New Zealand physical distancing policies and epidemiology from January - September 2020:
A case report

Policy Frameworks and Epidemiology of COVID-19 Working Group

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Conflicts of Interest

No conflicts of interest were reported.

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I. Introduction and project description

A new disease that spread around the world

On December 31, 2019, the World Health Organization (WHO) was notified of a cluster of individuals with pneumonia of unknown cause in Wuhan, China. (1) On January 12, 2020, China shared the genetic sequence of the novel coronavirus with other countries to help develop diagnostic tests. (1) Thailand reported the first known case of the novel coronavirus outside of China on January 13, 2020. WHO declared the novel coronavirus (2019-nCoV) outbreak a Public Health Emergency of International Concern on January 30, 2020 with 7,711 confirmed cases, 12,167 suspected cases, and 170 deaths in China and 83 cases in 18 countries outside of China. (1,2) The disease was later named COVID-19 for coronavirus disease 2019 and the virus referred to as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). (1) WHO declared COVID-19 a pandemic on March 11, 2020. (1)
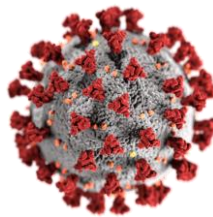
Physical distancing policies and knowledge gaps

As an emerging infectious disease, there were originally no effective vaccines or preventive treatments for SARS-CoV-2. Therefore, governments have had to rely on the use of public policies to combat the spread of the virus. (1-4) Creating policies has been difficult due to the large amount of information and ongoing uncertainty around the characteristics of the virus and who it affects. (4) One of the most commonly used policies to mitigate (slow) the spread of the virus that causes COVID-19 centres on physical or social distancing, which relies on separating people to reduce the transmission of the virus. (5) However, it is still unclear when is the best time to institute such policies and what happens when distancing policies are eased. There are many aspects of distancing, such as recommendations for maintaining a physical distance in public, banning group gatherings, or complete lockdowns, that complicate their assessment. (5) There are also many factors that have been attributed to people acquiring or having a worse outcome from COVID-19. (6-11) However, there is no harmonized database available with all the policies, epidemiology and contextual information that is needed in order to perform comparative analyses useful to informing policy making.

About this project

The Policy Frameworks and Epidemiology of COVID-19 Working Group was developed after a "CONVERGE Virtual Forum: COVID-19 Working Groups for Public Health and Social Sciences Research." A group of international researchers convened to explore what physical distancing policies countries implemented and their effects on the epidemiology of COVID-19. The Working Group was further supported through an award from CONVERGE and the Social Science Extreme Events Research (SSEER) Network. CONVERGE is a National Science Foundation-funded initiative headquartered at the Natural Hazards Center at the University of Colorado Boulder.

This project is registered in:

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II. Methods

Research design

A qualitative embedded multiple case study research design was used to compare countries (or subnational jurisdictions, such as provinces, states or territories). The suite of public policies and resulting changes in the epidemiology of COVID-19 are examined within their specific country setting. Our cases start in January 2020 and end in or around August 2020. (Please see full study proposal). Research ethics approval was obtained by the Hamilton Integrated Research Ethics Board (HIREB) (Project # 11243).

Data collection

For each country, the setting, such as health systems, political systems and demographics were described to help with interpretation of findings and potential transferability, or the degree to which findings are applicable to other sites or future research.

Publicly available data was first collected on the jurisdiction following a standardized data collection form. Epidemiological data was drawn from publicly available data. WHO, World Bank, Central Intelligence Agency and other publicly available sources were used for timelines and country characteristics, where possible. Other sources of information included governmental and non-governmental websites, news articles, government reports, and peer-reviewed journals.

Next, key informant interviews were conducted to fill in gaps, verify information found through the documentary searches, and identify further participants and documentary sources of relevant information. (See informed consent and interview guide) Key informant interviews were conducted with policymakers, health workers, researchers and other stakeholders as appropriate to fill in knowledge gaps.

Data analysis and presentation

Our COVID-19 policies and epidemiology databases harmonize data on setting characteristics, policies, demographic characteristics and epidemiological risk factors and outcome metrics. These will further be described in single country or jurisdiction case reports. Comparisons will be selected based on both literal and theoretical replication. Countries that have similarities in either policies or epidemiological trends can be considered literal comparisons, whereas countries that differ will be used as theoretical comparisons. These comparisons will be submitted to peer-reviewed journals for publication.

