INFLUENZA SURVEILLANCE IN NEW ZEALAND 2016

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SUMMARY

INFLUENZA REPORT AT A GLANCE

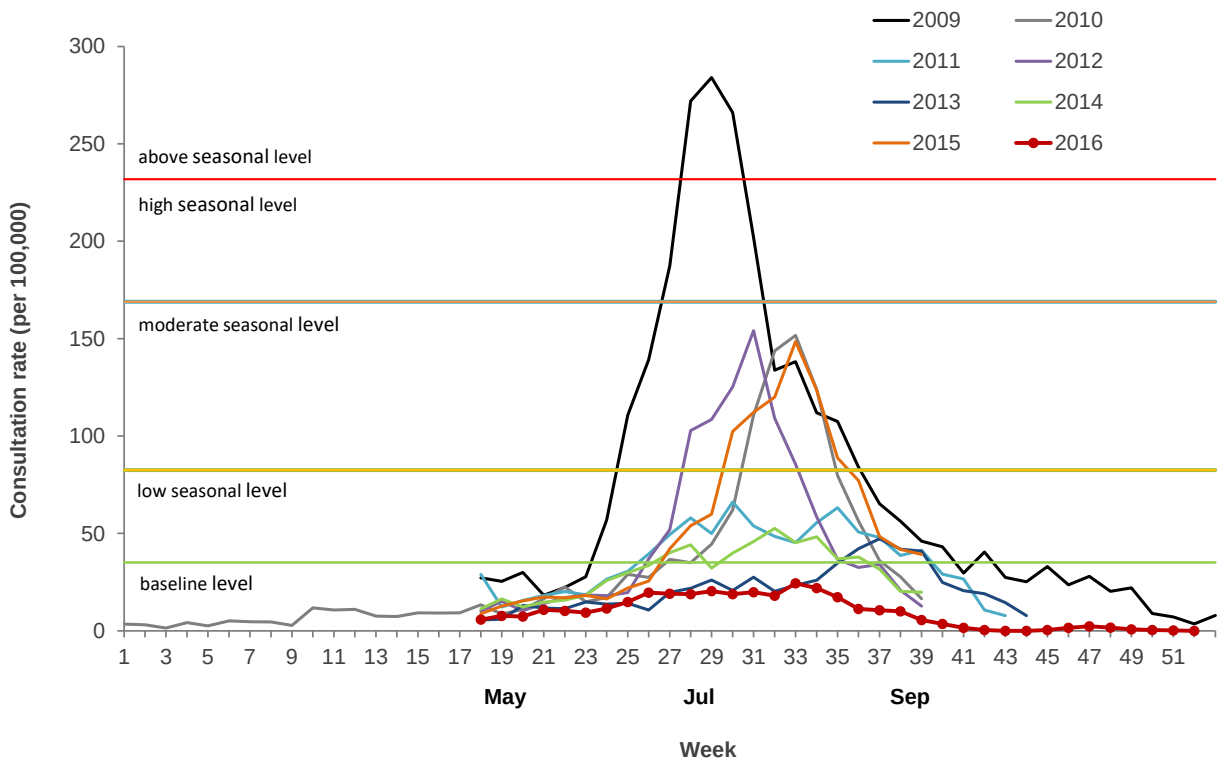
This document provides an overview of information gained from influenza surveillance in New Zealand in 2016 (https://surv.esr.cri.nz/virology/influenza_annual_report.php). The New Zealand influenza surveillance system compiles information from a variety of sources on disease burden, epidemiology, viral aetiology, risk factors, clinical presentation and outcomes, and vaccine effectiveness. The influenza surveillance system is in place to detect influenza epidemics/pandemics, inform vaccination policy and vaccine strain selection, and guide public health control measures. NZ influenza surveillance also contributes to these activities at a global level.

2016 Influenza Activity

New Zealand conducts both hospital- and general practice (GP) based surveillance, because these systems capture disease presentations at different levels of severity. Due to differences in care seeking and disease severity, the combination of these systems also allows for a better representation of the burden of influenza in NZ. The very young (under 5 years old), older adults (65 years or older), and those of Pacific peoples ethnicity are more likely to be admitted in hospital whereas school-aged children (5–19 years old), adults (20–49 years old), and Asians are more likely to visit GPs.

