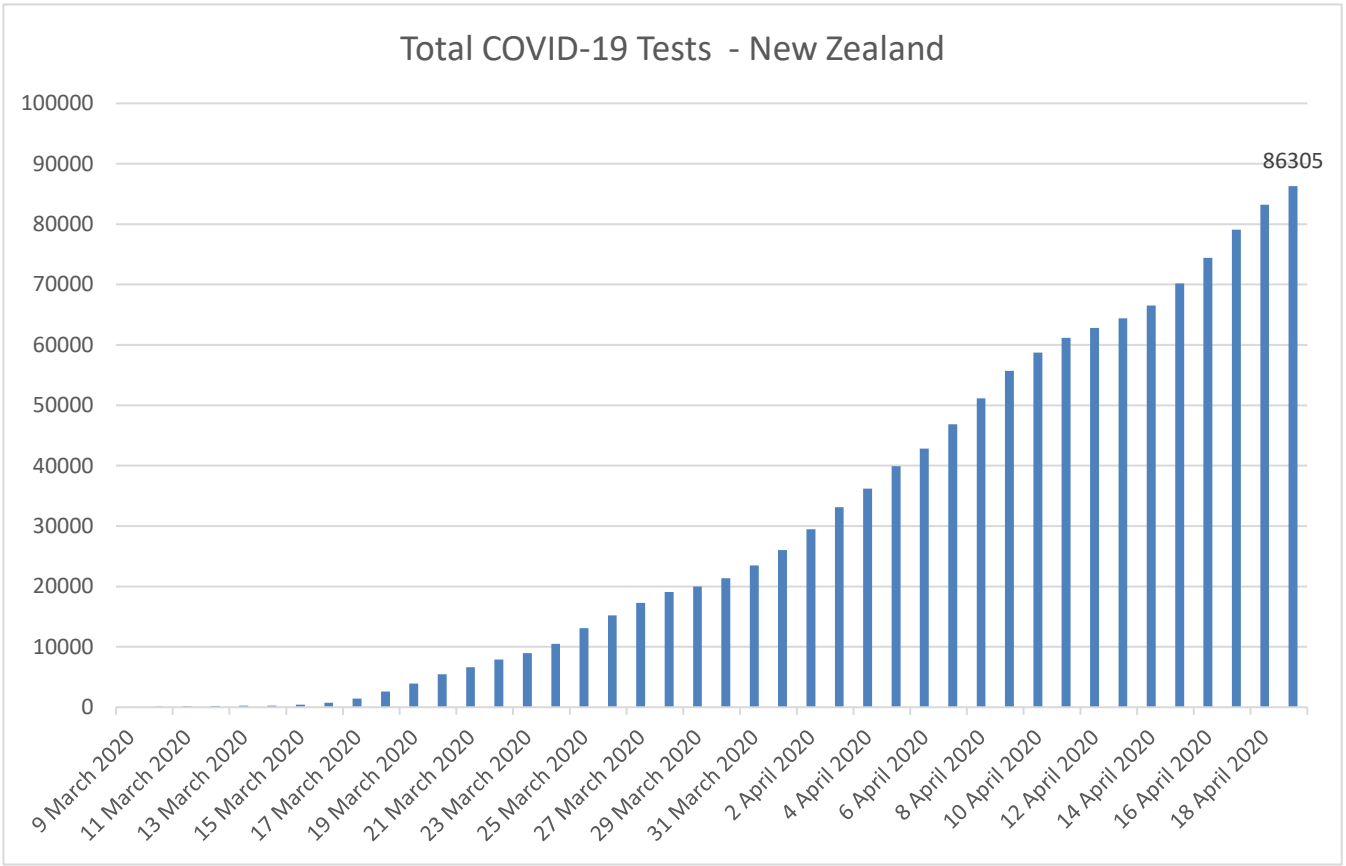


Figure 8: **'Active and Recovered Cases - New Zealand'. Source: Ministry of Health New Zealand.[33]**

