Clinical and epidemiological characteristics of COVID-19 in Wellington, New Zealand: a retrospective, observational study

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ABSTRACT

AIMS: To review the demographic and clinical characteristics of confirmed COVID-19 cases within the Greater Wellington Region (GWR).

METHODS: A retrospective, observational study of all 96 confirmed COVID-19 cases in the GWR. The primary outcome was time taken from onset to complete resolution of symptoms. Secondary outcomes were the epidemiological and clinical characteristics of cases.

RESULTS: The mean (SD) time from symptom onset to complete resolution was 19.1 (1.1) days. The mean (SD) age was 43.1 (16.9). 51% were male. The majority were of European ethnicity (84%), resided in the top five decile neighbourhoods (76%) and had travelled to New Zealand (69%). The mean (SD) time from onset of symptoms to obtaining RT-PCR testing results was 5.3 (0.4) days. The most common symptoms at onset were cough (36%), sore throat (22%) and fatigue (21%); the overall most common symptoms were cough (65%), sore throat (43%), headache (43%) and fatigue (42%); many symptoms were late manifestations. The most common co-morbidity reported was asthma (20%), with no reported exacerbations. The rate of secondary infections within households was 0.05 per primary infection.

CONCLUSION: The demography of COVID-19 cases reflected the imported nature of cases. The clinical presentation of COVID-19 was highly variable and there were no particular symptoms that could accurately predict infection.

The COVID-19 pandemic has constituted a Public Health Emergency of International Concern,[1] with New Zealand having reported its first case of COVID-19 on 26 February 2020.[2] While clinicians, researchers and authorities have been characterising the nature of COVID-19, the majority of data on COVID-19 has been limited to patients presenting or admitted to hospital and intensive care,[3–6] which provides invaluable data on disease progression in severe disease, but it only represents a minority of cases. It is estimated that 80%[7] of confirmed COVID-19 cases experience a mild course of disease and therefore are likely to be managed in the community.

The lack of knowledge surrounding the time-course, duration and progression of COVID-19 in mild cases poses challenges not only to those immediately affected, but also to the public health services charged with developing guidelines for the management of confirmed mild cases in the community.[8] It is therefore imperative that the progression of disease at the milder end of the spectrum is explored to fill this gap in knowledge.

New Zealand's burden from COVID-19 has been markedly lower than all other comparable Organisation for Economic Co-operation and Development (OECD) nations, with a lower rate of cases, related hospital admissions and deaths.[9] New Zealand managed to eliminate COVID-19 (defined as an absence of transmission in the community for at least 28 days[10]) for 102 days prior to the "second wave" that surfaced in Auckland in August 2020. The Greater Wellington Region (GWR), where this study was undertaken, remained free of community transmission until the recent outbreak in August 2021.

A combination of geographic isolation, early border restrictions, nationwide lockdown, managed isolation and widespread testing has meant that New Zealand's epidemic curve plateaued at a significantly earlier date from the first confirmed case compared to many other nations.[11] The smaller number of cases prevented an overwhelmed health sector and appropriate testing and contact tracing measures were able to be undertaken in a transparent and systematic way.

In this community-based review of all confirmed cases of COVID-19 within the GWR, we report the demographic and clinical characteristics of COVID-19 cases. With the recent publication of the comprehensive national epidemiological study of all COVID-19 cases in New Zealand,[12] we have focused on the data that complements the national study. This includes information on the time course of disease from onset to resolution, the difference in symptoms at onset versus throughout the disease, the frequency of exacerbations of asthma, the rates of secondary infection within households and the countries from which cases were imported.

Methods

This was a retrospective, observational study of confirmed COVID-19 cases managed in the community by the Regional Public Health Unit (RPH) in the GWR between 1 January and 1 August 2020. The GWR consists of three district health boards (DHBs), Capital and Coast DHB, Hutt Valley DHB and Wairarapa DHB, serving a population of 506,814 (10% of New Zealand's population).[13] A confirmed case of COVID-19 was defined as one with laboratory definitive evidence.[14] Given the evolving nature of the pandemic, there was no pre-determined sample size. All confirmed cases were included in the analysis.