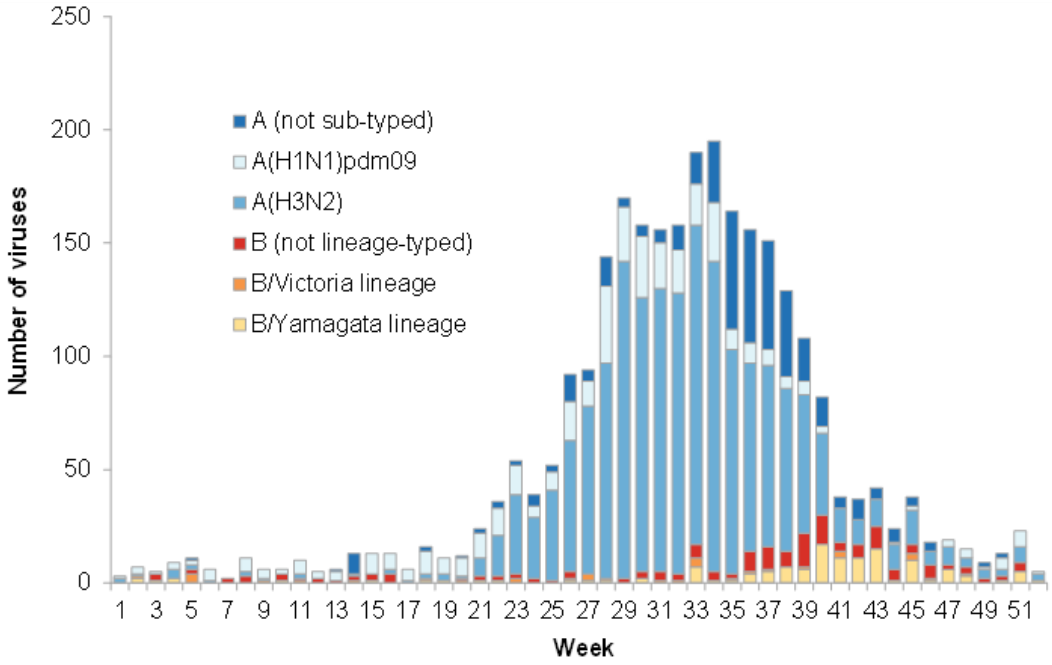
Visits to the GP (Figure 1) and hospital for acute respiratory illnesses were at a low level during 2016. Influenza-like illness consultation rates varied across District Health Boards (DHBs), with the highest rates reported from Tairawhiti and South Canterbury DHBs.

Figure 1. Weekly consultation rates for Influenza-like Illness (ILI) in New Zealand, 2009–2016



Influenza A(H3N2) was the predominant 2016 influenza virus that circulated in 2016; however, small proportions of influenza A(H1N1)pdm09 and two lineages of influenza B viruses (Yamagata and Victoria) also co-circulated (Figure 2). More details on 2016 influenza vaccine recommendations are here: https://surv.esr.cri.nz/virology/influenza_vaccine.php.

Figure 2.Total influenza viruses by types and subtypes and lineages in 2016



Influenza in Populations at Elevated Risk

Groups at increased risk of influenza or poor outcomes with influenza infection are a particular focus of influenza surveillance. Pregnant women, adults with specific underlying medical conditions, and children under five years old who have been hospitalised for respiratory illness or have a history of significant respiratory illness and those over 65 years old are all eligible for free seasonal influenza vaccine. http://www.influenza.org.nz/eligibility-criteria

Adults with underlying medical conditions: Around two thirds (70%) of adults (15 years or older) who were hospitalised with influenza had underlying medical conditions or prior hospitalisation for respiratory illness. Cardiovascular disease, asthma and chronic respiratory disease were the most common underlying medical conditions recorded.

Children: About 10% of children under 15 years old hospitalised with influenza had any underlying conditions or prior hospitalization for respiratory illness.

Vaccine Coverage and Antiviral Resistance in 2016

In 2016, a reported 27% of the NZ population was vaccinated for influenza, which is slightly lower than the peak in 2013 when influenza vaccine for children under 5 years old with significant respiratory illness became funded. The coverage for people 65 years and older was 67%, similar to that of 2015, but still below the target of 75% for this age group.

The circulating influenza viruses were all sensitive to oseltamivir and zanamivir (antiviral agents).

INTRODUCTION

Influenza viruses frequently undergo antigenic changes, enabling them to evade the host's immune response. This poses a real challenge for the prevention and control of influenza. The overarching goal of influenza surveillance is to provide information to public health authorities to facilitate appropriate control measures, health resource allocation, and case management at the national and international level, so as to minimise the impact of influenza on people. The objectives of influenza surveillance are included in the WHO Global Epidemiological Surveillance Standards for influenza [2].

There are two active influenza surveillance systems in New Zealand combining epidemiological and virological investigations for influenza:

1. National sentinel general practice-based influenza-like illness (ILI) surveillance.

   New Zealand's longitudinal sentinel general practitioner (GP)-based influenza surveillance system was established in 1989 as part of the World Health Organization's (WHO) Global Influenza Surveillance and Response System. It operated usually during May-September each year combining epidemiological and virological surveillance with stable, consistent and historical records. However, the data collection for numerators and denominators was manual-based and cumbersome. Additionally, only a small proportion of ILI patients were tested for influenza viruses.