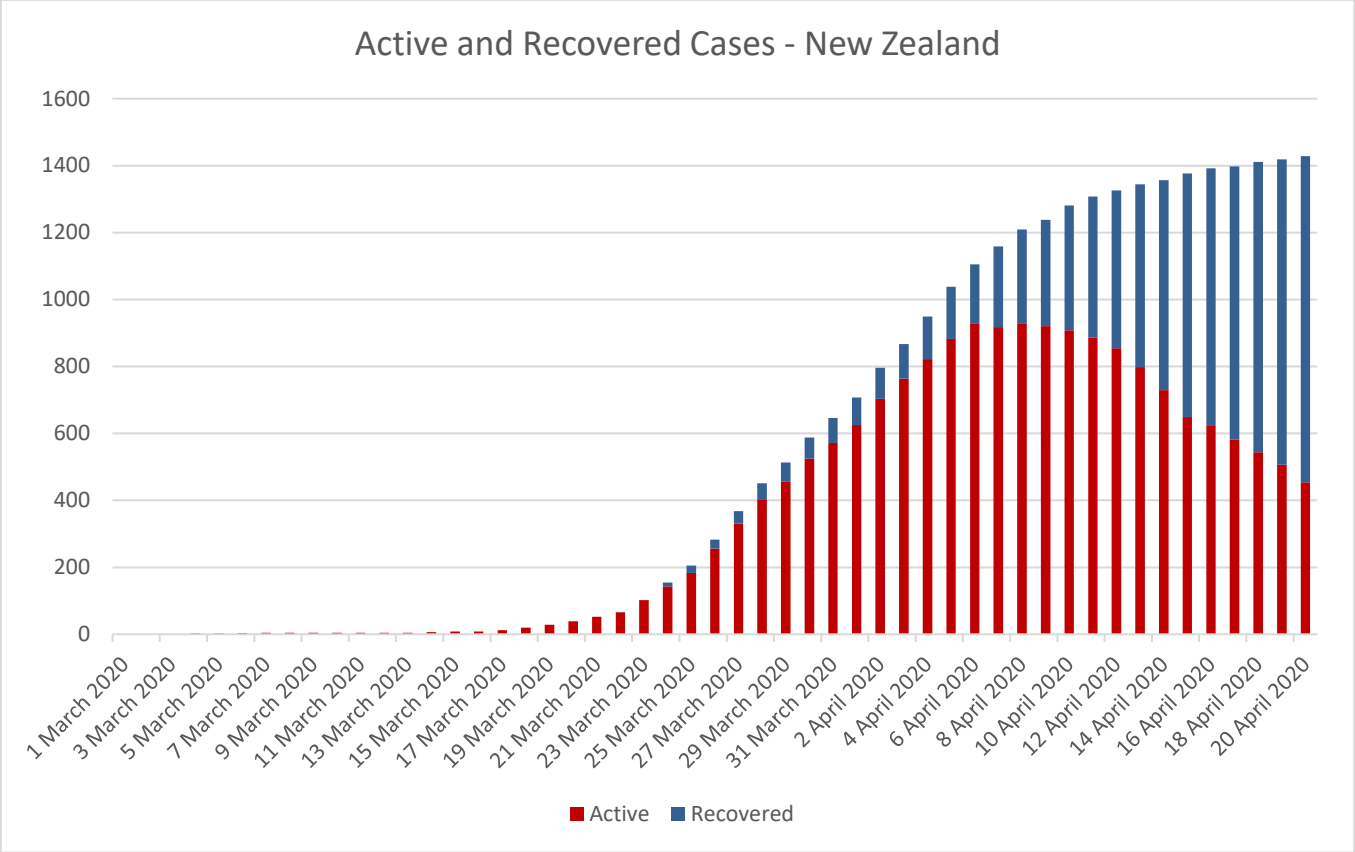
