Pandemic influenza A(H1N1)v in New Zealand: the experience from April to August 2009

M G Baker (michael.baker@otago.acnz)[1], N Wilson[1], Q S Huang[2], S Paine[2], L Lopez[2], D Bandaranayake[2], M Tobias[3], K Mason[3], G F Mackereth[3], M Jacobs[3], C Thornley[4], S Roberts[5], C McArthur[5]

1. University of Otago, Wellington, New Zealand
2. Institute of Environmental Science and Research (ESR), Wellington, New Zealand
3. Ministry of Health, Wellington, New Zealand
4. Auckland Regional Public Health Service, Auckland, New Zealand
5. Auckland City Hospital, Auckland, New Zealand

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Following the detection of imported cases of pandemic influenza A(H1N1)v on 25 April 2009, New Zealand implemented containment measures that appeared to slow establishment of the pandemic during May. The pandemic accelerated markedly in June, reaching a peak within four to six weeks, and has been declining since mid-July. By 23 August there had been 3,179 recorded cases (97.8% reported as confirmed), including 972 hospitalisations, 114 intensive care admissions, and 16 deaths. Influenza-like illness (ILI) surveillance in general practice suggests that 7.5% (95% CI: 3.4–11.2) of the population of New Zealand had symptomatic infection, giving a case fatality ratio of 0.005%. Hospitalisations were markedly higher for Māori (age standardised relative risk (RR)=3.0, 95% CI: 2.9–3.2) and Pacific peoples (RR=6.7, 95% CI: 6.2–7.1) compared with Europeans and others. The apparent decline of the pandemic (shown by all surveillance systems) cannot be fully explained. New Zealand remains in the middle of its traditional influenza season, the influenza A(H1N1)v virus appears relatively infectious, and we estimate that only about 11% of the population have been infected by this novel agent.

Introduction

There has been considerable international interest in how the influenza A(H1N1)v pandemic might evolve during the southern hemisphere winter [1]. Initial reports from Australia showed an epidemic increase in influenza-like illness (ILI) reported by general practice (GP) sentinel surveillance from late May and peaking four to six weeks later in June [2]. Another southern hemisphere country, Peru, also observed an epidemic that accelerated rapidly in June, followed by an apparent decline [3]. Here we report the epidemiology of this pandemic in New Zealand based on the experience of the first four months, from late April to late August 2009.

Methods

New Zealand has multiple systems for surveillance of influenza, as listed below. Here we report on key surveillance findings, particularly from the first seven of these systems.

- **Notifiable disease surveillance:** 'Non-seasonal influenza A(H1N1)' was made a notifiable disease on 30 April 2008. Data are entered into a national web-based database (EpiSurv) operated by the Institute of Environmental Science and Research (ESR) and are available for immediate analysis. This system also records hospitalised and fatal cases.
- **General practice (GP) surveillance:** Data on influenza-like illness (ILI) consultations with primary care medical practitioners are collected through two systems: the Sentinel GP Surveillance System (95 general practices covering about 10% of the New Zealand population) and HealthStat (84 computerised general practices with an additional 300 added in 2009, now covering about 40% of the New Zealand population). These systems provide weekly reports of ILI activity.
- **Laboratory-based surveillance:** Nasopharyngeal swabs are collected by practitioners contributing to the Sentinel GP Surveillance System, from a known number of patients seen with ILI every week. These influenza isolates are typed and tested for sensitivity to oseltamivir [4]. Specimens are also collected for diagnostic reasons from outpatients and hospitalised inpatients and as part of public health follow-up and investigation.
- **Healthline:** Reports on telephone calls regarding ILI made by the public to a national free-calling health information service are collated every week. This surveillance records daily counts of calls triaged for ILI, based on a wide set of key terms and clinical syndromes.
- **Hospital intensive care unit (ICU) utilisation:** This additional surveillance was established as part of the situation reporting system used by the Ministry of Health to support its ongoing pandemic management activities. It collects daily reports from all District Health Boards on a number of measures of healthcare utilisation including ICU influenza admissions, total occupancy, and ventilator capacity.
- **Population survey (Flutracker):** A cross-sectional survey was designed by the Ministry of Health and conducted by a market research company to measure the prevalence of ILI in the population and to assess the feasibility of using this form of surveillance on an ongoing basis. This survey used telephone interviewing. The pilot survey in June 2009 used a nationally representative sample of 629 people in 219 households. This full surveillance system was not continued because it was not considered necessary for the scale of the pandemic and was relatively expensive.