III. Findings

A. Setting characteristics

Geographic, environmental, social and economic contextual factors

New Zealand is in the WHO Western Pacific Region. (12) New Zealand has a population of 4,822,233 in 2020 and a population density of 18 people per km^2. (13) However, over three-quarters of New Zealanders, including indigenous Maori, live on the north island, primarily in urban areas. 87% of people live in urban centres. (14) The Maori population is estimated to be 850,500, which is 16.7% of the New Zealand population. (15)

Figure 1. Heat Map of New Zealand with total COVID-19 cases, as of 1 November 2020 (16)
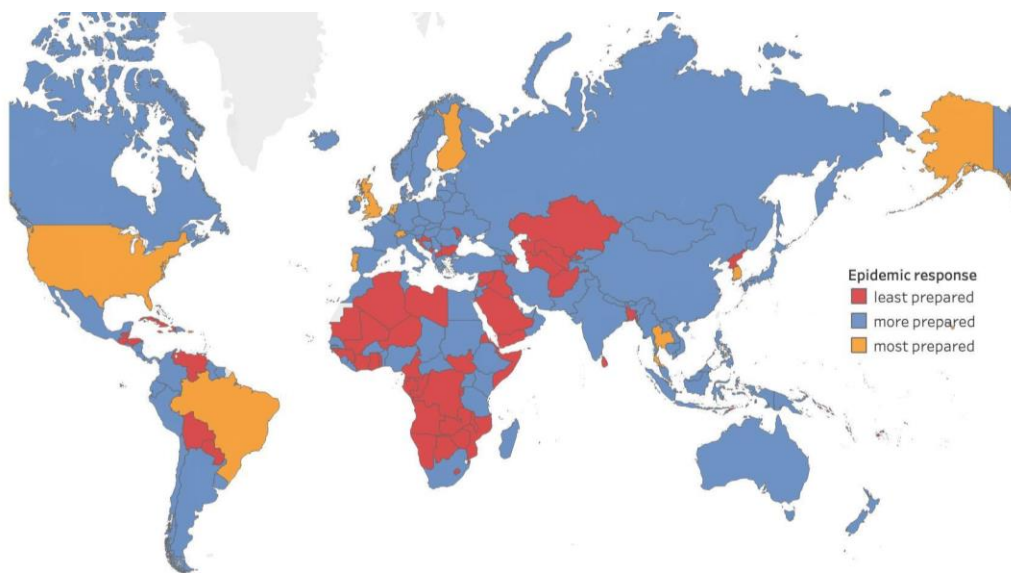
Figure 2. Global Health Security Epidemic Preparedness rank category (17)

Table 1. COVID-19 relevant contextual factors for New Zealand

Global Health Security Index, 2019 (Overall Index Score out of 100 and category) (17)	54 – More prepared
Global Health Security Index, 2019 (Epidemic Preparedness Index Score out of 100 and category) (17)	39 - More prepared
Particulate matter (PM2.5) air pollution, mean annual exposure, 2017 (micrograms per cubic meter) (18)	6
PM2.5 air pollution, population exposed to levels exceeding WHO guideline value, 2015 (% of total) (19)	0.35
International migrant stock, 2015 (% of population) (20)	22.96
Trust in national government, 2018 (% of population) (21)	75.06
Mobile cellular subscriptions, 2018 (per 100 people) (22)	134.93
Individuals using the internet, 2017 (% of population) (23)	90.81
Index of economic freedom, 2020 (Rank and category) (24)	84.1 – Free
World Bank classification, 2020 (25)	High income

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Gini Index (26)	--
GDP per capita, PPP, 2019 (Current international $) (27)	43,952.55
GNI per capita, PPP, 2019 (Current international $) (28)	42,710
Current health expenditure, 2017 (%) (29)	9.2
Vulnerable employment, total, 2020 (% of total employment) (30)	12.04
Vulnerable employment, female, 2020 (% of female employment) (31)	10.38
Vulnerable employment, male, 2020 (% of male employment) (32)	13.55
Homelessness, 2013 (%) (33)	0.94
Adult literacy rate (%) (34)	--
Literacy rate, adult female (% of females 15 and above) (34)	--
Literacy rate, adult male (% of males 15 and above) (34)	--
Primary school enrolment, 2017 (% net) (35)	99.12

GDP - gross domestic product; **GNI** - gross national income; **PPP** - purchasing power parity

Population health characteristics

Life expectancy at birth in New Zealand is 81.86 years (2018). (36) For males, life expectancy at birth is 80.20 years, and for females it is 83.6 years. (37, 38) Non-communicable diseases are believed to play a role in who develops severe symptoms of COVID-19. In New Zealand, the proportional mortality from cardiovascular diseases was 31%, cancers 30%, chronic respiratory diseases 7%, and diabetes 3%. (39) (See Figure 3.) The probability of dying between ages 30-70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease was 10.1% for all adults, and 11.6% and 8.6% for males and females, respectively. (40)

PROPORTIONAL MORTALITY

▶ 31% Cardiovascular diseases
▶ 19% Other NCDs
▶ 30% Cancers
▶ 5% Communicable, maternal, perinatal and nutritional conditions
▶ 7% Chronic respiratory diseases
▶ 6% Injuries
▶ 3% Diabetes