   During 2013-2015, with a research award received from United States Centers for Disease Control and Prevention (CDC), the SHIVERS (Southern Hemisphere Influenza and Vaccine Effectiveness Research and Surveillance) project established influenza-like illness surveillance, involving 16 sentinel general practices in the Central, South and East Auckland regions. The SHIVERS ILI surveillance system utilised electronic technology to capture required numerator and denominator data as well as influenza vaccination and antiviral usage data. A respiratory sample was also collected from all ILI patients for influenza and non-influenza respiratory virus testing.

   In 2016, an enhanced influenza-like illness (eILI) surveillance system was successfully established by building on previous operations of NZ's longitudinal sentinel GP influenza surveillance and SHIVERS ILI surveillance with enhanced data and sample collection as well as laboratory testing. This is an active, prospective, population-based surveillance system for ILI cases consulting their GPs in ~80-90 sentinel general practices nationwide (approximately one practice for every 50,000 people) covering about 8-10 % of the New Zealand population.

2. Hospital-based SARI surveillance.

   Hospital-based surveillance for severe acute respiratory infections (SARI) is a key component of SHIVERS. The system has been fully functioning since 30 April 2012. This is an active, prospective, continuous, population-based surveillance system for SARI cases admitted to four hospitals in the central, east and south Auckland region (population 906,000).

The overall aims of the national sentinel general practice based ILI surveillance and hospital-based SARI surveillance are to provide information on weekly incidence, cumulative incidence, viral etiology, risk factors, clinical presentation and outcomes, severity and effectiveness of vaccination and other public health control measures for influenza and other respiratory viral diseases of public health importance.

The specific aims of influenza surveillance are shown in the Table below:

Aim	Public health outcome
1. Conduct active, prospective, population-based surveillance (sentinel general practice surveillance for influenza-like illness and hospital-based surveillance for Severe acute respiratory illness)	Early detection of influenza epidemics/pandemics to guide the development and implementation of public health measures
2. Measure the incidence, prevalence, demographic characteristics (age/sex/ethnicity/socio-economic status) for ILI/SARI and associated influenza cases	Estimate burden of influenza in community consultation-seeking patients and hospitalized patients and guide pharmaceutical and non-pharmaceutical intervention
3. Identify ILI and SARI-associated influenza cases; identify antigenic and genetic drift, non-seasonal virus (i.e. A(H7N9) and A(H5N1)), antiviral susceptibility	Virological surveillance on influenza supports annual seasonal influenza vaccine strain selection, identify antigenic and genetic changes and antiviral profiles of seasonal influenza virus, early detection of non-seasonal virus
4. Identify etiologies of ILI and SARI cases attributable to non-influenza respiratory viruses (e.g. RSV, HRV, PIV 1-3, hMPV, AdV, EV) and newly/re-emerging respiratory virus (i.e. MERS-CoV)	Early detection of newly emerging respiratory viruses (i.e. MERS-CoV); Burden of other respiratory viruses and guide future vaccine development (i.e. RSV)
5. Assess impact of influenza on clinical spectrum, pre-existing medical conditions and outcomes for SARI cases including ICU admissions and deaths.	Guide population and subgroup-targeted vaccination strategies, clinical case management and other interventions
6. Conduct enhanced and continuous surveillance for ICU patients by screening SARI and non-SARI respiratory ICU patients with comprehensive etiology investigations.	Assess influenza severity so to better prepare for pandemics. Also monitor severe respiratory diseases caused by other newly emerging respiratory viral infections
7. Conduct pandemic influenza severity assessment (PISA)	Three PISA indicators (viral transmissibility, disease seriousness and overall impact) provide scientific evidence to determine the timinng, scale, emphasis, intensity and urgency of pandemic response actions; facilitates decision making for pandemic influenza risk management nationally and globally
8. Assess the annual effectiveness of seasonal influenza vaccination in the prevention of hospitalization	Support annual vaccine strain selection particularly for the southern hemisphere; guides vaccination policy

This report summarises the results from influenza surveillance in New Zealand in 2016. It provides information on community-based ILI and related influenza disease (obtained from national general practice based ILI surveillance). It also describes hospital-based influenza morbidity and mortality (obtained from SARI surveillance and the Ministry of Health's National Minimum Data Set [NMDS]). In addition, it includes surveillance data from Healthline and HealthStat, laboratory-based surveillance, antiviral susceptibility, vaccine efficacy and genetic data as well as influenza immunisation coverage data obtained from the Ministry of Health.