- **Mortality:** Data from death certificates and Coroner's reports are provisionally collated within days by the Ministry of Health (but final analysis and reporting of national data take about two years).
- **Hospital morbidity:** All publicly funded hospitals in New Zealand report hospitalisation data to the Ministry of Health with collated data available within three months (consequently these data were not available for this analysis, so notification data were used here to described hospitalisations).
- **Other influenza surveillance systems:** There are also regional systems for syndromic surveillance (based on one hospital emergency department in the capital city) and absenteeism surveillance (recording workplace and school absenteeism in one region of New Zealand).

Rates were calculated using 2008 mid-year population estimates except for ethnicity which used 2006 census data as the denominator. When calculating rates for ethnic groups we used prioritised ethnicity (where individuals record multiple ethnicities, Māori ethnicity takes precedence, followed by Pacific peoples, then Asian, with the remaining people included as European and other). Rates were age-standardised using the age distribution of the 2006 census.

Results

Incidence

Up to 23 August 2009 there had been 3,179 notified cases of influenza A(H1N1)v in New Zealand, a rate of 74.5/100,000. Most cases were reported as confirmed (97.8%), with the rest (2.2%) classified as probable. Of the total cases, 972 (30.6%) were reported to have been hospitalised, 114 admitted to an ICU, and 16 to have died of pandemic influenza as the primary cause of death. Other possible pandemic-associated deaths are still being investigated by the Coroner's office [5].

Over the 11-week period that the pandemic strain has been circulating in New Zealand (from week 24, starting 8 June, to week 34, ending Sunday 23 August), the Sentinel GP Surveillance System detected a cumulative consultation rate of 1,906.2 ILI cases/100,000 population (i.e. 1.9%). During that same period, 382 influenza A(H1N1)v viruses were obtained from these sentinel practices, which was 19.0% of the swabs collected from patients with ILI. These data suggest a cumulative general practice consultation rate for influenza A(H1N1)v of 408.9/100,000, equivalent to a cumulative total of 17,672 patients across New Zealand.

Time course

Epidemic curves for notifications, hospitalisations, ICU admissions and ILI cases (Sentinel GP Surveillance System, HealthStat, and Healthline calls) are shown in the figures below (Figures 1-7). The first known cases in New Zealand were detected on 25 April 2009 following arrival of a flight containing a school group who had travelled to Mexico. Containment efforts (case isolation, quarantine of contacts, and treatment with oseltamivir) appeared to have successfully prevented transmission from that group. No further cases of laboratory-confirmed disease were detected for about 4 weeks from 1 May until 31 May.

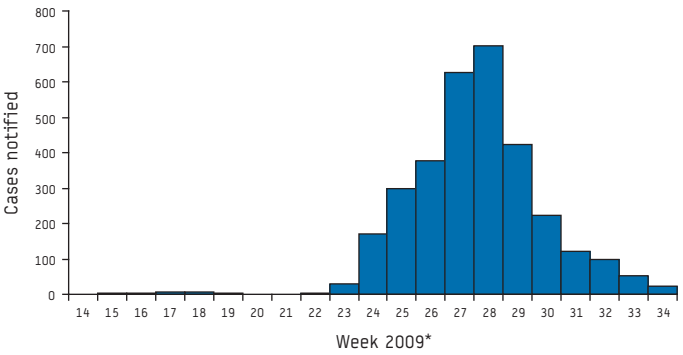
Following the end of May, a marked increase in influenza was detected by all surveillance systems starting in the first or second week of June (depending on the system). All surveillance systems showed that the epidemic reached a peak within four to six weeks (during the weeks starting Monday 27 June to 12 July).