NCDs are estimated to account for **89%** of all deaths.
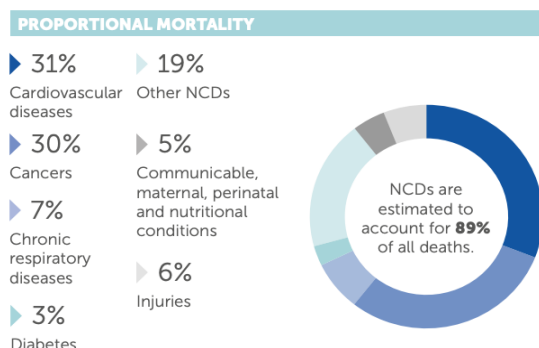
Figure 3. Proportional mortality from non-communicable diseases (NCDs) – New Zealand 2016 (39)

Table 2. Age and health characteristics for New Zealand

	Male	Female	Total
Population ages 0-14, total, 2019 (% of total population) (41-44)	493,947 (10.05%)	468,144 (9.52%)	962,090 (19.57%)
Population ages 15-64, total (% of total population) (45-48)	1,556,727 (31.66%)	1,611,757 (32.78%)	3,168,487 (64.44%)
Population ages 65 and above, total (% of total population) (49-52)	366,327 (7.45%)	420,098 (8.54%)	786,423 (15.99%)
Current tobacco use prevalence, total, 2018 (%) (53)	16.1	13.5	14.8
Raised blood pressure (Systolic blood pressure ≥140 or Diastolic Blood Pressure ≥90), ages 18+, 2015 (%) (54)	22.5	17.9	20.1
Raised fasting blood glucose (>7.0mmol/L or on medication), ages 18+, 2014 (%) (55)	9.5	7.6	8.5
Prevalence of obesity among adults (Body Mass Index ≥30), 2016 (%) (56)	31	32.9	32
Prevalence of Human Immunodeficiency Virus (HIV), 2019 (% of population ages 15-49) (57)			0.1
Bacillus Calmette-Guérin (BCG) Immunization coverage estimates (%) (58)			--
Prevalence of undernourishment, 2018 (% of population) (59)			2.5

Governance and health systems

New Zealand is a parliamentary constitutional monarchy. The Economist Intelligence Unit ranked New Zealand as 4th highest on the 2019 Democracy Index and describes New Zealand as a full democracy. (60) There is a central government and local governments, but no state/provincial governments. (61) New Zealand has a single chamber of parliament, which is the House of Representatives. (61) Members of the House are elected using a mixed member proportional representation voting system. (61, 62) Even though it is a constitutional monarchy, New Zealand does not have a constitution, rather laws passed by parliament. (62) As a result, there is no constitutional division of power for health, rather there is a statutory framework made up of 20 pieces of legislation. (63)

The New Zealand Public Health and Disability Act of 2000 established the structure for funding and organization of health services and established strategic priorities. (64) Health financing is mixed as it is mostly publicly funded but approximately one-third of the population has private insurance to help pay for noncovered services (e.g., private outpatient specialist consultations, elective surgery in private hospitals, supplementary coverage for faster access to nonurgent treatment and copayments). (65) Other key legislation is the Health Act of 1956 and the Crown Entities Act of 2004. (63) There is a central Ministry of Health and 20 District Health Boards, as well as some other health related crown entities. (63) Regional public health services are delivered by 12 district health-board owned public health units. (66, 67) These services are provided by the district health board as well as non-governmental organizations. (63, 64) New Zealand's hospital bed and intensive care capacity is less than other comparable countries. (67)

The two main political parties are the National Party (center-right) and the Labour Party (center-left). (68, 69) The Labour Party is a member of the international Progressive Alliance, which is a collective of social-democrat, socialist, and progressive political parties. (69, 70) The Labour Party has been in power since 2017. (69) An election had been scheduled for September 2020, but this was delayed until October 2020 because of the pandemic.

Table 3. Political and health system indicators for New Zealand

Fragile States Index score, 2020 (maximum 120, lower is better) (71)	17.9
Fragile States Index rank, 2020 (out of 178 countries, higher is better) (71)	173
Global Freedom score and status, 2020 (72)	97 - Free
Internet Freedom score and status, 2020	--
World press freedom index, 2020, global score (0-100, lower is better) and rank (out of 180 countries, lower is better) (73)	10.69 – Rank 9
Physician density, 2018 (physician/1,000 pop) (74)	3.59
Hospital bed density, 2013 (beds/1,000 pop) (75)	2.8