METHODS

NATIONAL SENTINEL GENERAL PRACTICE BASED INFLUENZA SURVEILLANCE

New Zealand's national sentinel general practice based enhanced ILI (eILI) surveillance is operated nationally by the ESR and locally by influenza surveillance co-ordinators in the public health services (PHS) all year around for syndromic surveillance. Local surveillance co-ordinators recruit general practices within their region to participate voluntarily in the program. Where possible, the number of practices recruited is proportional to the size of the population in each DHB covered by the PHS (approximately one practice for every 50,000 people).

For a consultation seeking patient, each participating general practice ascertains whether the patient meets ILI case definition* (attending with a cough and fever, onset within 10 days) then records illness details on the electronic HealthLink advanced form.

> * The case definition for influenza-like-illness (ILI) is:
>
> *An acute respiratory illness with onset during the last 10 days with:*
>
> - *a history of fever or measured fever of ≥38°C, AND*
> - *cough*
> - *requiring a general practice consultation*

Virological surveillance is conducted during the influenza season, usually between May to September (weeks 18–39). Each participating practice collects respiratory samples (ie, a nasopharyngeal or throat swab): For practices in Auckland (Auckland, Counties Manukau, Waitemata DHBs), Wellington (Capital & coast, Hutt Valley DHBs) and Canterbury DHB, samples are collected from all ILI patients from Monday to Friday; For practices in the remaining DHBs, samples are collected from the first ILI patient examined on each Monday, Tuesday and Wednesday (three samples per week). For GPs with a registered patient population of more than 10,000, six nasopharyngeal or throat swabs are collected weekly from the first two ILI patients examined on Monday, Tuesday and Wednesday.

Sentinel practices forward samples either to the WHO National Influenza Centre (NIC) at ESR or to the hospital virology laboratory in Christchurch for virus characterisation. Laboratory identification includes molecular detection using the polymerase chain reaction (PCR) and isolation of the virus. Influenza viruses are typed and sub-typed and lineage-typed as A, B, A(H3N2) or A(H1N1)pdm09, B/Yamagata, or B/Victoria lineage.

ILI consultation data is transmitted via HealthLink from practices to ESR in a real time format. Each week, virology laboratories report the total number of swabs received from each DHB and the influenza viruses identified to ESR, and updated details on influenza types and sub-types from previous weeks. ESR reported national information on epidemiological and virological surveillance of influenza weekly, monthly and yearly to relevant national and international organisations including the WHO; these reports are published on the ESR website: https://surv.esr.cri.nz/virology.php.

Consultation rates were calculated using the enrolled patient populations of the participating practices as a denominator. The patient population is stratified by age, sex, ethnicity and socio-economic status.

The start of influenza season and intensity level of the influenza epidemics is defined using the Moving Epidemic Method (MEM) based on WHO's interim guidance for influenza severity assessment [7, 8], which is described below in detail.

HOSPITAL-BASED SURVEILLANCE FOR SEVERE ACUTE RESPIRATORY ILLNESSES

Hospital-based surveillance for SARI operates in Auckland and Counties Manukau DHBs [9]. Inpatients with acute respiratory illnesses admitted overnight to any of the four hospitals (Auckland City Hospital and the associated Starship Children's Hospital, Middlemore Hospital and the associated Kidz First Children's Hospital), are screened by research nurses each day. An acute admission is defined as an unplanned admission on the day of presentation at the admitting healthcare facility. Admission may have been from the emergency or outpatient departments of the healthcare facility, a transfer from another facility or a referral from primary care. Overnight admission is defined as "a patient who is admitted under a medical team, and to a hospital ward or assessment unit". SARI cases are identified through a combination of reviewing the admission diagnoses and interviewing patients about their presenting respiratory symptoms. Research nurses interview the patients and document the components of the SARI case definition that are present.

The WHO SARI case definition [10] is used: "*an acute respiratory illness with a history of fever or measured fever of ≥38°C, AND cough, AND onset within the past 10 days, AND requiring an inpatient hospitalisation*".

The level of SARI and associated influenza is described using a set of thresholds to indicate the start of the influenza season and intensity level by using the MEM based on WHO's interim guidance for influenza severity assessment [7, 8], which is described in more detail below.

If a patient with acute respiratory illness meets the SARI case definition, a respiratory sample is collected to test for influenza and other respiratory pathogens. In addition, patient information is captured via a case report form that includes patient demographics, presenting symptoms and illness, pre-hospital healthcare, medication use, influenza vaccination history, co-morbidities, disease course and outcome (including major treatments, ICU admission and mortality), epidemiologic risk factors and laboratory results.

For ICU patients, SARI surveillance is enhanced. For all ICU patients with an acute respiratory illness a respiratory sample is collected for testing regardless of whether the patient meets the SARI case definition, as the case definition does not capture all cases of influenza.