Notifiable diseases

The first cases were notified in the week starting 27 April (student group from Mexico). There was a rapid rise in notified cases of influenza A(H1N1)v in week 23 (starting 1 June), with a peak six weeks later in week 28 (starting 6 July).

Figure 1

Influenza A(H1N1)v cases recorded on notifiable disease surveillance system by week, New Zealand, April-August 2009 (n=3,179)



* Week of onset, hospitalisation or reporting, whichever was earliest

Figure 2

Influenza A(H1N1)v cases hospitalised by week, New Zealand, April-August 2009 (n=972)

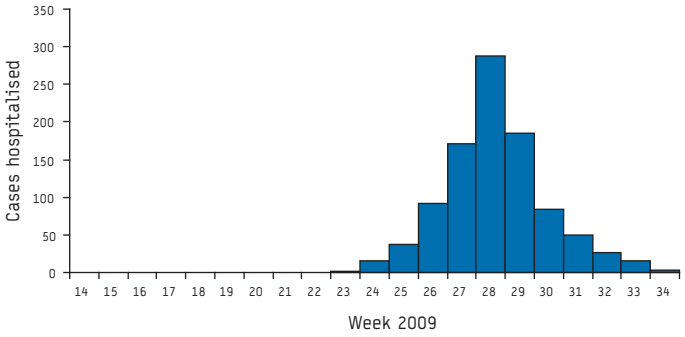
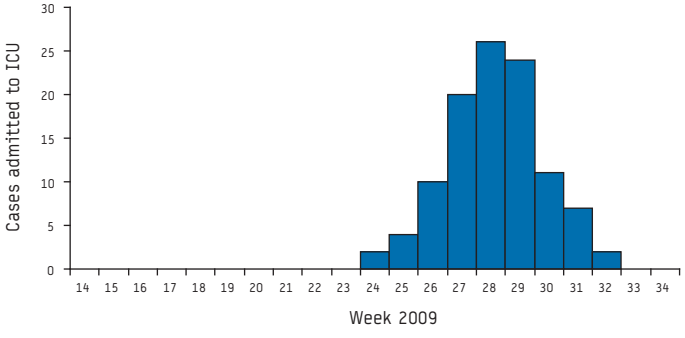


Figure 3

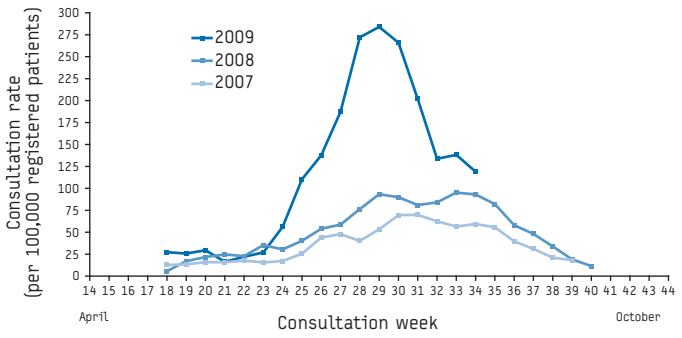
Influenza A(H1N1)v cases admitted to ICU by week, New Zealand, April-August 2009 (n=106*)



*excluding eight cases without reported admission dates

Figure 4

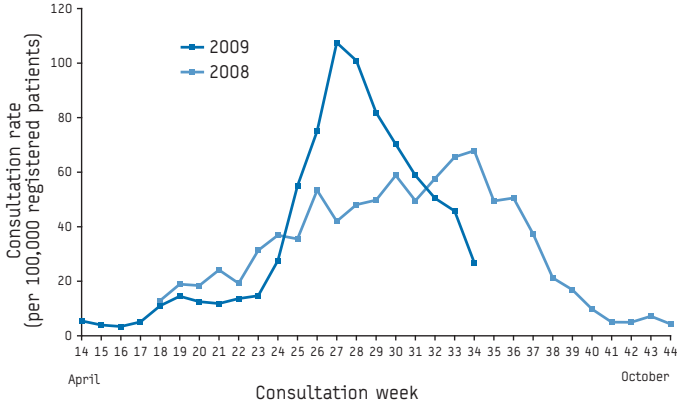
Weekly rate of ILI per 100,000 registered population, all ages, New Zealand, 2007–2009



