

Lessons from Abroad: Taiwan's Covid-19 Containment Model

Leonard Hong with assistance from Joel Hernandez

12 May 2020

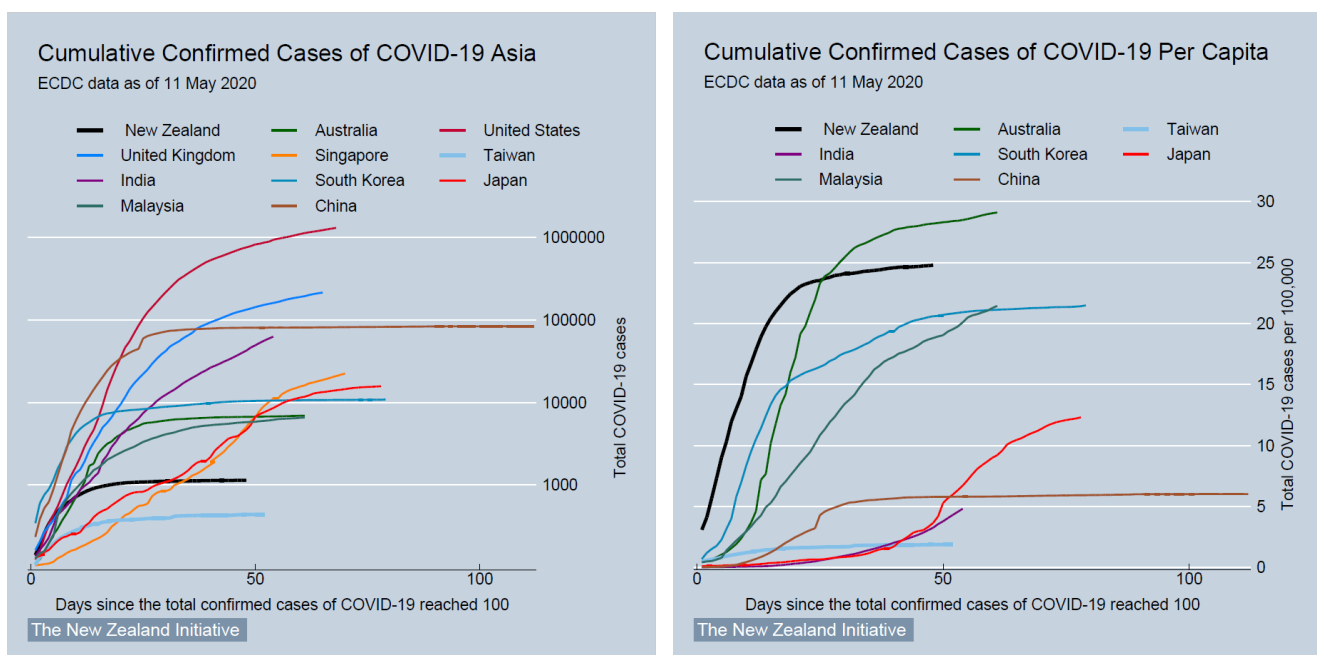
Introduction

Alongside South Korea, Taiwan is one of the few countries to “flatten the curve” of Covid-19 without a national lockdown due to its prior experience with the SARS epidemic of 2003. New Zealand’s pathway is similar to Taiwan’s and there are lessons to be learned as New Zealand moves into Alert Level 2. Last week, Deputy Prime Minister Winston Peters suggested creating “international bubbles” for countries with Covid-19 success to introduce new trade connections and travel links. His reasoning is that direct inbound travel to New Zealand from Taiwan cannot be riskier than travel within New Zealand at this point.

As of May 11, Taiwan is 53 days into its Covid-19 response compared to New Zealand's 49 days (measured by the date of the first 100 cases). Judging by cumulative cases per capita (see *figures 1 and 2*), New Zealand has 24.8 cases per 100,000 while Taiwan only has 1.9 cases per 100,000.

In early January, when the first outbreak began in Wuhan, Taiwanese Professor Dr Jason Wang from Stanford University predicted Taiwan would have the highest number of cases outside mainland China.¹ As of May 10, Taiwan only has 73 active cases and 366 recoveries from a total of 438 confirmed cases.² It also has a low case fatality rate (CFR) of 1.3% or 1.36% deaths. Italy, Spain, the US and New Zealand have CFRs of 13.9%, 10.1%, 5.9% and 1.4%, respectively.

Figure 1. (left) - Cumulative confirmed cases of Covid-19 total (European Centre for Disease Prevention and Control).³ Figure 2: (right) - Cumulative confirmed cases of Covid-19 per capita since 100 confirmed cases. [Black = New Zealand; Light Blue = Taiwan]



The Taiwanese Government dealt with the initial rise in cases while maintaining an open economy by using *optimal border controls, strict quarantine requirements, targeted testing measures, an advanced national healthcare system, effective contact tracing system, mask-wearing public policy, tight enforcement of new Covid-19 rules and general government competence.*

This report outlines eleven key examples of Taiwan's pandemic approach:

1. Isolation from Multilateral Institutions: Self-Reliance
 - Pandemic experience from SARS in 2003
2. Optimisation of Border Restriction
 - Temperature monitoring and stringent measurements
 - Two-way travel restrictions
 - Revision of immigration rules
3. Strict Quarantine Requirements
 - Government subsidies for quarantine
 - Local government quarantine management
 - Home quarantine rules
4. Targeted Testing Measures
 - Public and private testing innovation
 - Testing methods
5. National Healthcare
 - Healthcare procedures
 - Data integration
6. Contact Tracing – the Importance of Technology
7. Masks and Personal Protective Equipment
 - Mask-wearing public policy
 - Personal protective equipment
 - Private sector innovation
8. Geopolitics
 - Mask diplomacy
 - World Health Organisation
9. Open Domestic Economy
10. Enforcement of Covid-19 Measures
 - Types of punishment: quarantine violations
 - Types of punishment: mask disposal
 - Governmental restrictions: social distancing
 - Other governmental restrictions
 - Civil society's compliance of Covid-19 restrictions
11. Government Transparency and Competence

1. Isolation from Multilateral Institutions: Self-Reliance

The People's Republic of China claims sovereignty over Taiwan under its "One China" policy. As a result, Taiwan is not a recognised member-state of the United Nations, the International Civil Aviation Organisation, nor the World Health Organisation (WHO). Because it only had

limited international support and no access to vital data on the virus, Taiwan needed to be self-reliant when tackling Covid-19.

On December 31, 2019, Taiwan Centres for Disease Control (TCDC) Deputy Director-General Lo Yi-chun heard of an unidentified pathogen emerging in the Huanan Seafood Market in Wuhan, China and considered the strong plausibility it may spread through human-to-human transmission.⁴

Lo's quick decision-making allowed the Taiwan Government on January 15 to take pre-emptive action by instantly mobilising its epidemiological response team and quarantining all passengers entering the country on flights from Wuhan. The TCDC also found Covid-19 mirrored a known bat coronavirus.⁵ This set the precedent for Taiwan's much earlier measures than the rest of the world. By contrast, the UK, Italy, and Spain relied on the WHO's flawed recommendations.