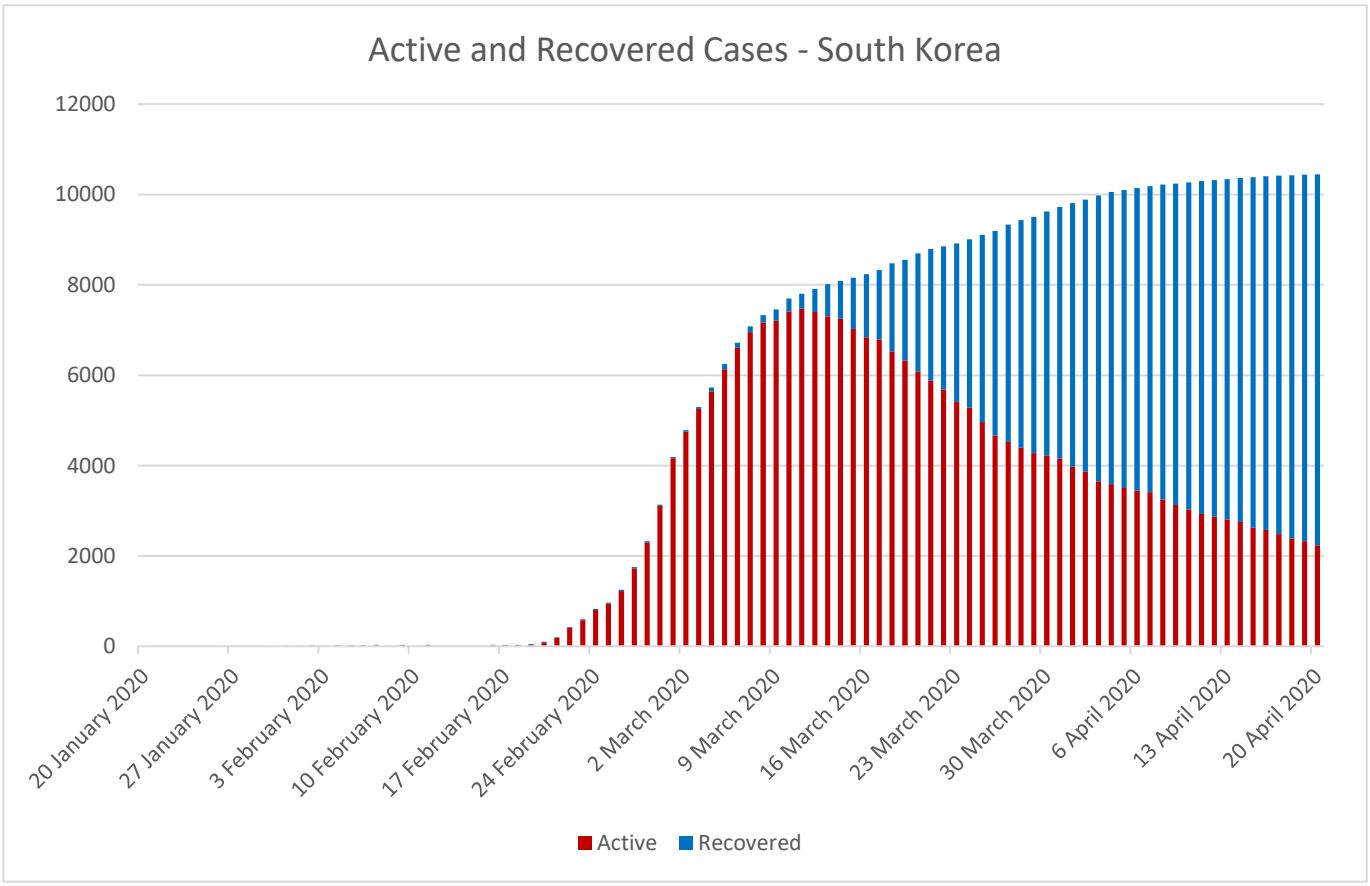