Source: Sentinel General Practice Surveillance System

Figure 5

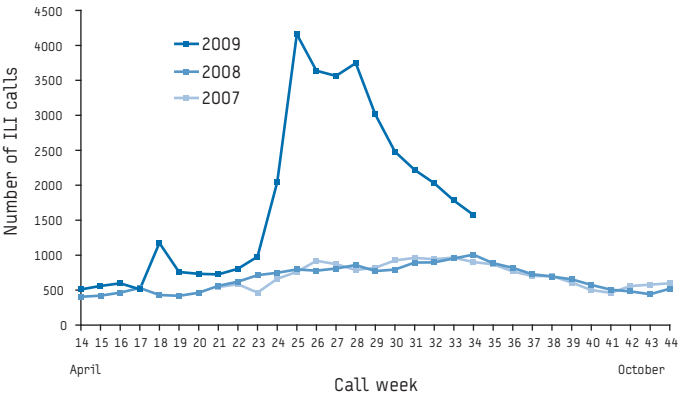
Weekly rate of ILI per 100,000 registered population, all ages, New Zealand 2008–2009



Source: HealthStat General Practice Surveillance System
ILI: influenza-like illness

Figure 6

Weekly ILI calls to Healthline, New Zealand 2007–2009



ILI: influenza-like illness

Hospitalisations (subset of notifications)

The hospitalisation numbers showed the same pattern as the notifications. The first hospitalisations were in week 23 (starting 1 June), with a peak six weeks later in week 28 (starting 6 July).

Hospital intensive care admissions

New admissions to ICU followed a similar pattern to hospitalisations with the first admission in week 24 and a peak in week 28. About 12% of hospitalised cases were admitted to ICU.

Figure 7

Influenza viruses obtained from Sentinel GP Surveillance System by week, New Zealand, April-August 2009 (n=602)

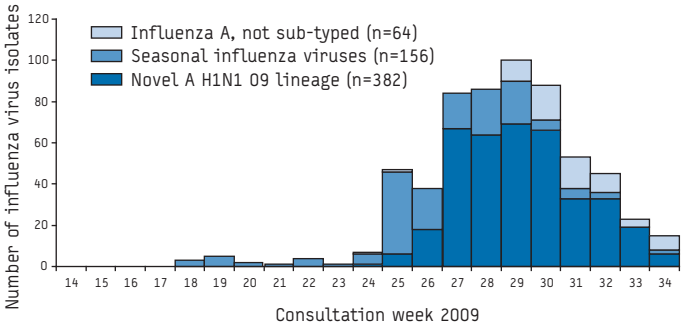


Figure 8

Rates of notified and hospitalised influenza A(H1N1)v cases by age group, New Zealand, cumulative rates for 2009

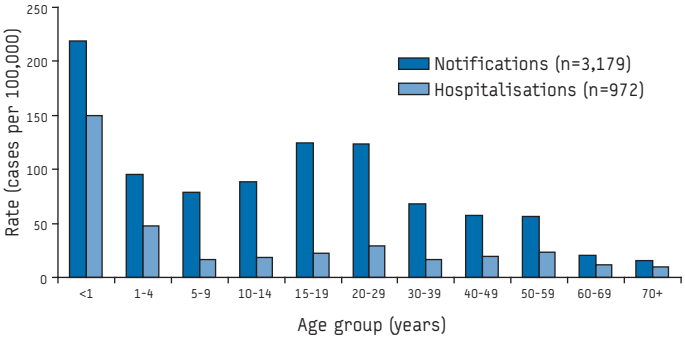
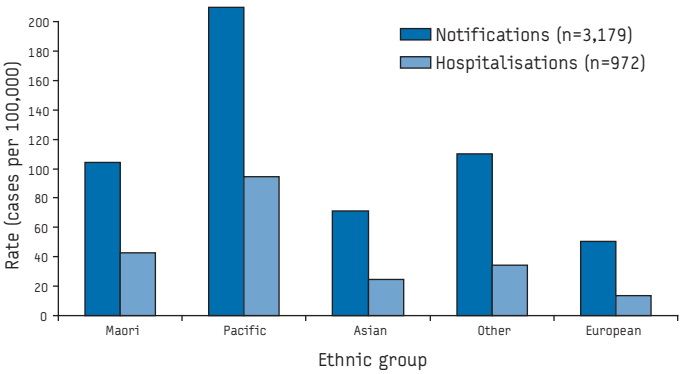