Pandemic experience from SARS 2003

Taiwan's rapid Covid-19 response was the result of prior experience with the 2003 SARS epidemic (severe acute respiratory syndrome). While it only had 346 cases of SARS, the Government implemented mandatory quarantine for thousands of people, reorganised its health ministry, trained medical staff and heightened screening standards.⁶ It also invested heavily in epidemiological screening infrastructure at ports of entry and amended its Communicable Disease Control Act to allow for greater surveillance of citizens. Finally, it also established a disaster-management system to enable a speedy technological and institutional response to future pandemics.⁷

2. Optimisation of Border Restriction

During Covid-19, Taiwan's Vice-President Chen Chien-jen, the TCDC developed the "TOCC" policy (Travel Occupation Contact and Cluster) at the border which optimises the collection of arrivals' travel history, occupation and recent contacts to help identify new clusters.⁸

Temperature monitoring and stringent measures.

Before the first case appeared in Taiwan on December 31, the TCDC began screening arrivals' temperatures and symptoms at the airport.⁹ The Government encouraged the wearing of masks and set up hand sanitising stations across the country.¹⁰ Airport staff also sprayed disinfectants on common areas following established epidemiological procedures developed after SARS in 2003.¹¹ These early border measures meant Taiwan kept its domestic economy open throughout the crisis.

Two-way travel restrictions

Immediately after Dr Lo Yi-chun's alert, the TCDC issued a list of strict travel restrictions to all inbound flights. These included:

- Screening and inspection of passengers and flight crew even before the first case was registered in Taiwan on January 21;
- Banning Chinese nationals from entrance after the first case was confirmed;¹²
- Closure of ports to any cruise ship that had recently visited Hong Kong, Macau or mainland China;
- Mandatory health and travel declarations for all arrivals with fines for falsified information up to \$NT150,000 (\$8278);¹³

- Stopping all international transits through Taiwan;
- All arriving Taiwanese nationals from affected areas such as China, Hong Kong, Iran or Italy were banned from using public transport after landing on March 11;
- All foreign nationals were barred from entry on March 19;
- Mandatory quarantine^A for Taiwanese citizens arriving from Wuhan was expanded to all arrivals from affected countries;
- Compliance with the Entry Quarantine System which compels all incoming passengers to fill out a health declaration using SMS on the popular social media 'Line' Application.¹⁴

Also, the TCDC advised against nonessential travel to countries designated as high risk (Level 3 countries). Level 1 and Level 2 are nations deemed a low and medium risk. Outgoing essential travel was also banned for front-line medical personnel so they would be available if an outbreak occurred. Students and teachers were also restricted from travelling until July.¹⁵

Revision of immigration rules

National Immigration Agency Director William Chang announced that until June 30, the Government would offer amnesty for undocumented visitors forced to stay in Taiwan due to the travel restrictions if they came forward for Covid-19 tests and potential treatment.

3. Strict Quarantine Requirements

As Taiwanese citizens returned home, this caused an uptick in new Covid-19 cases. In response, President Tsai Ing-wen set up two types of quarantine protocols:

- Quarantine at home using police-tracked mobile GPS data.¹⁶ Quarantined individuals are called twice a day and when violations occur police can either visit the home or attempt to reach the person with a video call;¹⁷
- Quarantine at Government managed facilities in Taichung and New Taipei.

As of April 1, more than 80,000 people are in home quarantine. And since April 3, all fresh cases of Covid-19 patients are now isolated in Government facilities.¹⁸

Government subsidies for quarantine

To encourage hotels to open for quarantine, Taiwan's Central Epidemic Command Centre prepared a daily subsidy of \$NT1000 (\$55) for everyone in quarantine at a hotel.¹⁹ To get the subsidy, a person must obey the quarantine rules — one person per room with a bathroom and three meals a day left at the door.²⁰ About 10,000 hotel rooms have been made available for Taiwanese citizens returning home and for non-citizen residents.²¹

For those in quarantine, the Government's Relief Act provides health caregivers and also daily compensation of \$NT1000 (\$55) for people without paid leave for up to 14 days. Anyone found violating the quarantine rules are exempt from the subsidy.²²

^A For instance, between December 31, 2019 and January 20, 2020, there were 26 flights with 2845 passengers and cabin crew that were investigated. They were put on a 14-day home quarantine, and those with symptoms — 13 people — were tested for Covid-19.

Local government quarantine management

Since March 2, local city governments have also acted:

- Taipei city's "epidemic-prevention hotels" are open for quarantine accommodation with 17 hotels currently available.²³ Hotel staff conduct regular check-ups and deliver meals to rooms without direct contact. Anyone detected with a fever, or other virus symptoms is taken to a separate location for a medical assessment.
- Yilan County released a home isolation package to make quarantine more comfortable. It includes masks, bleach, soap and plastic rubbish bags.²⁴