Pandemic experience and preparedness

One of the most recent defining moments for infectious diseases in New Zealand was with the influenza A (H1N1) pandemic in 2009, where there were 3,211 confirmed cases of H1N1 and 35 deaths. (76) In 2017, the New Zealand *Influenza Pandemic Plan: A Framework for Action*, was developed to replace the 2010 action plan, which had been in existence since 2002 (77). Significant revisions were incorporated to reflect the lessons learned from the H1N1 response, particularly for Māori and Pacific populations who experienced a higher rate of morbidity than other ethnic groups. (77) The plan recognized the need to consider the specific needs of vulnerable populations in all stages of pandemic planning and at various levels of government. (77) The plan also addressed the need for an all-of-government response that includes effective coordination, cooperation, and leadership. (77). The strategy outlined in the plan had six phases: plan for it, keep it out, stamp it out, manage it, manage it – post peak, recover from it. The plan noted that the *keep it out* and *stamp it* out approaches were in keeping with a containment strategy. New Zealand's pandemic response was also guided by the *National Health Emergency Plan (2015)*, which provides overarching guidance for a response. (77) New Zealand's most recent *National Hazardscape Report* was created in 2007. (78) This report includes a section on infectious human disease pandemics, which covers potential threats, impacts, and the Ministry of Health's strategy for managing a pandemic. (78) In the 2019 Global Health Security Index, New Zealand received a score of 75 out of 100 in the rapid response category for the emergency preparedness and response indicator. (79)

New Zealand has a network of private and hospital-based labs. (80) As part of the country's pandemic preparedness efforts, New Zealand developed laboratory guidelines that identify pandemic influenza referral laboratories and measures for laboratory surge capacity to ensure that services would be able to meet nationwide demands. (81)
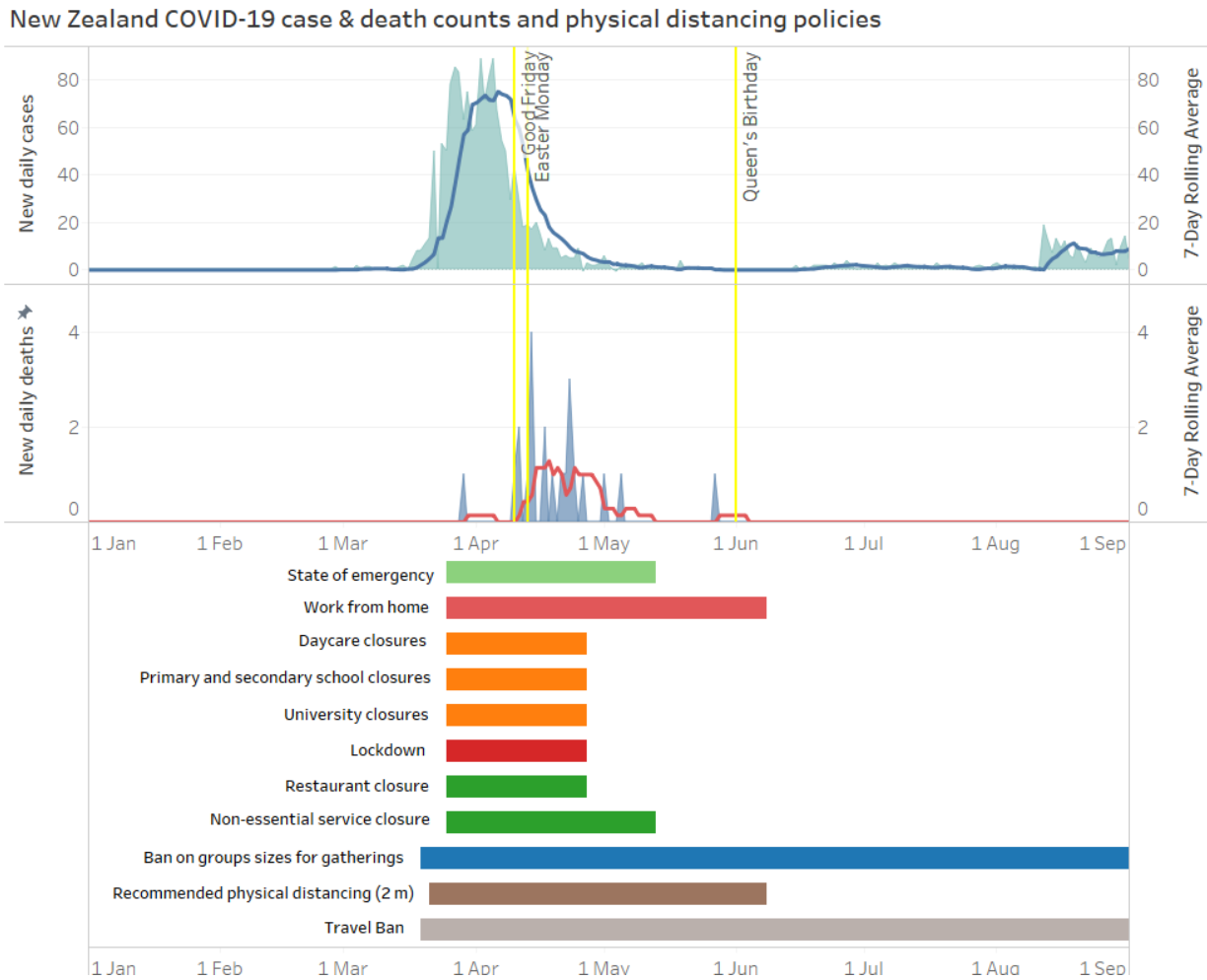
B. Policies and epidemiology

Cases and social distancing policies

New Zealand's first case of COVID-19 was recorded on February 28, 2020. (82) An Epidemic Preparedness (COVID-19) Notice was issued on March 25, 2020, which activated emergency response powers and a National Emergency was then declared by the Minister of Civil Defence; at that time, there were 283 cases and 0 deaths. (82, 83, 84) As of August 30, 2020, there were 1,729 cases and 22 deaths in New Zealand. (82) Figure 4 shows the number of daily cases and deaths in New Zealand and dates for selected policies from January to September 30, 2020.