The total number of all new hospital inpatient acute overnight admissions and newly assessed and tested SARI patients, including ICU admissions and deaths, is collected. This allows calculation of population-based incidence for SARI and associated influenza cases overall and stratified by age, gender, ethnic group and socioeconomic status among the ADHB and CMDHB resident population (from 2013 census data). Incidence rates are calculated along with 95% confidence intervals (95%CI). In addition, this allows for the calculation of the proportion of SARI and associated

influenza cases, including ICU admissions and deaths, overall and stratified for patients among all acute admissions regardless of residence status.

A case may have had more than one specimen taken for influenza and non-influenza virus testing. The number of specimens can therefore differ from the number of cases and specimens; and cases may be reported separately.

HEALTHSTAT

HealthStat is a computer-based surveillance system. HealthStat ILI surveillance is based on a nationally representative random sample of approximately 100 general practices that code for ILI. The case definition used for ILI by HealthStat is "*acute upper respiratory tract infection, with abrupt onset of 2 or more symptoms from chills, fever, headache and myalgia*". This surveillance system monitors the number of people who consult GPs with an ILI. HealthStat is based on automated extracts from practice management computer systems. CBG Health Research Ltd provides this data to ESR on a weekly basis. HealthStat ILI surveillance does not include virological surveillance.

Analysis is frequency-based with flags identifying statistical deviations (aberrations) from previous ILI counts. The analysis of the ILI count is based on the cumulative summation (CUSUM) algorithm implemented in the Early Aberration Reporting System (EARS) application developed by the CDC. EARS has three sensitivity thresholds—high, medium and low. If the daily consultation count exceeds a threshold, a flag is signalled.

HEALTHLINE

Healthline is the free national 24-hour 0800 telephone health advice service funded by the Ministry of Health. Calls made to Healthline are triaged using electronic clinical decision support software. The data collected is a daily count of all phone calls from people with symptoms for any illness made to Healthline and those triaged for ILI. The Healthline data is reported by ESR on a weekly basis, with daily reporting if required. About 70% of all calls to Healthline are symptom-related, and other calls (that are not part of this analysis) are queries for information.

Analysis is frequency-based, with alerts raised by identifying statistical deviations (aberrations) from previous patterns of call numbers. Data is reported for all ages in five age bands 0–4, 5–14, 15–44, 45–64 and 65 years and over. The analysis of the call frequency is based on the CUSUM algorithm implemented in EARS.

Cases of ILI are defined in the Healthline database as having one of the following 18 symptoms: fever (adult), breathing problems, breathing difficulty—severe (paediatric), colds (paediatric), cough (paediatric), cough (adult), fever (paediatric), flu-like symptoms or known/suspected influenza, flu-like symptoms (pregnant), influenza (paediatric), headache, headache (paediatric), muscle ache/pain, sore throat (paediatric), sore throat/hoarseness, sore throat/hoarseness (pregnant), upper respiratory tract infections/colds, or upper respiratory tract infections/colds (pregnant).

NMDS-CODED INFLUENZA HOSPITALISATIONS

Hospitalisation data for influenza (ICD-10AM-VI codes (J09-J11) are extracted from the New Zealand Ministry of Health's NMDS (by discharge date). In this dataset, patients who spent

less than one day in a hospital emergency department are excluded. Influenza-related hospitalisations are conservatively taken to include only those cases where influenza was the principal diagnosis. Repeat admissions were included because infection with a different influenza A sub-type or influenza B virus is possible.

LABORATORY-BASED SURVEILLANCE

In New Zealand, regional virus diagnostic laboratories at Auckland, Middlemore, Waikato, PathLab Tauranga, Wellington, Christchurch, Dunedin hospitals, and the National Influenza Centre at ESR perform laboratory-based surveillance. These laboratories receive specimens year-round largely from outpatients and hospital inpatients during routine laboratory diagnostic investigation, as well as specimens from sentinel GP-based surveillance and hospital-based SARI surveillance. Each week, all viral identifications, including influenza, are reported to the National Influenza Centre, which then collated and reported virology surveillance data nationally.

MOVING EPIDEMIC METHOD (MEM)

The start of the influenza season and the intensity level of the influenza epidemics is defined by using the MEM, based on the WHO's interim guidance for influenza severity assessment [7, 8]. The method involves using at least five years of weekly surveillance data to identify a threshold above which an influenza season is defined as occurring, using a complex mathematical algorithm. Activity below this threshold can then be defined as a background, or baseline level. The method allows the defining of further thresholds –low, moderate, high, above seasonal level– based on the mean and standard deviation of the historical data. This allows the beginning and end of an influenza season to be defined as the time when activity crosses the initial threshold, and can categorise the severity of the season from its maximum extent.

Based on New Zealand's ILI consultation rates during 2000–2015 (excluding the pandemic year, 2009), ILI and associated influenza activity for baseline, low, moderate, high and above seasonal levels are described below, Table 1.