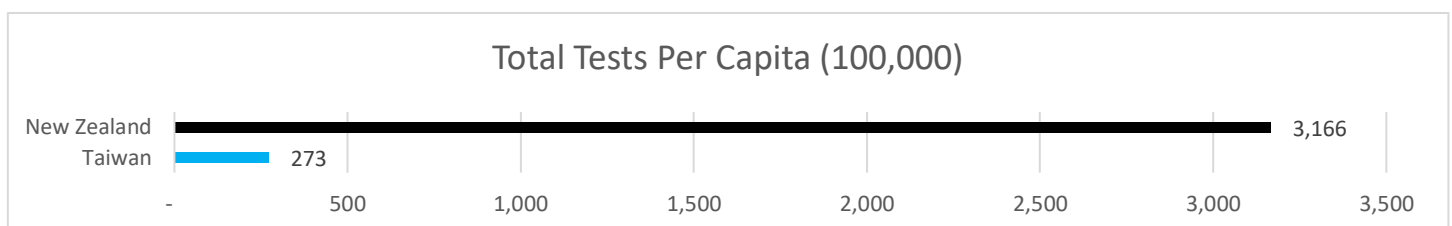
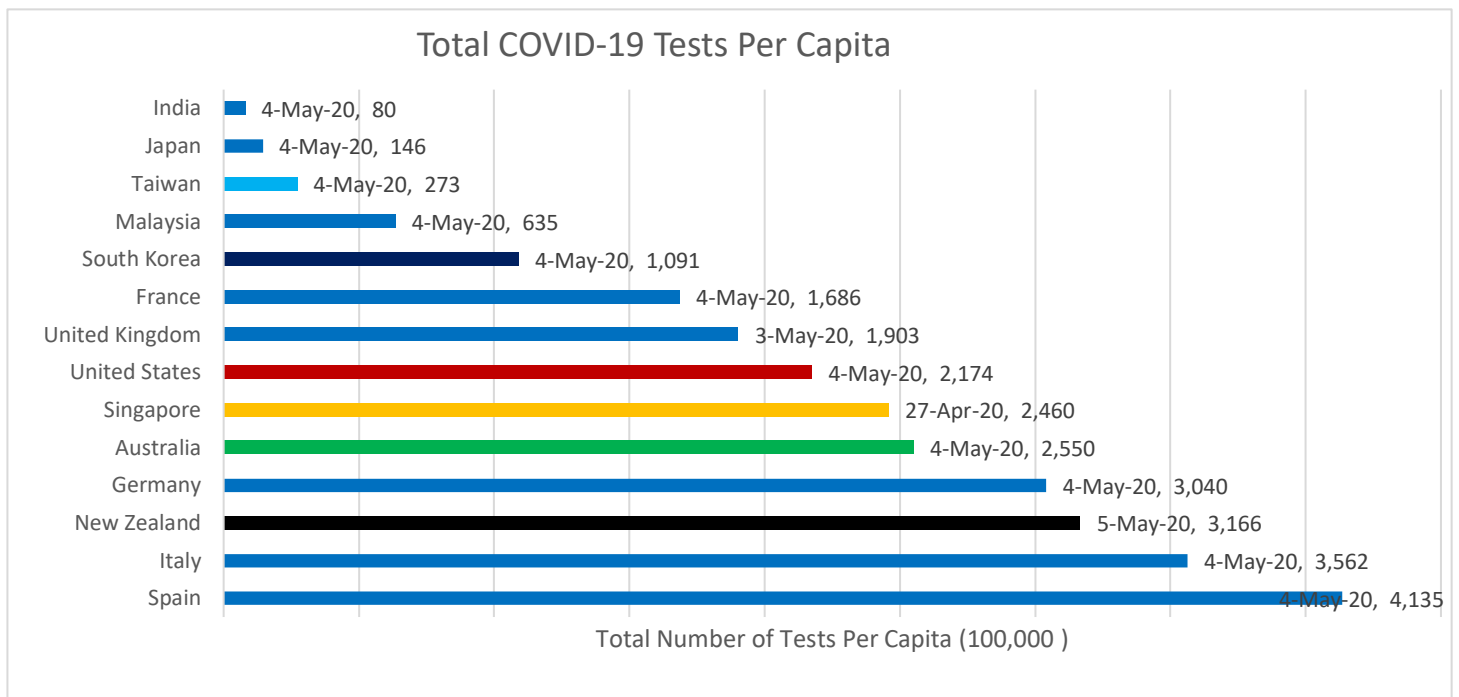
Home Quarantine Rules

The Central Epidemic Command Centre recommends those in quarantine:

- Be in a separate room away from the rest of the household;
- Remain a minimum of 1.5 metres away from family members;
- Do not share meals together;
- If sharing a common space, the room must be disinfected at least three times a day with bleach. Masks must also be worn.²⁵

4. Targeted Testing Measures

Figure 2: Total Covid-19 Tests Per Capita as of May 5.²⁶



Unlike South Korea, Taiwan did not prioritise high-volume testing. Instead, it concentrated on efficient tracking and strict quarantining of individuals susceptible to Covid-19.²⁷ Taiwan Vice President Chen said large volumes of tests are only necessary when infection origins cannot be identified.²⁸ Chen is a leading epidemiologist and served as Minister of Health during the 2003 SARS outbreak. He considers mass testing a tool to find out the state of contagion in a country, rather than as a conclusive solution.

However, the TCDC still developed 34 testing centres using a liberal testing requirement for anyone with potential symptoms. The Government certified enough laboratories to increase its testing capacity from 500 to 3200 tests a day.²⁹ As of May 10, it has tested a total of 67,133 people or 282 per capita (100,000).³⁰

Public and private testing innovation

Taiwan has encouraged public and private innovation to boost testing capacity:

- Academic Sinicia, a public research institution, developed a fast-track screening test which can detect Covid-19 in 15 minutes, a drastic reduction from four hours.³¹
- Developers at the National Taiwan University's Medical school developed a new testing device to diagnose lung health in thirty seconds. This test is a cheaper preliminary tool to screen for Covid-19 days before symptoms develop.³²
- The Taiwanese-Danish joint-venture BluSense Diagnostics produced ViroTrack, a portable Covid-19 test that detects anti-bodies in blood serum in 12 minutes.³³

Testing methods

Most Covid-19 diagnostic tests are conducted at hospitals in pop-up tents and private clinics. The National Taiwan University Hospital also reopened its epidemic clinic to cope with the outbreak.³⁴ To save on resources, some hospitals are also using drive through testing systems³⁵ and a "Glove-Wall" system, similar to South Korea's methods in which medical personnel put their hands into gloves attached to a clear acrylic wall separating them from a patient.³⁶

5. National Healthcare

Healthcare procedures

According to Bloomberg's 2018 Healthcare Efficiency Index, Taiwan's healthcare system ranks in the global top 10.³⁷ To prevent a system collapse, the Government increased hospital capacity to include 20,000 isolation rooms with 14,000 ventilators.³⁸ Taiwan has a population of 23.8 million compared with New Zealand's 4.8 million. This means Taiwan's hospital capacity is equivalent to 3400 isolation rooms and 2400 ventilators in New Zealand. To put that into perspective, New Zealand presently has hospital capacity of 533 ventilators and there is another 247 in private hospitals and other institutions.³⁹

The TCDC and the Government's Central Epidemic Command Centre (CECC) mandated hospitals implementing infection control while requesting all health facilities to keep different patient wards and healthcare staff separated to limit contagion.⁴⁰ On April 5,

hospitals banned outside visits since many clusters were beginning in hospitals.⁴¹

Other hospital requirements include:⁴²

- All staff must wear PPE;⁴³
- Mandatory temperature checks, including thermal cameras near the entrance:
 - Anyone with a fever is sent to triage tents set up outside the emergency centre for testing;
 - Those vetted for previous travel history and/or with respiratory symptoms sent to the triage tents.
- Visitors must wear face masks to enter hospitals for testing;
- All visitors must be in separate queues;
- A time limit has been placed on patient visits.

The CECC also created six strategies to prevent the spread of Covid-19 in hospitals:⁴⁴

- Expand testing capacity up to 3800 specimen tests;
- Community surveillance with different procedures of separate levels of care;
- Expanding hospital capacity for designated emergency response hospitals and wards;
- Taking inventory of clinical beds and health agencies tracking the total number of beds available for group quarantine;
- Requisitioning designated facilities for group quarantine;
- Patient diversion and transfers.

Data integration

An integrated immigration database from both the National Health Insurance Administration and the National Immigration Agency gives doctors and frontline healthcare officials easier access to data and vetting dishonesty from arrivals into the country.⁴⁵ The data tracks each citizen's health record, mask rationing and travel history.⁴⁶ The open data information sharing strategy has prevented vital mismatching between hospitals and patients, creating greater efficiency and saved the healthcare system from overload.

More than 10,000 private healthcare practices upload their data into this centralised national database.⁴⁷ These include patient symptoms, medical records and other important information that could be used by the TCDC to detect cases, respond rapidly to potential clusters and isolate any potential contacts.