Figure 4. Number of reported COVID-19 cases and deaths in New Zealand with select policies from January to September 30, 2020

New Zealand COVID-19 case & death counts and physical distancing policies

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Description of events in New Zealand

The main spokespeople for New Zealand's COVID-19 response have been Prime Minister Jacinda Ardern and Dr. Ashley Bloomfield, Director-General of Health, who almost always appeared together at a daily press conference. (67, 85, 86) The Health Minister David Clark, who also played a critical role in the first months of the response, stepped down on July 1, 2020 in response to public criticism of his performance during the pandemic, being described as a "liability", and his personal breaches of the country's strict lockdown measures. (87) Education Minister Chris Hipkins was appointed the interim Health Minister until the October election. (87) Peter Crabtree, from the Ministry of Business, Innovation and Employment coordinated the development of government strategy and policy response. (67) The government noted that its policies would be driven by science, and infectious disease experts and epidemiologists were invited to join a COVID-19 technical advisory group and offered advice to the government on its response to the emerging threat. (67) Health professionals (e.g., nurses) also provided regular guidance to government to help ensure that front line worker needs were met. (88) While the government teams lead strategy development, the phrase "team of 5 million" was used extensively in communication by Prime Minister Arden to recognize that the response to the COVID-19 pandemic required the commitment of all citizens in the country. (67, 88) This phrase was then picked up and became a common mantra in the response. (88)

Initially, New Zealand followed what can be called a *mitigation* strategy. (89) However, in March, New Zealand changed course and committed to an *elimination* strategy, as the evidence in China, Taiwan, Hong Kong, and South Korea suggested that COVID-19 could effectively be contained. (89, 90) The observed differences between transmission dynamics of influenza vs. SARS, the apparent challenges with the use of mitigation approaches to manage SARS-CoV2 in countries like Italy, and recognition of the limitations of the New Zealand health system capacity all reinforced the belief that an elimination strategy was a better approach for New Zealand. (89, 90, 91) This new strategy was introduced on March 21, 2020 with the objective of eliminating chains of community transmission for a minimum of 28 days and containing any future cases that were imported from overseas. (92) There were four pillars to the elimination strategy. The first was border controls including the use of quarantine. (92) The second was case detection and surveillance, including testing of people with symptoms as well as sentinel testing with the wider population. (92) The third strategy was contact tracing and quarantine. The fourth was community control measures, including physical distancing, good hygiene, staying home when sick, and use of personal protective equipment when required. (92)

In response to the emergence of the novel coronavirus, the Prime Minister activated the National Security System on January 27, 2020, one month before the first COVID-19 case in New Zealand. (67) The first documented cases of COVID-19 in New Zealand were travel-related, and not many New Zealand residents were directly affected by COVID-19 until mid-March when it became clear that community transmission had started to occur. (90, 93) On March 14, 2020 travellers from jurisdictions other than the Pacific were required to isolate for 14 days. (94) On

March 19, 2020, borders and ports of entry were closed to non-residents. (94) Although borders continue to be closed, citizens of New Zealand can return to the country but are legally obligated to complete 14 days of managed isolation or quarantine. (95, 96, 97) Government-managed isolation centres, which are rented hotels, were established in five key locations: Auckland, Christchurch, Rotorus, Wellington and Hamilton. (67, 98)

On March 19th, when there were 28 cases of COVID-19, indoor gatherings of 100 were banned. On March 21st, when the elimination strategy was announced, the government introduced a new four-level alert system, with Alert Level 2 being enacted immediately; Level 2 introduced physical distancing (2 meters expected; 1 meter in "controlled environments") and group size restrictions. (94) On March 23rd, when case numbers reached 100, the Prime Minister announced a shift to Alert Level 3, with notice that 48 hours later, on March 25th, Alert Level 4 would be enacted, which required a strict countrywide lockdown. (83, 90, 94) At Alert Level 4, facilities such as school, daycares, non-essential services, and restaurants were closed, and elective medical and dental procedures were suspended. (84, 94, 95, 96, 99). Vulnerable populations (e.g., persons with underlying medical conditions, immunocompromised, over the age of 70, resident of aged care facilities, ethnic minorities, history of smoking or pregnant) were also instructed to remain indoors/ isolated. (84) Mask wearing was recommended where physical distancing was not possible and if there was contact with someone outside of a person's bubble. (100) Thus, the shift from announcement of the elimination strategy and level system to a full "lockdown" occurred within less than a week.