Figure 9: **'Active and Recovered Cases -South Korea'. Source: Korea Centers for Disease Control and Prevention.[34]**



Exports of test kits

South Korea has also exported about 1.5 million surplus PCR test kits to the US, Brazil, Israel, Colombia, Romania and the UAE, overseen by a task force at its Foreign Ministry.[35] A total of 126 countries have requested the kits because of their reliable testing design compared with similar kits from China, which have a high failure rate.[36]

4. Quarantine Requirements

Just as all Kiwis are required to stay or work from home under Alert Level 4, South Korea's quarantine requirements are stringent. Violation of the rules results in severe consequences as outlined in the government's *Enforcement of Covid-19 Rules* stipulations.

For instance, all arrivals into ports of entry must download a government-mandated Self-Quarantine Safety Protection software application, which allows authorities to monitor their location using GPS.[37] The government will also contact those under isolation every day to check up on their conditions.

To decide who should be quarantined, the government separates positive and negative diagnostic tests. Those who test positive are immediately escorted to a hospital or Living Treatment Center for quarantine.[38] Those with negative test results – including Korean citizens, long-term visitors and long-term residents – can return home for a 14-day self-isolation but must be re-tested at a public health clinic within three days of the test.[39]

For short-term visitors, foreigners or citizens without guaranteed self-isolation facilities who test negative, the government places them in hotel accommodation.[B] During this 14-day self-isolation, individuals are checked by healthcare professionals twice a day, are restricted from making personal contact and required to wear N95 masks when outside their rooms. [40]

5. Enforcement of Covid-19 Rules

Types of punishments: national and foreign

Violation of the *Quarantine Act* and *Infectious Disease Control and Prevention Act* results in a maximum one-year prison sentence or ₩10 million fine ($13,500) for South Korean nationals.[41] However, a foreigner breaching the rules faces up to three years in prison or a fine up to ₩20 million ($27,000).[42] Both groups are required to check in with health authorities once a day for two weeks. Those who fail to do so within two days of arrival at the location will receive a direct call from health authorities.[43] Currently, 160 people out of 54,000 monitored have been caught for breaching self-quarantine.

Deportations and actions taken

Actions that trigger a violation of the new Covid-19 isolation rules include going outside without notifying health authorities and not answering check-up phone calls. Foreigners failing to comply risk their visas being cancelled.[44]

[B] South Korea's government will pay for the testing and treatment expenses for overseas travellers, but they do not provide the living expenses (~$170).

South Korea has deported eight foreigners from six different countries for violating quarantine.[45]

- As of April 3, South Korea has deported eight foreigners from six different countries for violating quarantine rule.
- On April 5, a Taiwanese national was sent back to Taiwan after refusing to pay ₩100,000 ($135) in accrued expenses at a state-run quarantine facility.[46]
- On April 15, a South Korean man in Seoul's Songpa-gu District was arrested for leaving his home for the second time to visit a sauna and a restaurant.[47]

Electronic wristbands

To better contain the spread of Covid-19, electronic wristbands are required for anyone who violates self-isolation rules, since it was discovered these people often kept their smartphones back at the accommodation before temporarily leaving the premises.[48] The wristbands require written consent from the wearer so as not to undermine civil liberties.[49]

Government measures: local and central

In comparison to New Zealand's total national lockdown, local governments in South Korea are empowered to act when necessary by closing schools and imposing curfews. For instance, Seoul's mayor recently shut down hundreds of bars, night clubs and discos when customers ignored social distancing guidelines.[50] He also banned public gatherings and rallies in Seoul Plaza and Cheonggye Plaza along with all Shincheonji churches in Seoul with fines of up to ₩3 million ($4000) for breaches.[51]

Similar to New Zealand however, South Korea has not codified social distancing legislation, but the Korea Centers for Disease Control and Prevention (KCDC) has issued strong recommendations for the public to keep good personal hygiene, conduct teleworking where possible, remain at home and practice social distancing of two metres.[52] It also restricted high-risk activities such as religious, sports and entertainment events.[53] Facilities that remain open are obligated to follow the quarantine rules.[54] The Korean public's excellent compliance is explained in the *Public solidarity and civil compliance* section.

6. Government Transparency and Competence

Open dialogue

As New Zealand considers downgrading its lockdown protocols, transparency in government and competent public policy execution will remain important. After South Korea announced its national emergency code 'Red' on March 3, as a result of the Shincheonji's cluster, Foreign Minister Kang Kyung Hwa stated, "the basic principle is openness, transparency and fully keeping the public informed."[55] The government now provides daily updates on its websites and social media platforms such as Naver and KakaoTalk, which was critical to strong public compliance.

Data availability

The KCDC has been briefing the South Korean government with daily updates, press releases, case numbers, testing statistics, number of contacts traced through patients, regional case numbers, details of cases, total recoveries, ongoing cases and other necessary information.[56] The agency is also providing real-time data on its remaining stockpiles of face masks by using Korea social networks and on smartphone applications such as Mask Scanner and Wear Masks.[57] As a result, panic buying of stocks in South Korea was rare, in contrast to Australia, the US and Europe.

Disinfection and fumigation of public spaces

The KCDC has also initiated sterilisation and fumigation procedures of public places such as subways stations, buses and movie theatres.[58] This is important because bus transport systems in cities like Seoul operate 24/7, whereas New Zealand bus services often do not operate overnight which is enough time for a virus on surfaces to die. The Korean Medical Association suggested that proper fumigation and disinfection is 99.9% effective in neutralising coronaviruses which means contaminated facilities can reopen 24 hours after disinfection.[59] Also, any infected location can be isolated for 14-days to ensure viruses in droplets cannot survive. On February 20, the government mandated daily fumigation of public transportation.[60] During the 2020 general election this month, the government fumigated all 14,000 polling stations across the country.[61] As a result, public transportation has not been shut down and South Koreans can still walk the streets.