6. Contact Tracing: Importance of Technology

A contact tracing team to monitor individuals using satellite location technology is led by the TCDC and local health authorities. The tracking for a person begins at symptom onset and ends at the date of Covid-19 confirmation. Close contacts of the patients are identified through the NHI database system and quickly asked to get their own diagnostic tests. Taiwan's CDC has tracked 2761 close contacts related to Covid-19.⁴⁸

Taiwan Digital Minister Audrey Tang has encouraged private individuals and tech volunteers to get involved with building mobile applications to aid in Covid-19 data gathering and

sharing and to display up-to-date information on commercial stocks of face masks.⁴⁹ In conjunction with private software engineers, the Government has created a citywide alert system for risky locations susceptible to Covid-19. The Taiwan CDC uses a digital contact tracing system to follow and record the daily health status of quarantined people.⁵⁰ The collected data also includes age, sex, date of exposure and the exposure location keeping two-way information flowing.⁵¹

7. Masks and Personal Protective Equipment

Even before Covid-19, many East Asian countries had a culture of wearing masks in public. When the World Health Organisation declared that masks were superfluous for the new virus, Taiwan's health officials continued advising the public to use them. The Government published new guidelines for residential communities by insisting on the regular use of masks and hand sanitisers in communal areas and required leisure areas to be blocked.⁵²

Mask-wearing public policy

On February 6, Taiwan announced the requisition of all domestically produced face masks to ensure enough supply remained in the country.⁵³ Similar to South Korea's mask policies, Taiwan initially banned the export of masks (and digital thermometers) to meet the demands of healthcare workers and the public.⁵⁴

The Government also instructed the military to help produce face masks.⁵⁵ As a result of collective effort, Taiwan has 92 manufacturing lines producing up to 17 million face masks per day.⁵⁶ About 1.4 million masks are released daily for healthcare officials and an additional 2.6 million masks go to the 6515 pharmacies and 10,000 other convenience stores.⁵⁷

The Government initially announced a rationing system using the National Health Insurance card which allows individuals (including foreign nationals) to purchase two masks per week at designated pharmacies. This quota has increased to three per week, then nine for \$NT5.⁵⁸ Additionally, an online ordering system^B 'eMask' was introduced through which individuals can order up to three masks and collect them at a local convenience store.⁵⁹

Taiwan's Ministry of Transport and Communications also announced on April 1, that face masks are compulsory on public transport, with fines for non-compliance.⁶⁰

Personal protective equipment

The campaign against Covid-19 has fuelled massive growth in healthcare workers' demand for personal protective equipment (PPE). One million hazmat or decontamination suits were being produced by the end of March by six manufacturers.⁶¹ Self-sustainability was at the core of this decision as prior to the outbreak most of Taiwan's PPE came from overseas, especially from the US.⁶² Taiwan was able to keep up with domestic demand for PPE and other critical supplies.

Private sector innovation

In Taiwan's Miaoli County, a factory producing skin-treating facial masks has converted one of its manufacturing lines to make a filter (a sheet of high-quality mask paper) that can be attached to the inside of a face mask for extra protection from airborne droplets.⁶³

To disincentivise long queues from forming in front of pharmacies, the local government has

^B On the first day of the online system on March 15, 470,000 face masks were ordered.

asked for help from the private sector.⁶⁴ Local businesses such as Yallvend Co also set up smart vending machines to distribute masks. The vending machines are integrated with the National Health Insurance database system to track face mask supply.⁶⁵

8. Geopolitics

Mask diplomacy

Taiwan's Minister of Foreign Affairs Joseph Wu introduced 'face mask diplomacy' to assist other countries facing high demand for face masks and other PPE. Beginning on April 1, the Government donated 11 million masks to the US, Italy, Singapore, Malaysia, Myanmar and the Philippines.⁶⁶ In addition, Taiwanese citizens have donated face masks through the National Health Insurance Administration's (NHIA) smartphone application.⁶⁷

World Health Organisation

WHO Director-General Tedros Adhanom defended China's early containment measures, and endorsed its official denial of any Covid-19 human-to-human transmission until January 21, despite the evidence to the contrary.⁶⁸ He also said Taiwan was being racist against Chinese citizens.⁶⁹

Taiwan's effective containment measure have restarted campaigns by Japan, Germany, Canada, the US and Australia for the state to be recognised by the World Health Organisation. The Tsai administration stressed that the state should not be a weak link in international cooperation as it limits Taiwan's ability to contribute medical expertise to the world and attain access to global health updates and information networks. Foreign Minister Winston Peters already announced the New Zealand Government's recommendation for Taiwan's membership as an observer status along with Canada, Australia, the US and Japan.⁷⁰

9. Open Domestic Economy

Throughout the crisis, Taiwan has maintained an open domestic economy and the shock to its economy has been mild in comparison to other countries. The Chung-hua Institution for Economic Research projects the economy will grow by about 1.03% in 2020.⁷¹ By contrast, the IMF estimated Taiwan's economy to contract by 4.0%⁷² over 2020, the smallest estimated contraction. By comparison, the IMF expects contractions of 5.9% in the US, 7.2% for New Zealand and 7.0% for Germany.⁷³

10. Enforcement of Covid-19 Measures

Types of punishments: Quarantine Violations

Politician Lo Ping-cheng announced a new legislation called *The Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens*,⁷⁴ which states that violations of the home quarantine requirements face fines of up to \$NT1 million (\$55,000).⁷⁵ Nationwide, 229 people have been fined for violating quarantine rules, with over \$NT18 million already collected.⁷⁶ Officials claim that severe punishments are necessary to reinforce zero tolerance for non-compliance.

Examples of punishments:

- March 3: Taiwan national Lin Tung-ching was fined a maximum penalty of \$NT1 million for ignoring the quarantine rules and evading the police;⁷⁷
- April 14: A woman and her daughter-in-law were fined \$NT1 million and \$NT700,000

respectively for going to the hospital without government authorisation;⁷⁸

- April 21: A Korean couple was fined a total of \$NT300,000 (\$16,476) for violating quarantine and was barred from exiting Taiwan by the Ministry of Justice.⁷⁹

Types of punishments: Mask Disposal

Since most Taiwanese wear face masks in public, the Environmental Protection Agency has introduced \$NT3600 (\$200) fines for improperly disposing masks under Article 27 of the Waste Disposal Act. The Taiwan EPA said Covid-19 droplets can spread if infected masks are tossed away and puts other people at risk.⁸⁰

Governmental restrictions: social distancing

In contrast to Singapore and Hong Kong, Taiwan does not have draconian social distancing laws and has opted instead for strong Government recommendations against large gatherings, defined as over 100 people in an indoor space or 500 people outdoors.⁸¹

On April 1, the Government created a national alert system urging people to stay at least one metre apart outdoors and 1.5 metres apart indoors along with wearing masks.⁸² Common violations during the holiday season at Kenting National Park resulted in harsh reprimands from the TCDC. Minister of Health Chen Shih-chung said “social distancing and masks are not optional. If people do not pay attention, the Government may have to impose a ban on leaving the house.”⁸³ Night markets, traditional markets and shopping areas are required to enforce social distancing and designate a single point of egress to manage people flow.⁸⁴ Officials have also constrained gatherings at ball rooms, clubs and festivals. Any event attracting more than 1000 people must complete a Covid-19 risk assessment.⁸⁵ The Government has also commissioned the development of a social-distancing smartphone app to alert people when they are too close to each other.⁸⁶