Gathering restrictions fluctuated according to the Alert Level that was in effect at the time. At Alert Level 4, social interaction is curtailed and other than for essential travel, people need to stay at home in their own bubble and public gatherings are not permitted. (84) At Alert Level 3, public venues are closed, only essential services are open, business that require close contact are closed, work from home is recommended, and people are required to maintain a home bubble and limit interactions to this bubble, with some exceptions, when outside of work or school. (84). While schools can open, learning at home is recommended. (84) Up to 10 people are permitted for wedding services, funerals and tangihanga (Māori traditional funeral rites). (84, 94). At Alert Level 2, domestic travel is permitted and groups of up to 100 are allowed. (84)

To reduce the economic impact of COVID-19 on workers and businesses, New Zealand implemented and extended economic relief policies. (101) For example, starting March 1, 2020, people that had recently lost their jobs were able to apply for the Income Relief Payment program. (84) To stimulate the economy, the New Zealand Government developed a fiscal package worth NZ$16.3 billion, which included wage subsidies for impacted businesses, COVID-19 sick leave and self-isolation support, and income support for vulnerable populations. (101) Economic policies were implemented such as increasing the minimum wage by $1.20 ($0.96 for new employees), rental freezes and mortgage deferrals for six months, and the measures aimed at preventing tenants from being evicted. (84, 101) Due to the impact of COVID-19 Public Health guidance on essential businesses, an essential worker leave scheme was developed.

(102). The scheme became available on April 6, 2020 and was expected to remain available for the duration of Alert Level 4 and reviewed after eight weeks. (102)

On April 27, 2020, after five weeks in lockdown, the number of COVID-19 cases in New Zealand was declining and the nation decreased to Alert Level 3. (90, 94) While daycares and schools were able to open, learning from home was encouraged. (84) However, if an educational facility was connected to a confirmed or probable case of COVID-19 it was legally required to close temporarily. (84) Restaurants were able to open for takeaway, delivery or drive through only. (95). While healthcare services were able to return to normal activity, dental services remained limited due to uncertainty about what dental treatment could be offered at each Alert Level as well as challenges in acquiring personal protective equipment. (84, 103) Public concerns regarding price gouging were directed at dentistry services, which may have been in relation to the cost and access to personal protective equipment. (103, 104)

On May 11, 2020, Prime Minister Ardern outlined the plan to move to Alert Level 2, which took effect on May 13, 2020, which is when the State of National Emergency ended. (94) A gradual lessening of restrictions led to two different start dates for daycares, upon which they partially opened initially and fully opened weeks later. (84) Primary and secondary schools were open for all age groups and universities opened campuses and residences with social distancing measures and log-in practices for visitors. (105) However, some universities (University of Auckland, Lincoln University, and Victoria University of Wellington) continued to teach online while campuses were open for studying. (105) Businesses were able to open to the public if they followed public guidance including physical distancing and record keeping. (84) On May 20, 2020 the Ministry of Health released the NZ COVID Tracer app to enhance contract tracing capabilities nationwide.

On June 8, 2020, New Zealand declared itself COVID-19 free and decreased to Alert Level 1, at which time social distancing measures, while no longer required, were still encouraged. (84, 94, 106) At Alert Level 1, the use of masks is still mandatory on all public transport, including taxi/ride share, buses, trains, and planes, with some exemptions (e.g., children under 12). (100) Vulnerable populations were not required to isolate but were encouraged to continue to take precautions. (84) Restaurants, cafes, and bars could have as many people on their premise as they wanted but they were legally obligated to have a QR code poster on display to enable contract tracing via the NZ COVID Tracer app. (84) All quarantine requirements were still in effect for anyone returning to New Zealand, with known or suspected COVID-19, or if a person had been in contact with someone with COVID-19. (97, 107, 108).

New Zealand remained COVID-19 free for 102 days. On August 11th, 4 new community cases of COVID-19 were identified and on August 12th, the Auckland region moved back to Alert level 3, while the remainder of the country moved back to Alert Level 2. (94) On August 30th, Auckland moved to Alert Level 2, with some additional restrictions on travel and gatherings. (94) By October 7, 2020, all regions had moved to Alert Level 1. (94)

Throughout the pandemic, public transportation remained available, but restrictions applied based on the Alert Level. Social distancing and the recommendation to not board/ travel if experiencing any flu-like symptoms or if positive for the virus remained in effect. (109) Loose guidance from the Ministry of Health recommended that passengers consider frequently touched surfaces as dirty and to therefore perform cleaning/ sanitizing practices. (110). At night, buses were 'fogged' or sprayed down (Auckland 'fogs') with disinfectants. (110) The New Zealand Transport Agency communicated that public transportation was safe at all Alert Levels as transport operators continued to follow Ministry of Health cleaning guidance: vehicles were regularly treated with disinfectant and high contact surfaces were regularly cleaned during the day. (111).