Ethics approval

This study was approved for conduct with a waiver of patient consent by the New Zealand Northern B Health and Disability Ethics Committee (reference 20/NTB/109). The request for waiver of consent was granted by the Ethics Committee as the study aimed to re-use existing data that have already been collected and were also in line with the privacy law criteria.[15]

Patient and public involvement

Neither patients nor the public were involved in the design, conduct, reporting or dissemination plans of our research.

Data

The list of confirmed cases was obtained from New Zealand's national notifiable disease surveillance database, EpiSurv. Data relating to cases were collected from existing patient records held by the RPH and three DHBs. As part of daily monitoring, RPH staff contacted all cases daily by phone to ascertain self-reported symptoms, duration and resolution. Data on co-morbidities and smoking status were included if they were recorded in existing RPH/DHB records. All available data were analysed and missing data were not imputed. Data were entered directly into the REDCap database—a secure, United States Health Insurance Portability and Accountability Act 1996 (HIPPA)-compliant web-based application,[16] hosted and supported by the Medical Research Institute of New Zealand (MRINZ).

Bias

This was a retrospective study collecting existing data and therefore susceptible to potential information bias and missing data.

Statistical methods

Data descriptions for continuous and ordinal variables are mean and standard deviation (SD), median and inter-quartile range (IQR) and minimum (min) to maximum (max). Data descriptions for categorical variables are by counts and proportions expressed as percentages. Data descriptions for survival data are by Kaplan-Meier survival curves and estimates of 25th, median and 75th percentiles of survival.

Table 1: Definition of variables.

Variable	Definition
Ethnicity	As per EpiSurv and reported as Prioritised output using Level 1 codes defined by the Ministry of Health.[17]
Occupation	As per EpiSurv and classified at Level 1 of the Australian and New Zealand Standard Classification of Occupations (ANZSCO).[18]
Deprivation	The NZDep[18,19] is an area-based measure of socioeconomic deprivation in New Zealand based on a composite score for each meshblock (smallest geographical area defined by Statistics New Zealand) determined using EpiSurv data.
Likely source of infection[20]	1. Imported cases: cases with a reported history of international travel within 14 days of onset. 2. Imported related cases: cases that had a reported link (close contact or epidemiological link) to an imported/overseas acquired case. 3. Locally acquired cases, epidemiologically linked: cases that had a reported link (close contact or other epidemiological link) to a locally acquired case with unknown source. 4. Locally acquired cases, unknown source: cases that had no reported history of international travel within 14 days of onset and no recorded epidemiological link to a source case.
Resolution of symptoms	The date on which a case had been asymptomatic (absence of acute symptoms) for the preceding 48 hours.
Severe exacerbation of asthma	Presentation to an emergency department or other hospital unit during the 28-day period from onset of symptoms.[21] Admission was defined as hospitalisation for at least four hours.
Severe exacerbation of chronic obstructive pulmonary disease (COPD)	Presentation to an emergency department or other hospital unit during the 28-day period from onset of symptoms.[22,23] Admission was defined as hospitalisation for at least four hours.
Secondary household infection	If a household member living with a confirmed COVID-19 case, received a diagnosis of COVID-19 within 14 days of the initial household member getting unwell, this was defined as secondary household infection.

Data descriptions for count data are by rates and total counts in relation to observation time and/or primary infections. Kaplan-Meier plots of survival were used to determine time to resolution of symptoms and recovery. SAS version 9.4 was used.

Results

Baseline characteristics

All 96 confirmed cases of COVID-19 in the GWR during the study period were included in the analysis. Ninety-four cases presented to either their general practitioner or a community-based assessment centre (CBAC) for testing following onset of symptoms. Two cases were tested as part of the managed isolation exemption protocol.

The mean (SD) age of cases was 43.1 (16.9). Fifty-one percent were male and the majority were recorded as being of European ethnicity (84%) (Table 1). Forty-three percent of cases were employed in professional and managerial jobs, 25% lived in decile 1 areas (the least deprived 10% of areas in New Zealand) and 9% were healthcare workers.