Table 1. ESR ILI activity thresholds

ESR ILI surveillance		Seasonal level (per 100,000)			Above seasonal level (per 100,000)
Method	Below seasonal threshold	low	moderate	high	
MEM	<35.1	35.1-82.5	82.5-168.9	168.9-231.8	>231.8

ESR ILI-associated surveillance		Seasonal level (per 100,000)			Above seasonal level (per 100,000)
Method	Below seasonal threshold	low	moderate	high	
MEM	<11.4	11.4-43.3	43.3-85.7	85.7-115.7	>115.7

(Note: ESR's ILI surveillance system only had swabs taken for influenza testing from a proportion (~25%) of ILI cases. The proportion of influenza positivity (number of influenza positive cases divided by the tested ILI cases) was used to estimate total influenza positive cases among all ILI cases by applying the same positive rate of influenza positivity to all ILI cases (tested plus not tested ILI cases).

Based on SARI and associated influenza hospitalisation rates during 2012–2015, SARI and associated influenza activity for baseline, low, moderate, high and above seasonal levels are described below, Table 2.

Table 2. SHIVERS SARI and associated influenza activity thresholds

SHIVERS SARI surveillance		Seasonal level (per 100,000)			Above seasonal level (per 100,000)
Method	Below seasonal threshold	low	moderate	high	
MEM	<8.0	8.0-12.1	12.1-15.0	15.0-16.5	>16.5

SHIVERS SARI-associated surveillance		Seasonal level (per 100,000)			Above seasonal level (per 100,000)
Method	Below seasonal threshold	low	moderate	high	
MEM	<0.8	0.8	3.1-4.8	4.8-5.9	>5.9

IMMUNISATION COVERAGE

Immunisation benefit claims data from Sector Services in the Ministry of Health is used. Since the only eligible group with an estimated population size is those 65 years and older, coverage rates are calculated using the total New Zealand population.

DATA USED TO CALCULATE RATES

Population data used to determine rates of ILI consultations, hospitalisations, mortality and immunisation coverage is derived from 2016 mid-year population estimates published by Statistics New Zealand. Rates calculations include the estimation of 95% confidence intervals (95% CI).

NEW ZEALAND DEPRIVATION INDEX (NZDEP)

A proxy measure of socioeconomic status (SES) is derived from the deprivation index (NZDep) based on the patient's home address. The NZDep scale measured deprivation on an ordinal scale of 1 to 10, where 1 indicates the individual is living in a household that is in the least deprived decile of all New Zealand households. Upper SES is grouped as deciles 1–2, upper middle SES as deciles 3–4, middle as 5–6, and lower middle SES as deciles 7–8 and low SES as deciles 9–10.

ETHNIC GROUP

For different ethnic groups, the number and rates of hospitalisations and GP consultations are based on a prioritised classification of ethnicity, with the Māori ethnic group at the top of the hierarchy, followed by Pacific peoples, Asian, and European/Other (including New Zealander) ethnic groups. The NMDS and SHIVERS projects use this prioritised ethnicity classification.

ANTIVIRAL SUSCEPTIBILITY TESTING

The NIC employed a phenotypic method (fluorometric neuraminidase inhibition assay) for the surveillance of antiviral drug resistance in influenza viruses. In addition, the NIC employed a molecular method (PCR and sequencing) to monitor the H275Y mutation (histidine-to-tyrosine mutation at the codon of 275 in N1 numbering) which confers resistance to oseltamivir. Antiviral susceptibility testing to neuraminidase inhibitors (oseltamivir and zanamivir) was performed for those clinical specimens that yielded viral isolates.

COMMUNITY-BASED SURVEILLANCE

NATIONAL SENTINEL GENERAL PRACTICE-BASED SURVEILLANCE

In 2016, 84 practices were recruited from across all 20 DHBs for sentinel GP-based surveillance. In 2016, national ILI surveillance commenced on 2 May 2016. The overall patient roll was 479,743 – approximately 10.2% of the New Zealand population.

During the 2016 influenza season (2 May to 3 October), a total of 1557 sentinel consultations for ILI were reported. Based on this, the cumulative incidence rate of ILI consultations was 324.5 per 100,000 (95% CI: 308.7, 341.1) patient population. This rate is much lower than the cumulative incidence rates for 2015 (1203.4 per 100,000 (95% CI: 1136.3, 1272.5)) and 2014 (660.1 per 100,000 (95% CI: 610.8, 712.1)). The average national weekly consultation rate in 2016 was 14.8 per 100,000 (95% CI: 11.6, 18.7) patient population. This rate is lower than the average weekly rates for 2015 (56.3 per 100,000 (95% CI: 42.3, 72.7)) and 2014 (30.6 per 100,000 (95% CI: 21.1, 44.0)).