Other governmental restrictions

The TCDC also recommends cleaning and disinfecting doorknobs, keyboards, phones, light switches, faucets, toilets, sinks, remotes and children’s toys to help contain the virus.⁸⁷

Civil society compliance

In contrast to countries with a lockdown, Taiwan allows non-essential services to operate with certain requirements.⁸⁸ At universities, schools, gyms, libraries, hair salons, cinemas and cafes, visitors must wear masks and are refused entry if they have a fever above 37 degrees Celsius. Those with normal temperatures are offered hand sanitisers and must fill out a health declaration about travel history.⁸⁹ Non-essential organisations are to disinfect all frequently-touched areas every few hours. Taiwanese schools also erect plastic yellow dividers around their desks for additional measures.⁹⁰

According to the World Value Survey, Taiwan’s society has a more collectivist spirit to foster civic compliance.⁹¹ Bloomberg’s Andreas Kluth defined this as the ‘Confucian-democratic’ method because the public good is valued above individual rights and privacy.⁹²

11. Government Competence and Transparency

To contain Covid-19 early, the Central Epidemic Command Centre was upgraded to Level 1, the highest level of authorisation.⁹³ This unlocked extra powers to block the spread of the virus including the rapid mobilisation of epidemiological institutions, greater coordination of resource distribution and open information.⁹⁴

The Government issued quick travel alerts and warnings and had daily CECC press conferences providing information on health education and open database available to the public. The CECC and the Ministry of Health and Welfare also hold daily press briefings for relevant virus statistics, updates on recent cases and clusters, procedures, high-risk areas and other necessary information.

As a result, President Tsai Ing-wen's approval rating reached 75.7% and public satisfaction with her Cabinet also nudged an all-time high of 69.4%.⁹⁵

Conclusion

Taiwan's methods show what public policy measures New Zealand could implement to contain future coronaviruses while retaining a more open economy:

- The Government took rapid border measures on December 31, well before the virus became a global epidemic;
- It relied on excellent public health and epidemiological infrastructure set up after SARS in 2003;
- Taiwan implemented selective and efficient testing instead of high-volume diagnostic testing;
- It used QR-codes from social network apps to trace people's movements within a national integrated database;
- Public discipline and compliance for regular temperature checks, face masks, maintaining social distancing and disinfecting frequently-touched areas.

Taiwan's self-reliance was also critical to its containment success. If Taiwan followed the WHO's early advice, its story would have been dramatically different. As a result, with a competent and self-sufficient Government, Taiwan has maintained one of the lowest rates of Covid-19 globally, despite its geographic proximity to China.

Lessons

For New Zealand, an initial lockdown became necessary because its public health infrastructure was unprepared. In the 2019 Global Health Security Index (GHSI), New Zealand scored 54 out of 100 on an international assessment of pandemic preparedness.⁹⁶ Using the IMF-World Economic Outlook's projections, if New Zealand had performed like Taiwan its GDP may have contracted far less than 8.3%, a loss of \$31 billion (see *Table 1* in the *Appendix*).

An audit of the Ministry of Health's preparedness by Otago University's Dr Ayesha Verrall also revealed worrisome details about the incompetence of New Zealand's contact tracing

system which only displayed 60% efficiency.⁹⁷ The Government was scaling up its capacity even during the peak of the pandemic.

As New Zealand prepares to open once again for business, it can also look to Taiwan:

- Make a more rigorous approach to monitored quarantine — along with sufficient compensation for companies forced to shut down temporarily;
- Ministry of Health must create a system of rapid contact tracing capacity;
- Encourage Kiwis to regularly wear face masks, keep social distancing and diligently disinfect frequently touched areas in public places;
- Create epidemiological infrastructure in both domestic and international travel and ports of entry;
- Build greater international cooperation on travel and encourage free trade with other well-managed Covid-19 countries such as Taiwan, Australia, and South Korea.

Appendix

Due to its better healthcare preparation, Taiwan is projected to lose 3.6% of its GDP over the next two years. By contrast, New Zealand's GDP is projected to dip by 8.3%. The difference between the two levels represents about \$31 billion.

IMF-WEO projections in April 2020 for GDP current prices, purchasing power parity (\$ billions)						
	2018	2019	2020	2021	2020+2021	Reduction
Australia	1,314	1,362	1,279	1,384	2,663	-250
New Zealand	201	209	195	211	405	-37
Taiwan	1,282	1,340	1,294	1,366	2,660	-100
IMF-WEO projections in October 2019 for GDP current prices, purchasing power parity (\$ billions)						
	2018	2019	2020	2021	2020+2021	
Australia	1,318	1,365	1,423	1,490	2,914	
New Zealand	198	206	216	226	442 (656)	
Taiwan	1,252	1,300	1,352	1,408	2,760	
Reductions in forecasts						
Australia	-0.3%	-0.2%	-10.1%	-7.1%	-8.6%	
New Zealand	1.6%	1.2%	-9.8%	-6.9%	-8.3%	
Taiwan	2.4%	3.0%	-4.3%	-3.0%	-3.6%	
NZ Treasury Dec 2019 projections for GDP year ended June 2020 = \$319 billion						
Estimated reduction in NZ GDP (NZD) (8.3%) (IMF estimated contraction)	-54.4 billion		= 656 billion * -8.3%			
Estimated reduction in NZ GDP (NZD) (3.6%) (Healthcare system as prepared as Taiwan)	-23.6 billion		= 656 billion * -3.6%			
The difference illustrates the cost of not being as ready	-30.8 billion		= -54.4 billion +23.6 billion			