7. Contact Tracing: Importance of Technology

South Korea's tracing actions were considered an "all-of-society" effort in which individual citizens, along with the public sector, participated in containing the virus. South Korea's meticulous Contact Tracing system uses both technology and manual procedures, led by 130 epidemiological investigators from the KCDC.[62] Before the emergency, the country had the necessary technological infrastructure for enacting digital contact tracing, such as the world's fastest internet, one of the highest surveillance camera densities in cities, a high smartphone ownership rate and a high proportion of cashless transactions.

Citizens' initiatives

Students from Korea University created a website called Corona Nearby to track infected people's movements on maps using data from Bluetooth.[63] The website shows the history, location, and time, along with what mode of transportation the patient used. If the person visited a public space, such as a movie theatre, the website could also display the seat number booked. A similar application called Corona 100m shows the total number of confirmed Covid-19 patients, along with their nationality, age, gender and movement history since they contracted the virus.[64] If the app user comes within 100 meters of an infected person, an alarm warning sounds on the user's smartphone.[65]

Government actions

Following its trend of government transparency, detailed tracking data on people with Covid-19 is regularly disseminated in reports such as *Contact Tracing Results of the*

First Confirmed COVID-19 Case in the Republic of Korea to inform interested parties in how the South Korean government collects the sensitive data.[66]

On April 10, the KCDC began using the 'smart city data hub programme' to quickly trace potential Covid-19 cases using smartphone data, credit card transactions and CCTV footage.[67] As of April 20, 27 public and private organisations including the National Police Agency, Credit Finance Association, three mobile carriers and 22 credit card companies have partnered to expedite the programme.[68] Previously, investigators had to request such data from the police, which took up to seven hours.[69]

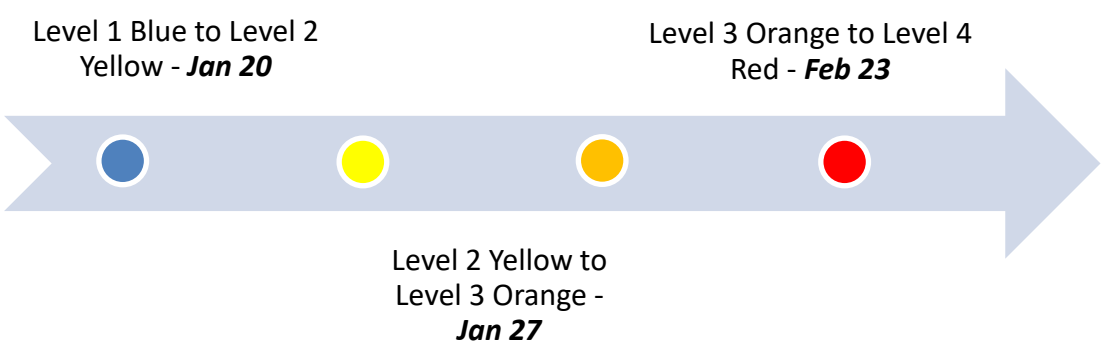
While New Zealand is unlikely to implement such digital tracing technologies due to civil liberty concerns, this is how the South Korean government controlled the precarious outbreak in Daegu early in its emergency. On the other hand, South Korea's "all-of-society" cooperation emerged as a lesson from the 2015 MERS outbreak, which led to an amendment of privacy laws allowing the government to track personal information if national health was deemed to be at risk. The South Korean government is also using data analysis to monitor patients.[70] Although some concerns were raised about privacy following the first Covid-19 cluster at Shincheonji when the public reportedly bullied many patients on Facebook,[71] the KCDC has affirmed its focus on public health rather than civil liberties due to the law change after MERS.[72]

8. Others:

Public solidarity and civil compliance

Although international media credits the South Korean government with its relative success in containing Covid-19, an important element was the rapid mobilisation of the public due to deep social trust, which helped boost the country's collective effort.[73] This voluntary collaboration among citizens meant the South Korean government preserved a balance between public health and civil liberties.[74] Well before the government recommended social distancing, South Koreans acted individually to close gyms, cafes and academic institutions.[75] New Zealand's government also has strong public support and high trust in its institutions, which allowed its government to implement a nationwide lockdown successfully.