Clinical characteristics

Of the 96 cases, one was asymptomatic and not been included in this analysis. The most common symptoms at onset were cough (36%), sore throat (22%), fatigue (21%) and fever (19%), and the most common symptoms overall were cough (65%), sore throat (43%), headache (43%) and fatigue (42%) (Figure 1). Approximately two-thirds of cases experienced two or more of the four most common symptoms during their illness, and only five cases experienced all four most common symptoms. Myalgia and altered sense of smell and taste were each experienced by approximately a third of cases. Gastrointestinal upset was a late onset manifestation accounting for only 1% of symptoms at presentation; but over time, 16% of cases developed diarrhoea and 10% of cases vomiting or nausea. Eleven cases had a recrudescence of symptoms and all but one tested negative on repeat testing. The mean (SD) time taken from onset of initial symptoms to obtaining RT-PCR testing results was 5.3 (0.4) days.

The mean (SD) time taken from onset of symptoms to resolution of acute symptoms was 19.1 (1.1) days (Figure 2) with 75% of cases reaching complete resolution in 23 days (95% CI: 19 to 32) after onset.

Seven of the 12 cases that presented to hospital were admitted. Two of these admissions were from aged residential care facilities. The mean (SD) length of stay in hospital was 11.4 (4.6) days. The majority of admissions (71.4%) were in males and had a mean (SD) age of 63.23 (21.3). Two of the admitted cases who were within the 76–85 age group died in hospital.

The most common co-morbidity reported was asthma (19.8%), followed by cardiovascular disease (15.6%), malignancy (6.3%) and liver disease (2.1%). There were no severe exacerbations of asthma or COPD. Data on obesity was poorly reported, with six cases having obesity recorded in their medical records. Seven cases (10.9%) were active smokers and 14 (21.9%) were former smokers.

Source of Infection

The majority of COVID-19 infections (69%) were in people who travelled to New Zealand from overseas via international flights (Figure 3). Two cases were linked to a cruise ship. The most common country of origin of imported cases was the United Kingdom (n=28, 42.4%), followed by United States of America (n=17, 25.8%). Two additional cases were related to imported cases, and 25 infections (26.0%) were locally acquired and epidemiologically linked. Three cases (3.1%) had no identifiable source of infection. The rate of secondary infections within households was low, at 0.05 secondary infections per primary infection.

Discussion

In this study we explored the clinical and epidemiological characteristics of consecutive COVID-19 cases in the community. The mean time from symptom onset to resolution of acute symptoms was 19 days, with a tail in which the duration of symptoms lasted at least six weeks. The majority of cases were middle aged, European descent, higher socioeconomic background and related to travel, which mirrored the characteristic of cases in the national study, and therefore our data are likely to representative of the New Zealand COVID-19 cases.[24]

The ethnic make-up of the Wellington cases is of interest as Māori have histori-

Figure 1: Symptoms of COVID-19 cases at presentation and during the course of illness.