A noted feature of an elimination strategy, compared to a mitigation or suppression strategy, is that it offers an early and more predictable exit strategy to the pandemic. (89) Due to New Zealand's aggressive approach, the country was able to rapidly control community transmission, and this prevented the country's healthcare system from becoming overwhelmed and allowed for a quicker return to regular day to day norms and activities compared to jurisdictions that took a mitigation, suppression, or herd immunity approach. (89, 90, 112) An elimination strategy requires significant border management efforts, use of quarantine, and contact tracing and isolation if new cases emerge. (89, 92) Further, the strategy required and was supported by strong communications campaign that launched on March 18th, branded "Unite Against COVID-19" and a new government website (https://covid19.govt.nz/) was set up to provide a trusted source of information. (67) Several individuals both inside (e.g., Prime Minister Jacinda Ardern and Dr. Ashley Bloomfield, Director-General of Health) and outside of government (e.g., Dr. Siouxsie Wiles, a microbiologist and science communicator, and Dr. Michael Baker, an epidemiologist) have been widely recognized for their strong and effective communications skills, which generated public support for the elimination strategy. (86, 88). Dr. Wiles collaborated with animator Toby Morris to visually explain COVID-19 issues; their work has garnered international attention and been used by other governments and WHO.

Management of challenges in the response

Early in the response, district health boards and public health units were responsible for their own procurement of supplies, including labs supplies for testing and PPE, both of which ended up being in short supply. (67, 88) In addition to there not being enough PPE, what was available was not always in the place it was needed. (88) In March, the Ministry of Health took action to help manage health supply chains and helped to build an appropriate stockpile, but this took time. (67) To address the initial shortage of PPE, the Ministry of Health allocated available PPE based on need. (67) Additionally, the staffing levels in public health units was not able to meet the growing demand for contract tracing, and further, there was no central system or process for managing contract tracing data. (67) In response, the Ministry of Health created a central contract tracing centre and implemented new data management processes. (67, 88) While the

number of contacts to trace was reduced by the Level 4 lockdown, the need for a robust and efficient contact tracing system was a critical component of an elimination strategy to effectively deal with any new cases that might emerge. (92, 67) Further, to help ensure sufficient medical staff were available to support the response, the Ministry of Health put out a call to medical professionals who were not clinically active to sign up for a surge workforce. (88)

Other kinds of challenges were also experienced. In April 2020, concerns regarding price gouging for some products (e.g. shelf life and sanitization products) became an issue that gained media attention and spurred the development of a government watchdog, which was assigned to monitor the situation. (104, 113) The Fair-Trading Act, which is intended to prevent unfair or unrepresented price increases, was also leveraged to ensure businesses could justify price increases. (114) Some New Zealanders also hoarded products (e.g., toilet paper) because they thought that they would be put into isolation like other countries, whereas others hoarded because they saw others hoarding. (115) As a result, nearly twice the normal amount of groceries were purchased prior to the lockdown as well as an increase in the purchase of weapons. (91) The increased purchase of certain items increased dramatically: toilet paper, 87%; household cleaners, 78%; canned food, 67%; and, medicine, 20 %. (116) As a result, the government reassured New Zealanders that the country's supply chain was strong and requested that individuals practice normal shopping habits. (116)

New Zealand has also been impacted by misinformation and conspiracy theories. For example, a French conspiracy website called Les Moutons Enragés suggested a connection between 5G technology and the coronavirus pandemic noting that 5G towers had been installed in Wuhan in 2019 before the outbreak. (117, 118) Within days, a local doctor suggested that this conspiracy theory could explain coronavirus outbreak in an interview with the Belgian newspaper Het Laatste Nieuws, which was taken down within hours of publishing. (118) Nevertheless, the spread of misinformation on social media resulted in cell towers being set on fire across Europe and 16 cell towers being attacked in New Zealand. (118, 119)

Disproportionately affected populations

The elderly in care homes were disproportionately affected by COVID-19 in New Zealand. Clusters of cases of varying sizes (13-56 people) were identified in aged residential care facilities in Auckland, Christchurch and Waikato, with clusters being defined as "10 or more cases connected through transmission and who are not all part of the same household." (112) As of November 9, 2020, New Zealand had reported a total of 17 clusters, five of which were related to aged resident care facilities. (112) While only 6.5 percent of COVID-19 cases occurred in persons 70 years of age and older, this population accounted for 42.9 percent of total COVID-19 related hospitalizations and 80 percent of total deaths. (112) In addition to direct COVID-19 impacts, there were indirect impacts as result of the lockdown, which included an increase in domestic violence in the home. (88)

Comparisons with other country responses

There are many concerns in trying to compare countries' responses to COVID-19. This is shaped by limitations of the data itself and differences in contextual factors. A separate paper by this working group describes limitations of COVID-19 data. (Submitted) Table 4 presents a list of countries included in this project and their use of different physical distancing policies.