Figure 9

Rates of notified and hospitalised influenza A(H1N1)v cases by ethnic group, New Zealand, cumulative rates for 2009



Sentinel GP Surveillance

This system showed a rapid rise in ILI cases evident in week 24 (starting 8 June), with a peak six weeks later in week 29 (starting 13 July).

HealthStat GP Surveillance

This system showed a rapid rise in ILI cases evident in week 24 (starting 8 June), with a peak four weeks later in week 27 (starting 29 June).

Healthline calls

There was a rapid rise in ILI calls from the public evident from late in week 23 (starting 1 June). The calls peaked two weeks later in week 25 (starting 15 June).

Laboratory surveillance

Influenza A(H1N1)v was first detected by the Sentinel GP Surveillance System in week 24 (starting 8 June). It became the dominant circulating strain after four weeks (week 27 starting 29 June).

Population survey (Flutracker)

For the week of 22–28 June (week 26), ILI was reported by 2.0% (95% CI: 0.9–3.0) in a sample of 619 people. This was an ILI prevalence of 2,000/100,000 population (95% CI: 900–3,000). During that week the Sentinel GP Surveillance System reported a consultation rate of 137.7/100,000 (peaking two and three weeks later at a rate of 272.0 and 284.0/100,000). Also during that week, the expanded HealthStat GPs (n=384 GPs) reported a consultation rate of 80.7/100,000 (peaking one and two weeks later with a consultation rate of 112.0 and 119.6/100,000). Taking the average of these two rates for week 26 (109.2/100,000) implies that only one in 18.3 people with ILI consulted a GP and were also recorded by the ILI surveillance system (95% CI: 8.2–27.5).

Region

The intensity of the epidemic varied widely across New Zealand with some regions experiencing rates markedly higher than others. Across the 21 district health board regions, the cumulative hospitalisation rate ranged from 0.0/100,000 in Wairarapa to 52.9/100,000 in Hutt Health District (Wellington). The national average was 22.8/100,000.

Person characteristics

Notification data were analysed according to the age, sex, and ethnicity of notified and hospitalised cases (see Figures 8 and 9).

Rates of notified disease were highest in the under one year-olds (218.5/100,000) and the 15–29 year-olds (124.6/100,000), with the lowest rates in those over the age of 70 years (15.3/100,000). Hospitalisations showed a similar pattern with markedly higher rates in those under one year of age (149.8/100,000), but with rates falling to a relatively low level for all age groups over the age of five years. Hospitalisation rates for females (24.3/100,000) were slightly higher than for males (20.9/100,000).

Rates of notified disease were highest in Māori (age standardised relative risk (RR)=2.0, 95% CI: 1.9–2.1) and Pacific peoples (RR=4.0, 95% CI: 3.8–4.3), compared with Europeans and others. These inequalities were even more marked for hospitalisations (Māori RR=3.0, 95% CI: 2.9–3.2, Pacific peoples RR=6.7, 95% CI: 6.2–7.1).

Discussion

The virus

The pandemic influenza A(H1N1)v virus became the predominant circulating influenza virus in primary care settings in New Zealand within four weeks of its appearance [6]. It has been genetically very stable, based on testing conducted in New Zealand, and remains sensitive to oseltamivir [7]. The virology of this influenza epidemic was unique in that it was characterised by the co-circulation of three influenza A strains. As of 23 August 2009, there has been virtually no influenza B activity.