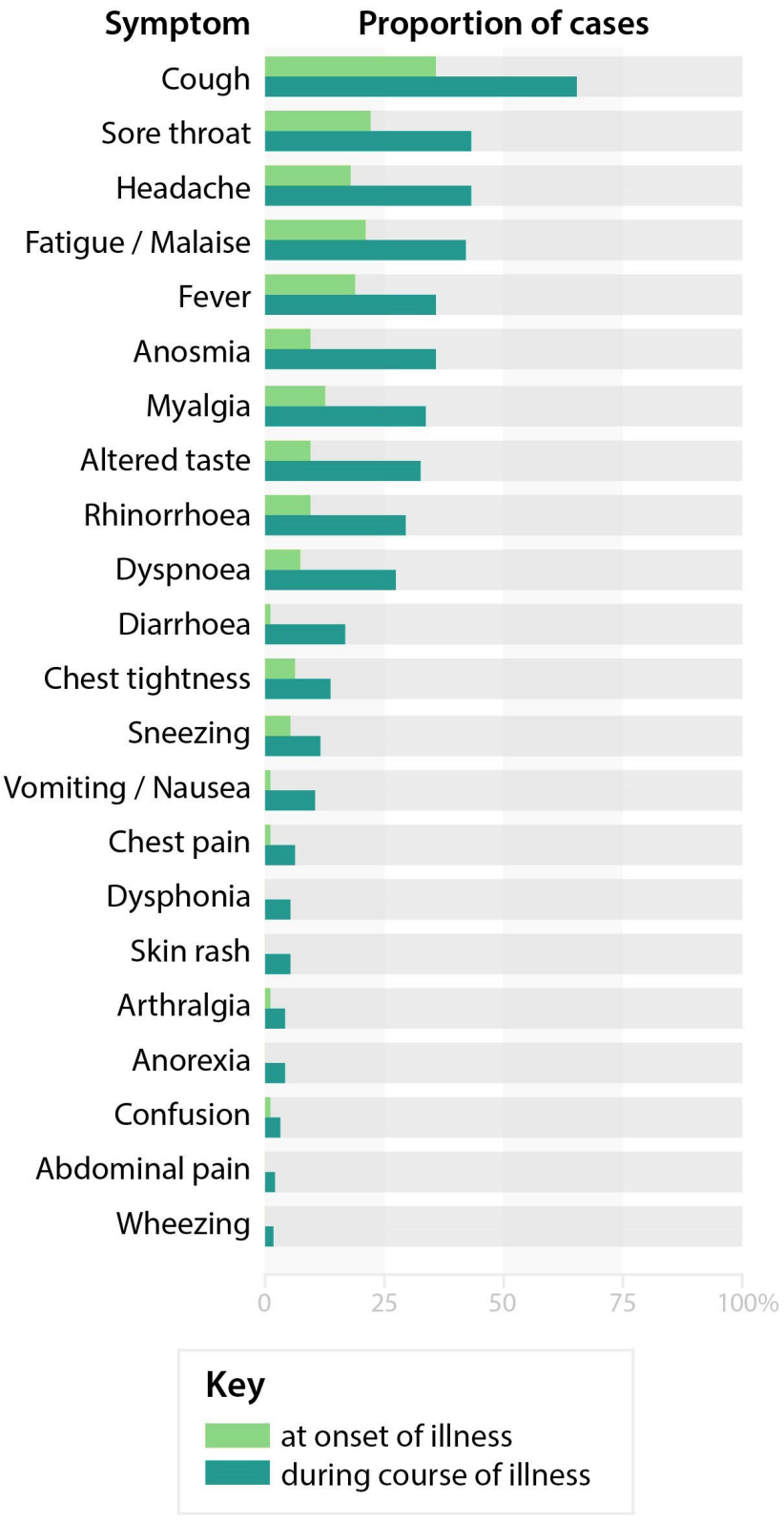

Figure 2: Kaplan-Meier curve showing time taken from onset to resolution of acute symptoms.