Table 4. Comparative national-level responses to COVID-19 by country – updated August 21, 2020 (filled in means policy was implemented)

Column headers (left to right): AUS, BGD, BRA, CAN, CHN, CUB, DNK, DJI, EGY, ENG, FRA, GHA, IND, IRN, IRE, KAZ, NDL, NZL, N-IR, PAK, RUS, SCL, SLE, SGP, KOR, SRI, UAE, VN, WLS

Category	Policy
Government	State of emergency
Case Management	Recommended self-isolation after travel
	Recommended self-isolation for cases
	Recommended self-isolation for symptoms
	Recommended self-isolation for contacts
	Separation of cases or suspected cases within institutions
Closure	Non-essential service closure
	Closing restaurants
	Suspended elective medical/dental procedures
Detection	Surveillance systems
	Contact tracing
	Assessment centres
	Drive through testing centres
	Mass fever screening in public transportation
Economics	Economic relief policies for individuals/families
	Economic relief policies for businesses
	Housing economic relief
	Anti-hording
	Anti-price gouging
Education	School closure - daycare
	School closure - elementary school
	School closure - high school
	University closure
Health Workforce	Health workers allowed to only work at one site
	LTC Health workers allowed to only work at one site
Healthcare Resources	Audio/video telehealth
	Telehealth access to prescription medication
Physical Distancing	Physical distancing recommendation
	Ban on group size
	Quarantine orders after travel
	Quarantine orders for cases
	Quarantine orders for contacts
	Isolation for vulnerable populations
	Work from home/remote work
	Recommended use of masks/PPE for public
	Required use of masks/PPE for public
	Quarantine for "at risk" or priority neighbourhoods
	Lockdown
Public Decontamination	Public decontamination transit
	Public decontamination streets
Travel bans	International bans for non-essential travel
	Screening at airports/borders
	Closing public transportation

AUS–Australia, **BGD**–Bangladesh, **BRA**–Brazil, **CAN**–Canada, **CUB**-Cuba, **DNK**–Denmark, **DJI**–Djibouti, **EGY**-Egypt, **ENG**-England, **FRA**-France, **GHA**-Ghana, **IND**-India, **IRN**-Iran, **IRE**-Ireland, **KAZ**-Kazakhstan, **NDL**-Netherlands, **NZL**- New Zealand**, NIR**-Northern Ireland, **PAK**-Pakistan, **RUS**-Russia, **SCL**-Scotland, **SLE**-Sierra Leone, **SGP**-Singapore, **KOR**-South Korea, **SRI**-Sri Lanka, **UAE**-United Arab Emirates, **VN**-Vietnam, **WLS**-Wales

IV. Discussion of main findings, limitations, and next steps

New Zealand has a population of 4,822,233, with 1,986 reported cases and 25 deaths as of 9 November, 2020. (13, 82) Given that the arrival of first cases of COVID-19 in New Zealand came later than in other countries, New Zealand was able to benefit from watching the experience of others, including seeing how the lockdown in China worked to eliminate the virus, as well as how a mitigation approach in Italy led to spread of the virus, overwhelmed hospital systems, and higher death rates, particularly with the elderly. New Zealand's decision to commit to an elimination strategy early on in the pandemic proved to be quite successful in controlling community transmission and preventing the healthcare system from being overwhelmed. (112) Part of this success can be attributed to strong empathetic leadership from Prime Minister Ardern, clear and consistent communication via the COVID-19 Alert System, and risk-based decision-making. (90) There was also strong advocacy for an elimination strategy from the scientific community, who continued to offer advice to the government. Most sources of the virus came from overseas, which prompted the government to impose strict border restrictions as well as quarantine and isolation protocols to prevent further spread into the community.

However, due to the nation's quick action at the onset of the pandemic some limitations in data may exist in terms of fully assessing New Zealand's capacity to respond to large-scale community transmission or a large surge of COVID-19 cases. While New Zealand experienced challenges with price gouging and misinformation, national strategies and preparedness to address these issues on a larger scale in the future are currently unknown. (104, 113, 118) New Zealand implemented several economic programs and policies to stimulate the economy. However, the long-term effects and sustainability of these programs has yet to be realized. This may be a limitation in the data provided in this case report as those impacts will take time to be better understood.

The COVID-19 pandemic has highlighted the need for a robust public health system in New Zealand, and there have been calls for implementation of a national public health agency.

Conclusions

Through strong leadership, effective policies and risk-based decision-making, New Zealand has experienced fewer cases of COVID-19 and deaths, compared to other countries. As a result, the country has safely decreased from lockdown to Alert Level 1, while remaining cautious of a potential increase in cases. When three new cases were detected in February 2021, they were quickly contained and managed. Recognizing that travel and the potential for imported cases pose the highest risk to the nation, strict border measures and quarantine regulations remain in effect. Also, to prepare for a potential increase in community spread, New Zealanders are encouraged to maintain physical distancing practices, use the national contact tracing app, and exercise good judgement if experiencing symptoms.

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