The pandemic

The pandemic in New Zealand has been characterised by relatively high transmissibility but low case fatality ratio (CFR). The reproduction number estimated for the early stages of the epidemic was 1.96 (95% CI: 1.80–2.15) [8]. The data from the Sentinel GP Surveillance System imply that about 17,672 patients infected with the pandemic strain have consulted a GP during the initial 11 weeks of the pandemic period. Given that the data from the cross-sectional survey (Flutracker) for week 26 imply that only one in 18.3 of the population with ILI are reported to this sentinel system, these data suggest that a cumulative total of 323,400 New Zealanders (7.5%, 95% CI: 3.4–11.2) have had symptomatic infection with the pandemic strain during this period. Experimental studies suggest about one third of seasonal influenza infections are asymptomatic [9], so these findings would be consistent with about 11% of the population having been infected with the pandemic strain. This result is broadly consistent with one other New Zealand estimate: Using capture-recapture methods and combining data from four sources it was estimated that 3.7% of the population of two Auckland regions (population 0.93 million) were symptomatically infected in a single month (July) [10].

Case fatality ratio

Calculating the CFR is highly dependent on estimates of the total number of people with symptomatic illness [11]. There have been 16 deaths with the pandemic influenza strain recorded as the principal cause (as of 23 August). Using the estimated denominator population of 323,400 symptomatic cases, this suggests a CRF of 0.005% (95% CI: 0.003–0.011). Interestingly, this estimate is in the range found for seasonal influenza in the population under the age of 65 years (according to data from the United States [12] and various assumptions [11]). This impact appears mild compared with the 1918 influenza pandemic in New Zealand, which killed 0.7% of the population [13] and which may have had a CFR of around 2.0% [14]. We can, however, speculate that those people admitted to ICU today (114 so far in New Zealand) would not have survived in 1918. On that basis, the comparable CFR estimate for the current pandemic would be considerably higher at 0.04%. Other interventions, such as use of antivirals (mainly oseltamivir), antibiotics to treat secondary bacterial pneumonia, and public communications have probably also contributed to lowering the CFR. Developing countries without access to such resources might, therefore, experience far more severe health impacts than those seen in a developed country like New Zealand.

Vulnerable groups

Some population groups appear more vulnerable to influenza A(H1N1)v infection than others. A distinctive epidemiological feature of pandemics is the shift in the age distribution to younger people [15], and this feature was clearly evident in New Zealand. In addition, there have been markedly higher rates of severe disease (as reflected by the number of hospitalisations) for Māori (cumulative age-standardised hospitalisation rate of 43.0/100,000)

and Pacific peoples (94.2/100,000) compared with Europeans and others (14.1/100,000). Similar ethnic inequalities between Māori and non-Māori were seen for fatalities in the 1918 influenza pandemic in New Zealand [16]. The reasons for these differences have not been established. However, Māori and Pacific peoples in New Zealand experience marked health inequalities, and these are also manifest for other infectious diseases [17]. Chronic health conditions have been commonly reported for hospitalised cases (notably respiratory disease, cardiac disease, diabetes, and immune suppression) along with some infections in pregnant women.

Impact of school holidays

There is some evidence that the start of the school holidays in New Zealand reduced influenza transmission and that the return to school slightly accelerated the epidemic. In New Zealand, the holidays for all schools lasted from Saturday, 4 July to Sunday, 19 July this year (weeks 28 and 29). It is difficult to identify what impact the start of the school holidays had as it coincided with what appears to have been the 'natural' peak of the pandemic. However, following the return to school on Monday 20 July, HealthStat GP consultation rates for school age groups (5–14 years) increased and remained elevated for three weeks (weeks 30–32) before continuing their downward trajectory in week 33. These relationships require further in-depth analysis, but the overall effect on the pandemic appears to have been small.