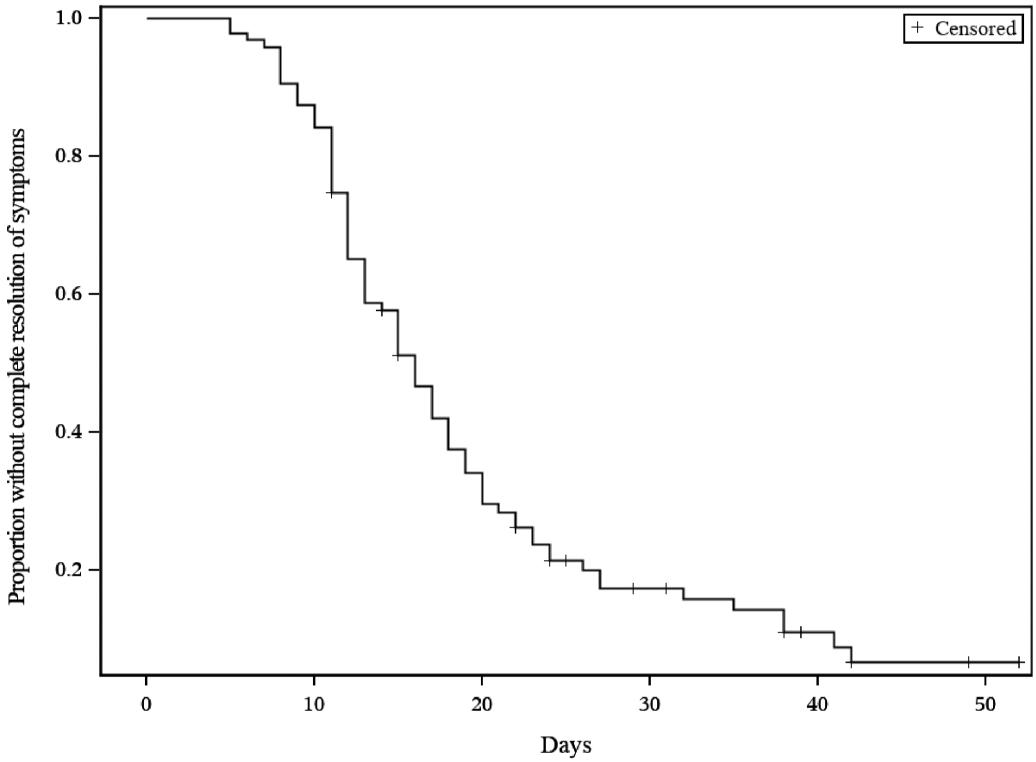

Figure 3: Map of entry route for imported COVID-19 cases, Wellington, New Zealand.

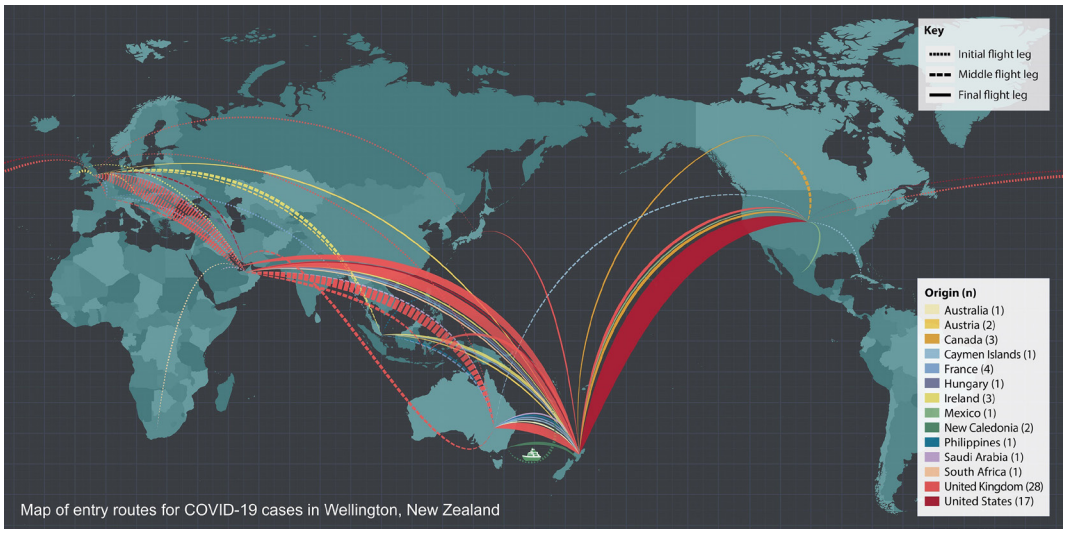

Table 2: Baseline characteristics of COVID-19 cases.

Variable (N=96)	N (%)
Sex: Female	47 (49.0)
Age	
0–19	4 (4.2)
20–39	40 (41.7)
40–59	36 (37.5)
60–79	15 (15.6)
80 and above	1 (1.0)
Ethnicity	
Māori	7 (7.3)
Pacific Peoples	2 (2.1)
Asian	5 (5.2)
Middle Eastern/Latin American/African	1 (1.0)
European	81 (84.4)
Occupation	
Managers	12 (12.5)
Professionals	29 (30.2)
Technicians and trades workers	6 (6.3)
Community and personal service workers	9 (9.4)
Clerical and administrative workers	7 (7.3)
Sales workers	3 (3.1)
Machinery operators and drivers	3 (3.1)
Labourers	4 (4.2)
Retired	7 (7.3)
Student	5 (5.2)
Unemployed	11 (11.5)
Healthcare and support workers	9 (12.3)

Table 2: Baseline characteristics of COVID-19 cases (continued).