Extrapolating ILI consultations obtained from the general practice patient population to the New Zealand population, it is estimated that an ILI resulting in a visit to a GP affected 15,221 New Zealanders during the 2016 influenza season (0.3% of total population). This is lower than the estimated number of people affected in 2015 (55,304, 1.2% of total population) and in 2014 (29,768, 0.6% of total population).

Figure 3 presents the weekly consultation rates for ILI for 2009–2016. Consultation rates peaked at week 33, the same peak time as in 2015. Using the MEM to define the start and intensity level of the influenza season, the overall influenza-like illness activity in 2016 was at a low level (Figure 3).

Figure 3. Weekly consultation rates for ILI in New Zealand, 2009–2016

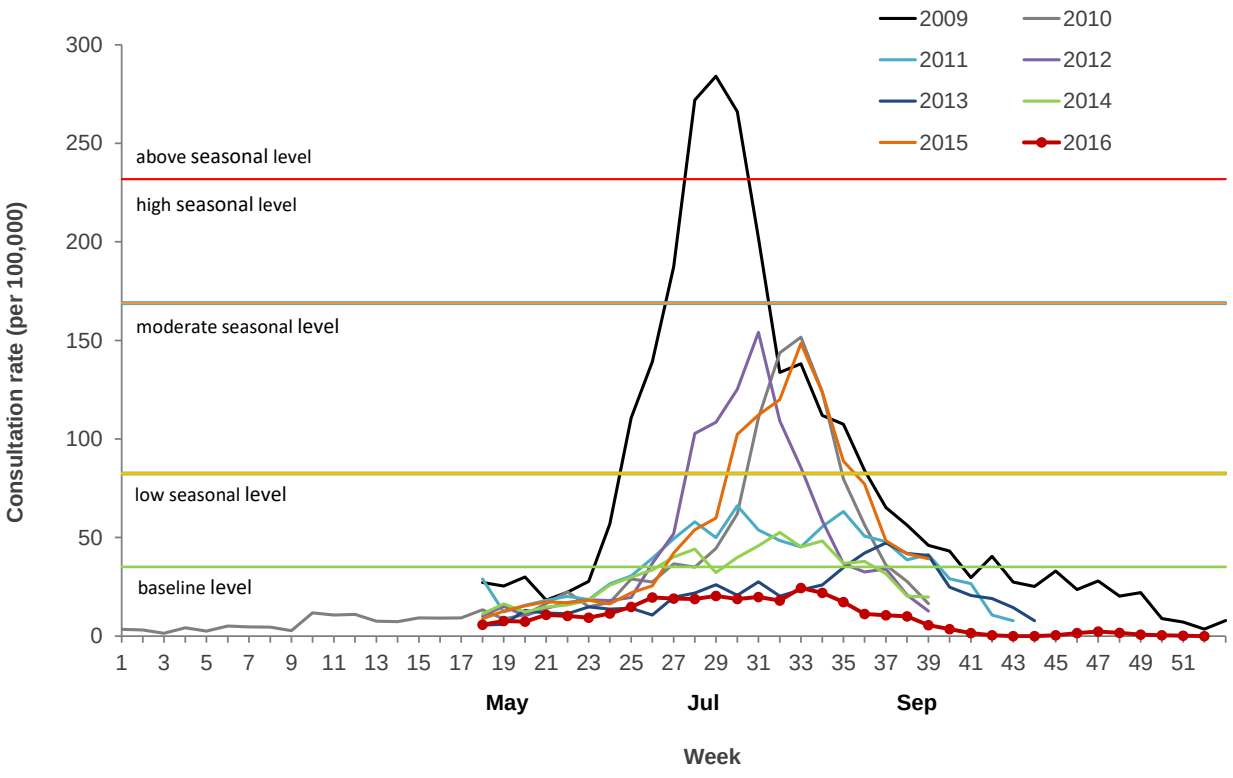


Figure 4 compares the weekly consultation rates for ILI in 2016 with the weekly consultation rates for ILI in 1992–2016. The peak ILI rate in 2016 was the lowest during the period 1992–2016 (the highest was in 1996, the second highest was in 2009 and second lowest in was 2000).