ENDNOTES

- ¹ Wang CJ, Ng CY, Brook RH. Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing. *JAMA*. 2020;323(14):1341–1342. doi:10.1001/jama.2020.3151
<https://jamanetwork.com/journals/jama/fullarticle/2762689>
- ² Taiwan Centers for Disease Control. Coronavirus disease 2019(COVID-19). (Accessed May 6, 2020).
<https://www.cdc.gov.tw/en/Disease/SubIndex/>
- ³ Data downloaded from <https://ourworldindata.org/coronavirus-source-data>
- ⁴ Overseas Community Affairs Council. CORONAVIRUS/How an online post forewarned Taiwan about COVID-19. April 18, 2020.
<https://www.ocac.gov.tw/OCAC/Eng/Pages/Detail.aspx?nodeid=329&pid=16234390>
- ⁵ Taiwan Centers for Disease Control. Press Releases: Two experts from Taiwan visit Wuhan to understand and obtain information on severe special infectious pneumonia outbreak. January 20, 2020.
https://www.cdc.gov.tw/En/Bulletin/Detail/jFGUVrLkluHmzZeyAihHQ?typeid=158&mod=article_inline
- ⁶ Taiwan Centers for Disease Control. SARS (Severe Acute Respiratory Syndrome). November 24, 2014.
https://www.cdc.gov.tw/En/Category/ListContent/bg0g_VU_Ysrgkes_KRUDgQ?uaid=u1D6dRGtmP4Q5YA1GmSKlw
- ⁷ Wang CJ, Ng CY, Brook RH. Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing. *JAMA*. 2020;323(14):1341–1342. doi:10.1001/jama.2020.3151
<https://jamanetwork.com/journals/jama/fullarticle/2762689>
- ⁸ Chen, Chien-jen.; MacKenzie, Ellen. Inside Taiwan’s Response to COVID-19. *John Hopkins Bloomberg School of Public Health*. April 25, 2020.
<https://www.youtube.com/watch?v=Rel6ROZNbkk>
- ⁹ Sui, Cindy. In Taiwan, the coronavirus pandemic is playing out very differently. What does life without a lockdown look like? *NBC News*. April 24, 2020.
<https://www.nbcnews.com/news/world/taiwanese-authorities-stay-vigilant-virus-crisis-eases-n1188781>
- ¹⁰ Whitfield, Kathryn. Taipei seems to have the virus in hand. Now I worry about returning to the UK. *The Guardian*. March 7, 2020. <https://www.theguardian.com/world/2020/mar/07/coronavirus-outbreak-taipei-taiwan-china>
- ¹¹ Taiwan Centers for Disease Control. SARS (Severe Acute Respiratory Syndrome). November 24, 2014.
https://www.cdc.gov.tw/En/Category/ListContent/bg0g_VU_Ysrgkes_KRUDgQ?uaid=u1D6dRGtmP4Q5YA1GmSKlw
- ¹² Taiwan Centers for Disease Control. Taiwan timely identifies first imported case of 2019 novel coronavirus infection returning from Wuhan, China through onboard quarantine. January 21, 2020.
https://www.cdc.gov.tw/En/Bulletin/Detail/pVg_jRVvtHhp94C6GShRkQ?typeid=158
- ¹³ All travellers to Taiwan required to fill out health declaration. *Taiwan News*. February 12, 2020.
<https://www.taiwannews.com.tw/en/news/3875187>
- ¹⁴ Taiwan Centers for Disease Control. Taiwan timely identifies first imported case of 2019 novel coronavirus infection returning from Wuhan, China through onboard quarantine. January 21, 2020.
<https://www.cdc.gov.tw/En/Bulletin/Detail/j99d7-x-hlc8AhOvTySo6w?typeid=158>
- ¹⁵ Everington, Keoni. Greater Taipei students, teachers barred from overseas travel. *Taiwan News*. March 16, 2020. <https://www.taiwannews.com.tw/en/news/3897992>
- ¹⁶ Duff-Brown, Beth. How Taiwan Used Big Data, Transparency and a Central Command to Protect Its People from Coronavirus. *Stanford University’s Freeman Spogli Institute*. March 3, 2020.
<https://fsi.stanford.edu/news/how-taiwan-used-big-data-transparency-central-command-protect-its-people-coronavirus>
- ¹⁷ Huang, Yasheng.; Sun, Meicen.; Sui, Yuze. How Digital Contact Tracing Slowed Covid-19 in East Asia. *Harvard Business Review*, April 15, 2020. <https://hbr.org/2020/04/how-digital-contact-tracing-slowed-covid-19-in-east-asia>
- ¹⁸ Taiwan Centers for Disease Control. Starting April 3, travellers having symptoms in the past 14 days to be required to undergo home quarantine at designated location. April 3, 2020.
https://www.cdc.gov.tw/En/Category/ListContent/tov1jahKUv8RGSbvmzLwFg?uaid=6emsMaYdnl2HLYCy_8t9IQ

- ¹⁹ Lee, I. Virus Outbreak: Health minister lays out rules for social distancing. *Taipei Times*. April 2, 2020. <https://www.taipeitimes.com/News/taiwan/archives/2020/04/02/2003733850>
- ²⁰ Ibid.
- ²¹ Ibid.
- ²² CECC announces compensation for COVID-19 quarantine. *Taiwan Today*. March 12, 2020. <https://taiwantoday.tw/news.php?unit=2,6,10,15,18&post=173220>
- ²³ Taipei City Government's Covid-19 Epidemic Prevention SOPs. Quarantine Hotels in Taipei. April 23, 2020. https://english.gov.taipei/covid19/News_Content.aspx?n=D22A801689E62181&sms=DFD7BFAE73CCOB5C&s=64FCF26A5E5620FD
- ²⁴ Yilan launches packages full of everything needed for 14 days' self-isolation. *Formosa News English*. March 5, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=39503440F8A65377957B3D4D8ACE07B0>
- ²⁵ FAQ: Taiwan's 14-day quarantine requirements. *Taiwan Today*. March 18, 2020. <https://taiwantoday.tw/news.php?unit=2,6,10,15,18&post=173589>
- ²⁶ Reported Cases and Deaths by Country, Territory, or Conveyance: COVID-19 CORONAVIRUS PANDEMIC. *Worldometers*. Accessed on May 10, 2020. <https://www.worldometers.info/coronavirus/>
- ²⁷ Hsu, Elizabeth. CORONAVIRUS/Taiwan defends relatively limited COVID-19 testing. *Focus Taiwan*. March 24, 2020. <https://focustaiwan.tw/society/202003240013>
- ²⁸ Ibid.
- ²⁹ President Tsai praises personnel on front line of COVID-19 response. *Taiwan Today*. March 23, 2020. <https://taiwantoday.tw/news.php?unit=2,6,10,15,18&post=174057>
- ³⁰ Reported Cases and Deaths by Country, Territory, or Conveyance: COVID-19 CORONAVIRUS PANDEMIC. *Worldometers*. Accessed on May 10, 2020. <https://www.worldometers.info/coronavirus/>
- ³¹ Team develops antibodies for rapid virus screening. *Taipei Times*. March 9, 2020. <https://www.taipeitimes.com/News/taiwan/archives/2020/03/09/2003732352>
- ³² NTU unveils test that checks lungs for early signs of coronavirus. *Formosa News English*. March 27, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=0931FA834C829323A88BBBCAD4C905F1>
- ³³ Taiwan unveils a portable 12-minutes coronavirus COVID-19 testing kit. *ABC Mundial*. April 8, 2020. <https://abcmundial.com/en/2020/04/08/asia/technology/taiwan-unveils-a-portable-12-minutes-coronavirus-covid-19-testing-kit>
- ³⁴ Huang, T. National Taiwan University Hospital reopens 'epidemic clinic' to cope with outbreak. *Taiwan News*. January 30, 2020. <https://www.taiwannews.com.tw/en/news/3867240>
- ³⁵ Hospitals launch 'drive-thru' services to lower transmission risk. *Formosa News English*. March 3, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=F70C553AEC9FD7C51618690D11B76B0F>
- ³⁶ Arrivals with virus symptoms required to stay at quarantine facility. *Formosa News English*. April 5, 2020. <https://www.youtube.com/watch?v=5YTBjZBN110>
- ³⁷ Lu, Wei.; Lee, J Miller. These Are the Economies With the Most (and Least) Efficient Health Care. *Bloomberg*. September 19, 2018. <https://www.bloomberg.com/news/articles/2018-09-19/u-s-near-bottom-of-health-index-hong-kong-and-singapore-at-top>
- ³⁸ Chen, Chien-jen.; MacKenzie, Ellen. Inside Taiwan's Response to COVID-19. *John Hopkins Bloomberg School of Public Health*. April 25, 2020. <https://www.youtube.com/watch?v=ReI6ROZNbkk>
- ³⁹ Campbell, G. On Buying Ventilators, And Expanding The Testing For Covid-19. *Scoop*. April 1, 2020. <https://www.scoop.co.nz/stories/HL2004/S00002/on-buying-ventilators-and-expanding-the-testing-for-covid-19.htm>
- ⁴⁰ Huang, T. National Taiwan University Hospital reopens 'epidemic clinic' to cope with outbreak. *Taiwan News*. January 30, 2020. <https://www.taiwannews.com.tw/en/news/3867240>
- ⁴¹ Hospital rules tighten and facilities prepare for upsurge in COVID-19 cases. *Formosa News English*. February 28, 2020. <https://www.youtube.com/watch?v=6N7uDQnfN7U>
- ⁴² Front-line Taiwan hospital armed for coronavirus fight. *Formosa News English*. April 24, 2020. <https://www.youtube.com/watch?v=rztbKAVjZgE>
- ⁴³ Huang, T. National Taiwan University Hospital reopens 'epidemic clinic' to cope with outbreak. *Taiwan News*. January 30, 2020. <https://www.taiwannews.com.tw/en/news/3867240>
- ⁴⁴ Taiwan Centers for Disease Control. CECC maintains six strategies to prevent COVID-19 spread in hospitals. April 7, 2020.