Figure 10: Alert level system in South Korea.[76]



Prominent use of masks by South Koreans

Considering that the number of asymptomatic Covid-19 cases remains unknown, Professor Kim Woo-Joo from Korea University credits the prevalent use of face masks as a key reason for South Korea's successful Covid-19 containment.[77]

Other countries outside East Asia generally do not have public policies regarding face masks. Still, President Moon Jae-in has consistently championed the need to have enough masks available for everyone. Unlike New Zealand, South Korea already had a culture of wearing face masks to protect from air pollution, 32% of which is reportedly blown in from factories in China.[78] Despite the World Health Organisation's recommendation in February about the ineffectiveness of face masks, South Koreans largely ignored this advice.[79]

The South Korean government sent 1.5 million masks to China as Wuhan began to get out of control. After public outrage at the face mask shortages, the government supplied 720,000 masks to vulnerable workplaces such as construction, manufacturing, and services sectors.[80] On February 28, together with 140 private retail businesses, the government began distributing 10 million masks each day. The Moon administration has also said manufacturers must cut face mask exports to less than 10% of total production while allocating about 50% to the government.[81] The government also fixed mask prices at ₩1500 ($2).[82] This month, Germany joined South Korea in restricting exports of personal protective equipment (PPE). [83]

The Experience of MERS 2015

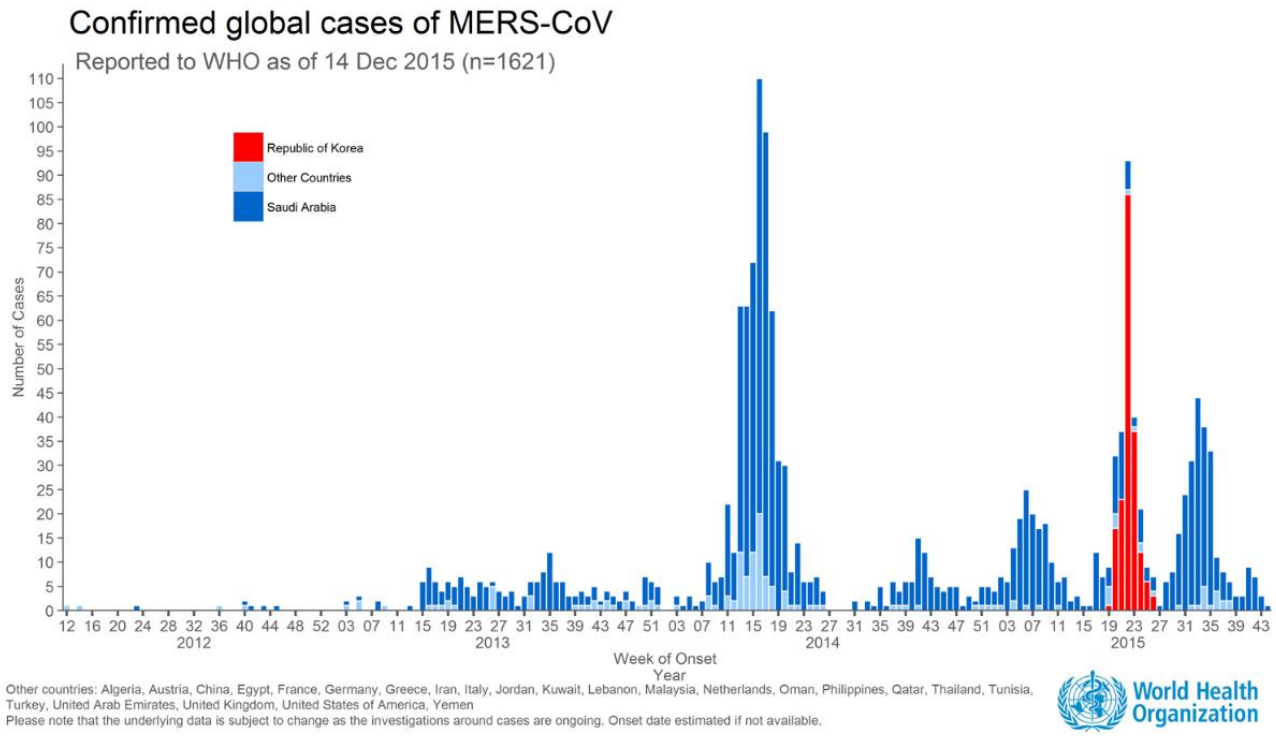
Covid-19 is not South Korea's first experience with a pandemic. Oh Myoung-Don, an infectious disease specialist at Seoul National University, said the 2015 Middle East Respiratory Syndrome (MERS) outbreak showed that laboratory testing was "essential to control an emerging infectious disease" and that MERS helped South Korea "improve hospital infection prevention and control."[84] During that outbreak, Korea University College of Medicine Professor of Infectious Diseases Dr Kim Woo-Joo said South Korea learned about the importance of diagnostic tests, the need for basic infection prevention measures and contact tracing based on surveillance.[85]