Public health response

New Zealand has a relatively well developed pandemic plan that includes 'keep it out', 'stamp it out', 'manage it', and 'recover' phases [18]. At the point of writing this article, the country is continuing with the management stage. The first two containment stages were applied from the first detection of imported cases on 25 April until 22 June, when New Zealand formally switched to the 'manage it' phase. The considerable interval without reported cases during May (before the epidemic accelerated in June) provides some suggestive evidence for the success of the containment measures, although this assessment requires further evaluation.

Impact on health care services

The pandemic resulted in a heavy demand for health services in those geographic areas where it was most intense. This demand was experienced by general practices, emergency departments, inpatient paediatric and adult medicine services, diagnostic laboratories, as well as public health services. The impact was particularly marked in ICUs because a relatively large proportion of hospitalised cases were admitted to these units and because many patients stayed there for a relatively long time. The demand on intensive care services peaked at 25% of national ICU occupancy. The health services were not overwhelmed, largely because of considerable additional time and effort by staff, postponing and cancelling of non-urgent work, and also because the numbers of infected people and the morbidity in this pandemic were lower than had been initially expected.

Surveillance

The notifiable disease surveillance system was useful during the containment stage for recording individual cases and supporting control measures aimed at interrupting spread of the disease. Once New Zealand moved into the management phase, this system ceased to provide a meaningful indication of the progression of the pandemic, mainly because routine laboratory testing of ILI patients was discouraged unless clinically indicated. However, this system has increasingly been used for recording hospitalisations and deaths, and the resulting dataset (EpiSurv) therefore provides insights into the more severe end of the disease spectrum. The two GP surveillance systems have provided the most consistent data about the progression of the pandemic. The sentinel GP system with integrated epidemiological and virological surveillance has been particularly valuable in estimating the disease burden as it enables the contribution from different circulating influenza strains to be measured. The pilot testing of the Flutracker cross-sectional survey suggested that this system has good potential for surveillance of more severe pandemics which might overwhelm routine surveillance systems.

Limitations of this analysis

All of these surveillance systems have considerable limitations. The cross sectional survey (Flutracker) in particular was run as a pilot and consequently had a relatively small sample. Consequently, there is considerable uncertainty around the multiplier this study has suggested for estimating ILI in the population based on healthcare events (such as GP visits). It is reassuring that data from a cross-sectional telephone survey in New York City suggested a very similar multiplier (18.2) between physician visits and self-reported ILI (this calculation is based on an estimated emergency department multiplier of 60 and the ratio of 3.3 physician visits per emergency department visit reported in this study) [19]. Sentinel surveillance data themselves were affected by advice discouraging most patients with ILI from attending their GP, which would have lowered the consultation rates compared with previous years. Notification data include only a small proportion of all cases and are unlikely to be representative of influenza A(H1N1)v virus infections in the community. All of the findings presented here require more in-depth analysis based on finalised data following the end of the pandemic.

Persisting uncertainties

All surveillance systems currently show a consistent decline in pandemic disease rates in all areas of New Zealand. This decline cannot be fully explained. New Zealand is still in the middle of its traditional influenza season, the A (H1N1)v virus appears relatively infectious, and we estimate that so far only about 11% of the population have been infected by this novel agent. Similar patterns of a relatively short epidemic have also be reported in other countries in the southern hemisphere, notably Australia [2]. This pattern would be consistent with a range of potential explanations. The lower levels of infections in older age groups may be indicative of some existing immunity in the population. Certain changes in behaviour may also have contributed to reducing the effective reproduction number.

The largest uncertainties relate to the future development of this pandemic. Previous pandemics tended to cause multiple waves over periods between two and five years [15]. This present pandemic is causing widespread illness with low mortality, which would be consistent with the first wave seen in some previous pandemics. In other respects it could be seen as behaving like a typical seasonal influenza strain which usually infects 5–10% of the population over a period of about eight weeks every winter and then largely disappears. It would be prudent for health authorities to plan for a range of pandemic scenarios that might unfold over the months and years ahead. There is also a need to maintain existing surveillance systems and supplement these with an operational research programme including, for example, population sero-surveys to provide more accurate estimates of the pandemic impact to date

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