<https://www.cdc.gov.tw/En/Bulletin/Detail/pOahsDWbIKw6KMVDsPed9Q?typeid=158>

⁴⁵ Duff-Brown, Beth. How Taiwan Used Big Data, Transparency and a Central Command to Protect Its People from Coronavirus. *Stanford University's Freeman Spogli Institute*. March 3, 2020.

<https://fsi.stanford.edu/news/how-taiwan-used-big-data-transparency-central-command-protect-its-people-coronavirus>

⁴⁶ Wei, Katherine. Coronavirus: Taipei unveils vending machines for surgical masks. *Strait Times*. April 14, 2020. <https://www.straitstimes.com/asia/east-asia/coronavirus-taipei-unveils-vending-machines-for-surgical-masks>

⁴⁷ Taiwan's private practices serve as whistleblowers for disease outbreaks. *Formosa News English*. April 15, 2020.

<https://englishnews.ftv.com.tw/read.aspx?sno=0956D5BC9B8F7DE6A964C61C1B29F492>

⁴⁸ Hao-Yuan Cheng, MD, MSc; Shu-Wan Jian, DVM, MPH; Ding-Ping Liu, PhD; Ta-Chou Ng, BSc; Wan-Ting Huang, MD; Hsien-Ho Lin, MD, ScD. Contact Tracing Assessment of COVID-19 Transmission Dynamics in Taiwan and Risk at Different Exposure Periods Before and After Symptom Onset. *JAMA Internal Medicine*. May 1, 2020. <https://www.cdc.gov.tw/Uploads/bc8579cb-6e47-44dd-bb65-7a6361f73f7f.pdf>

⁴⁹ Mouth mask supply and demand. Taiwanese government.

https://mask.pdis.nat.gov.tw/?fbclid=IwAR0K7R4_14ztQ1bEY0UiQmwsfoA9e3iQhhtowEkkMej647aOhlo_RfxvggA (Accessed on May 6, 2020).

⁵⁰ Hao-Yuan Cheng, MD, MSc; Shu-Wan Jian, DVM, MPH; Ding-Ping Liu, PhD; et al. Contact Tracing Assessment of COVID-19 Transmission Dynamics in Taiwan and Risk at Different Exposure Periods Before and After Symptom Onset. *Jama Network*. May 1, 2020.

<https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2765641#ioi200031r18>

⁵¹ Lanier, Jaron; Weyl, E. Glen. How Civic Technology Can Help Stop a Pandemic. *Foreign Affairs*. March 20, 2020. <https://www.foreignaffairs.com/articles/asia/2020-03-20/how-civic-technology-can-help-stop-pandemic>

⁵² Residential communities required to shut leisure areas, doubts hang over large gatherings. *Formosa News English*. March 5, 2020.

<https://englishnews.ftv.com.tw/read.aspx?sno=52E3B39914FB85B697CD820A4769032C>

⁵³ Wu, Po-wei.; Chiang Yi-ching. Taiwan's government requisitions domestic N95 mask capacity.

Focus Taiwan. April 8, 2020. <https://focustaiwan.tw/society/202004080017>

⁵⁴ Taiwan bans exports of digital thermometers without permission. *Formosa News English*. March 4, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=FE71F954DA89872AD122C3FE86C2190C>

⁵⁵ Huang, T. Taiwan pledges military aid to boost mask supply. *Taiwan News*. February 2, 2020.

<https://www.taiwannews.com.tw/en/news/3869320>

⁵⁶ Huang, T. Taiwan to produce 19 million face masks daily by next month. *Taiwan News*. April 28, 2020. <https://www.taiwannews.com.tw/en/news/3924318>

⁵⁷ Kim, Amber. The world can learn from Taiwan. *Taipei Times*. March 18, 2020.

<https://www.taipetimes.com/News/editorials/archives/2020/03/18/2003732892>

⁵⁸ CORONAVIRUS/Timeline: COVID-19 in Taiwan. *Focus Taiwan*. April 18, 2020.

<https://focustaiwan.tw/society/202004185001>

⁵⁹ Chuan, Ku.; Kao, Evelyn. CORONAVIRUS/Face masks can soon be ordered at convenience stores.

Focus Taiwan. April 21, 2020. <https://focustaiwan.tw/society/202004210010>

⁶⁰ Taiwan steps up the fight against COVID-19. *Focus Taiwan*. April 12, 2020.

<https://focustaiwan.tw/video/004335141>

⁶¹ Taiwan to produce protective suits amid suit import delays. *Formosa News English*. March 23, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=368AD18776FFD03C2B33C2C80CB5CCA4>

⁶² Ibid.

⁶³ Sheet mask factory creates 'mask behind a mask. *Formosa News English*. March 30, 2020.

<https://englishnews.ftv.com.tw/read.aspx?sno=E13F5E640CC131744A1D414DA0238B9E>

⁶⁴ Wei, Katherine. Coronavirus: Taipei unveils vending machines for surgical masks. *Strait Times*. April 14, 2020. <https://www.straitstimes.com/asia/east-asia/coronavirus-taipei-unveils-vending-machines-for-surgical-masks>

⁶⁵ Huang, Li-yun.; Hsu, Elizabeth. Startup develops mask vending machine amid rationing in Taiwan. *Focus Taiwan*. February 21, 2020. <https://focustaiwan.tw/society/202002210011>

⁶⁶ Ministry of Foreign Affairs: Republic of China. MOFA announces donation of 10 million face masks to the US, Europe, diplomatic allies to extend humanitarian assistance in wake of COVID-19. April 1, 2020.