Variable (N=96)	N (%)
New Zealand Index of Deprivation decile	
1	24 (25.0)
2	17 (17.7)
3	15 (15.6)
4	12 (12.5)
5	5 (5.2)
6	9 (9.4)
7	9 (9.4)
8	5 (5.2)
9	0
10	0

cally fared poorly in pandemic respiratory illnesses compared to New Zealand Europeans, with higher rates of death[25,26] and hospitalisations.[27] This study found that, during the first wave, Māori comprised only 7% of Wellington cases (with no deaths) and 8% of cases across New Zealand,[20] which contrasts with the national Māori population of 16.5%.[28] This has been attributed to the higher rate of European New Zealanders returning with COVID-19 infection from overseas.[29]

Consequently, only 24% of Wellington cases were in the lower five deciles. The New Zealand Index of Deprivation considers the "living space" (number of people living in equivalised households below a bedroom occupancy threshold). The majority of cases that were in less deprived areas, and therefore in less crowded housing, could have arguably been able to isolate better and result in the reduced household transmission of 0.05 secondary infections per primary infection. A strong public health mitigation framework with timely lockdowns, early border restrictions, mandatory quarantine of international arrivals and clear communication of risk, as seen in Wellington and in New Zealand overall during the first wave, minimised transmission from arriving travellers to vulnerable communities.

The mean age of COVID-19 patients (43.1 years) was similar to that of the positive community cases in Reykjavik, Iceland (44.4 years).[30] However, our hospitalised cases tended to be younger (63.2 years) compared to other hospital COVID-19 cohorts in the United Kingdom (73 years),[31] but both deaths occurred in the 76–85 age group. This was in keeping with the mean age of 81.5 years among the 22 COVID-19 deaths nationally.[24] Increasing age has been associated with increased risk of mortality with people aged 80 or over having a more than 20-fold-increased risk compared to 50–59-year-olds.[32] Our hospitalised cases also had a longer length of stay (11.4 days) compared to the median five days of hospital stay in countries outside China.[33] China had a median length of stay of 14 days. Wellington's longer stay may have been in part due to availability of beds and the system not being under pressure from COVID-19.

The frequency of symptoms in COVID-19 cases in Wellington were similar to those exhibited by positive community cases across New Zealand[24] and Iceland.[30] In Wellington, the most common symptoms overall were cough (65%), sore throat (43%), headache (43%) and fatigue (42%). Fever (36%) and dyspnoea (27%) occurred less commonly than in hospital cases,[31] which probably reflected the differences in severity of disease. Anosmia (36%) and ageusia (33%) were more prevalent in the Wellington cohort compared to those who reported either anosmia or ageusia (2.2%) in the Icelandic cohort. In many cases, specific symptoms such as dyspnoea, rhinorrhoea, diarrhoea, nausea and vomiting were late manifestations of the illness. Although this study lacks a control group to determine the predictive value of symptoms, our findings suggest that there was no characteristic symptom or cluster of symptoms that could predict COVID-19 infection, which is consistent with analyses of other studies.[34]

There was only one asymptomatic case in this study. New Zealand guidelines required individuals to be symptomatic in order to be tested in the community at this time. However, during the study period , individuals who arrived at the border and were exempted from mandatory quarantine underwent testing regardless of symptoms, resulting in the identification of our only asymptomatic case. Asymptomatic persons may have accounted for approximately 40% to 45% of COVID-19 infections, with possible transmission for extended periods, perhaps longer than 14 days.[35] In the Icelandic cohort, 43% of those aged ten years and older had no symptoms at testing.[30] In an Italian sample, 42.5% of those who tested positive had no symptoms at testing and never developed any symptoms.[36] These studies showed that the symptom profile of COVID-19 was inconsistent and variable and that the testing of asymptomatic persons represented an important approach in population surveillance.

A limitation of this study is that, for the majority of cases, the source of the infection was from overseas, yet socioeconomic/deprivation data were based on their local address in New Zealand. Confining the study to confirmed cases and excluding probable cases is also a limitation, as some

probable cases may have been confirmed if they had been tested. The strengths of this study include the collection of standardised data from consecutive cases in a population where extensive contact tracing occurred as part of the public health response.

This study of community cases has illustrated that the profile of symptoms in COVID-19 was highly variable and there was no particular symptom(s) that could accurately predict infection. The overall make-up of Wellington cases being of European descent and higher socioeconomic background and related to travel, in combination with public health measures, meant that there was minimal community transmission in Wellington, which protected vulnerable communities.

Competing interests:
Prof Beasley reports grants and personal fees from Health Research Council outside the submitted work.

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