In 2015, the Health Ministry's slow preparation and inadequate early response were widely blamed for the 185 cases and 38 deaths from the MERS virus — shown in *Figure 11*.[86] The first case of MERS was from a South Korean businessman returning from Bahrain. Despite presenting symptoms, the ministry rejected a request for a MERS test from the Samsung Medical Centre where the man was staying as a patient, resulting in 85 cases transmitted into the facility.[87] Afterward, the government lacked any indication of who had the virus or which hospitals housed infected patients. Due to privacy concerns, the government could not be completely transparent. The Infectious Disease Control and Prevention Act was amended later to include public disclosure provisions in future outbreaks.[88]

The South Korean government also learned the importance of having early warning and accurate diagnoses. Testing for MERS was cumbersome, and doctors had to wait several days to confirm a case with a lab-based diagnostic. Consequently, in 2016 new legislation allowed laboratories to use unapproved in-vitro diagnostic kits during a public health emergency. The KCDC was also in a position to enhance the capacity of triages or pre-

diagnostic sites to prevent potential Covid-19 patients from spreading the virus into hospitals. Ten days after the first Covid-19 case, the government designated nearly 300 triages across the country, including public health centres.[89]

Figure 11: Confirmed Global cases of MERS-CoV.[90]



Conclusion

By implementing lessons from previous epidemics, South Korea's Covid-19 response allowed it to avoid a full lockdown and maintain a relatively open economy while enacting border protection policies with mandatory temperature checks and quarantine, all with strong public compliance.

Well before the virus entered the country, South Korea had already built robust healthcare infrastructure and rapidly developed fast PCR testing systems through public and private sector innovation. It also digitalised its entire contact tracing system to track Covid-19 patients, fumigated public spaces and encouraged the wearing of face masks.

Although the country did not impose overly draconian Covid-19 policies, it does operate an invasive surveillance system as a result of its experience with MERS in 2015. Compared with New Zealand, South Korea prioritises public health over civil liberty in emergencies.

Its experience shows that the critical ingredient when fighting a pandemic in a liberal democracy is competent government officials cooperating with the private sector and diligently enacting key lessons from previous pandemics to prepare the country's healthcare sector for future outbreaks. New Zealand can learn from South Korea's experience as it attempts to reinvigorate its economy while containing Covid-19.

If the New Zealand government had quickly developed its contact tracing systems and was more vigorous with quarantining cases and contacts, it may not have needed to rise to Alert

Level 4. It could have stayed at Level 3 for longer. South Korea's early testing and rapid contact tracing demonstrate that flattening the curve does not require a Level 4 lockdown. It also suggests further epidemiological research and upgrades to New Zealand's health infrastructure is *necessary to be well-prepared for the next pandemic*. As MERS 2015 was a public policy learning experience for South Korea, Covid-19 should be a lesson for the future pandemic in New Zealand too.

- To contain any future viruses without a lockdown, New Zealand must make ensure we *already* have the epidemiological institutions in place prior to future outbreaks.
- Have an early testing regime and a rapid contact tracing system prepared before a pandemic hits New Zealand.
- Secure the border with measures such as mandatory temperature monitoring and quarantine systems at airports as part of the vetting.
- Coordinate a single, centralised coordinated data system between all the DHBs and the Ministry of Health.

In summary for Level 3:

- More transparency from the Ministry of Health and the government – more dataset availability.
- Continued testing should be mandated with vigorous contact tracing shown in our 'National close contact service' (NCCS) hub without undermining civil liberties like South Korea's surveillance system.
- Encourage the public usage of masks without undermining the supply for public healthcare workers – E.g. self-made cotton masks or export from other nations.
- Diligent Disinfection of public spaces such as buses *is a must* as New Zealand goes down to Level 3.

ENDNOTES

[1] Data downloaded from https://ourworldindata.org/coronavirus-source-data
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