- https://www.mofa.gov.tw/en/News_Content.aspx?n=1EADDCFD4C6EC567&s=2A434037CB463FEE
- ⁶⁷ Yen, William. CORONAVIRUS/Taiwan citizens can now donate masks to countries in need. *Focus Taiwan*. April 27, 2020. <https://focustaiwan.tw/society/202004270010>
- ⁶⁸ China's Xi Jinping knew of coronavirus earlier than first thought. *Financial Times*, February 17, 2020. <https://www.ft.com/content/3da73290-5067-11ea-8841-482eed0038b1>
- ⁶⁹ Coronavirus: WHO chief and Taiwan in row over 'racist' comments. *BBC*. April 9, 2020. <https://www.bbc.com/news/world-asia-52230833>
- ⁷⁰ Sachdeva, Sam. NZ formally backs WHO role for Taiwan. *Newsroom*. May 5, 2020. <https://www.newsroom.co.nz/2020/05/07/1161574/chinese-embassy-hits-backs-at-peters-over-taiwan-remarks>
- ⁷¹ Central News Agency. Think tank cuts Taiwan 2020 GDP growth forecast to 1.03%. *Taiwan News*. April 18, 2020. <https://www.taiwannews.com.tw/en/news/3918725>
- ⁷² IMF. IMF Country Information. *IMF*, April 14, 2020. <https://www.imf.org/en/Countries/>
- ⁷³ Ibid.
- ⁷⁴ Ministry of Health and Welfare 衛生福利部. Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens. *Law and Regulations Database of Taiwan*. February 25, 2020. <https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=L0050039>
- ⁷⁵ Everington, Keoni. Quarantine violators in Taiwan could be slapped with NT\$1 million fine. *Taiwan News*. February 21, 2020. <https://www.taiwannews.com.tw/en/news/3879338>
- ⁷⁶ Chung, C. CECC Denounces Quarantine Violators. *Taiwan Public Television Service Online*. March 26, 2020. <https://news.pts.org.tw/article/472042>
- ⁷⁷ Strong, Matthew. Taiwanese man who evaded coronavirus quarantine fined maximum NT\$1 million. *Taiwan News*. March 3, 2020. <https://www.taiwannews.com.tw/en/news/3884486>
- ⁷⁸ Strong, Matthew. N. Taiwan family of four fined for violating coronavirus quarantine rules. *Taiwan News*. April 14, 2020. <https://www.taiwannews.com.tw/en/news/3915856>
- ⁷⁹ Chen, Kelvin. South Korean couple fined NT\$300,000 for quarantine violation. *Taiwan News*. April 21, 2020. <https://www.taiwannews.com.tw/en/news/3920159>
- ⁸⁰ Taipei City Government to reward those who report mask litterers. *Taiwan News*. April 2, 2020. <https://www.taiwannews.com.tw/en/news/3909264>
- ⁸¹ Wu, Hsin-yun.; Yu, Hsiao-han.; Chen, Yi-hsuan.; Yeh, Joseph. CECC advises against large gatherings. *Focus Taiwan*. March 25, 2020. <https://focustaiwan.tw/society/202003250012>
- ⁸² Taiwan Centers for Disease Control. CECC announces social distancing measures for COVID-19. April 1, 2020. https://www.cdc.gov.tw/En/Bulletin/Detail/kM0jm-lqLwNBt6chKk_wg?typeid=158
- ⁸³ Taiwan CECC reminds public of social distancing during Labor Day weekend. *Taiwan News*. April 26, 2020. <https://www.taiwannews.com.tw/en/news/3923138>
- ⁸⁴ Chen, Ming-hsuan.; Yu, Hsiao-han.; Yen, William. CORONAVIRUS/Crowd management enforced at scenic and popular areas: CECC. *Focus Taiwan*, April 10, 2020. <https://focustaiwan.tw/society/202004100012>
- ⁸⁵ Taiwanese Centers for Disease Control. Guidelines for large-scale public gatherings in the wake of the COVID-19 outbreak. March 4, 2020. https://www.cdc.gov.tw/File/Get/7Jccf6fQ4P_rFLac01kkA
- ⁸⁶ Wang, Cheng-chung.; Huang, Frances. Taiwan developing social distancing app. *Focus Taiwan*. April 11, 2020. <https://focustaiwan.tw/society/202004110013>
- ⁸⁷ Disinfection 101: Expert tips on how to kill viruses in your space. *Formosa English News*. April 8, 2020. <https://www.youtube.com/watch?v=nnJpbgZnbps>
- ⁸⁸ Government issues advisory for cinemas, including denying feverish patrons entry. *Formosa English News*. March 26, 2020. <https://englishnews.ftv.com.tw/read.aspx?sno=C02A9053D246789C85A01EE622C69E03>
- ⁸⁹ Government issues advisory for cinemas, including denying feverish patrons entry. *Formosa English News*. March 31, 2020. <https://www.youtube.com/watch?v=Nyi1sP2ibzY>
- ⁹⁰ Hamacher, Fabien.; Blanchard, Ben. Taiwan school uses dividers during lunch to counter coronavirus. *Reuters*. March 14, 2020. <https://www.reuters.com/article/us-health-coronavirus-taiwan-schools/taiwan-school-uses-dividers-during-lunch-to-counter-coronavirus-idUSKBN21029K>
- ⁹¹ World Values Survey. Findings and Insights. <http://www.worldvaluessurvey.org/WVSContents.jsp> (Accessed on May 6, 2020)
- ⁹² Kluth, Andreas. If We Must Build a Surveillance State, Let's Do It Properly. *Bloomberg*. April 22, 2020. <https://www.bloomberg.com/opinion/articles/2020-04-22/taiwan-offers-the-best-model-for-coronavirus-data-tracking>
- ⁹³ Executive Yuan Press Release. Central Epidemic Command Center raised to level-1 facility.

Department of Information Services. February 27, 2020.

<https://english.ey.gov.tw/Page/61BF20C3E89B856/de8adc4f-d276-42cd-a7c9-cd4d551d6a7d>

⁹⁴ Wittenberg-Cox, Avivah. What Do Countries With The Best Coronavirus Responses Have In Common? Women Leaders. *Forbes*. April 13, 2020.

<https://www.forbes.com/sites/avivahwittenbergcox/2020/04/13/what-do-countries-with-the-best-coronavirus-reponses-have-in-common-women-leaders/#17b530703dec>

⁹⁵ Shan, Shelley. Virus Outbreak: Most people happy with Chen as CECC head, survey finds. *Taipei Times*. March 30, 2020.

<https://www.taipeitimes.com/News/taiwan/archives/2020/03/30/2003733651>

⁹⁶ Global Health Security Index. 2019 Global Health Security Index. <https://www.ghsindex.org/> (Accessed on May 6, 2020).

⁹⁷ Verrell, Ayesha. Rapid Audit of Contact Tracing for Covid-19 in New Zealand. *Ministry of Health*. April 10, 2020.

https://www.health.govt.nz/system/files/documents/publications/contact_tracing_report_verrall.pdf