Figure 4. Weekly consultation rates for ILI in New Zealand, 1992–2016

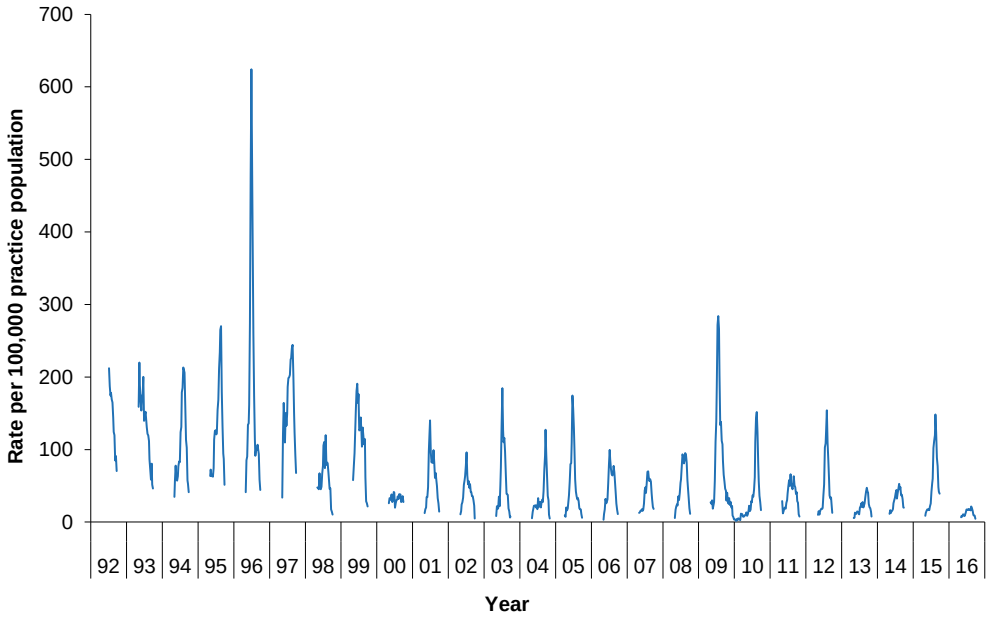
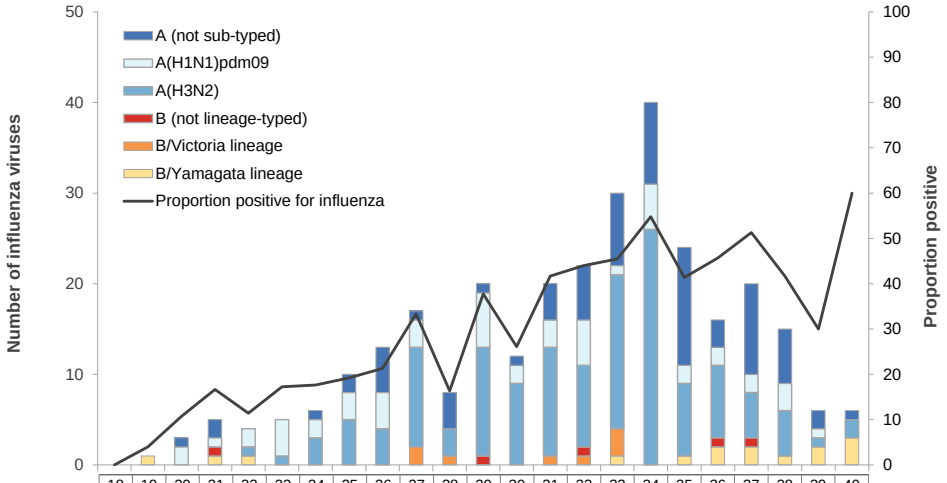


Figure 5 shows the temporal distribution of influenza viruses from sentinel surveillance from weeks 18–40. Peak influenza virus detection from sentinel surveillance occurred in week 34 (40 viruses). Influenza A (H3N2) viruses predominated during much of the 2016 influenza season (weeks 29–38) with a peak in week 34 (22–28 August), when 65.0% of all viruses detected were influenza A(H3N2).

Figure 5. Influenza viruses from sentinel surveillance by type and week reported, 2016



	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A (not sub-typed)	0	0	1	2	0	0	1	2	5	1	4	1	1	4	6	8	9	13	3	10	6	2	1
A(H1N1)pdm09	0	0	2	1	2	4	2	3	4	3	0	6	2	3	5	1	5	2	2	2	3	1	0
A(H3N2)	0	0	0	0	1	1	3	5	4	11	3	12	9	12	9	17	26	8	8	5	5	1	2
B (not lineage-typed)	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0
B/Victoria lineage	0	0	0	0	0	0	0	0	0	2	1	0	0	1	1	3	0	0	0	0	0	0	0
B/Yamagata lineage	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	1	2	3

Figure 6 shows the average weekly sentinel incidence rates for each DHB from May to December 2016. Weekly ILI incidence rates per 100,000 patient population varied among DHBs, with rates above the national average in Tairawhiti (38.5), South Canterbury (35.9), Canterbury (29.5), Capital & Coast (25.7), Waitemata (20.6) and Auckland (20.5).

Figure 6. Sentinel average weekly consultation rates for influenza by DHB from North to South, 2016

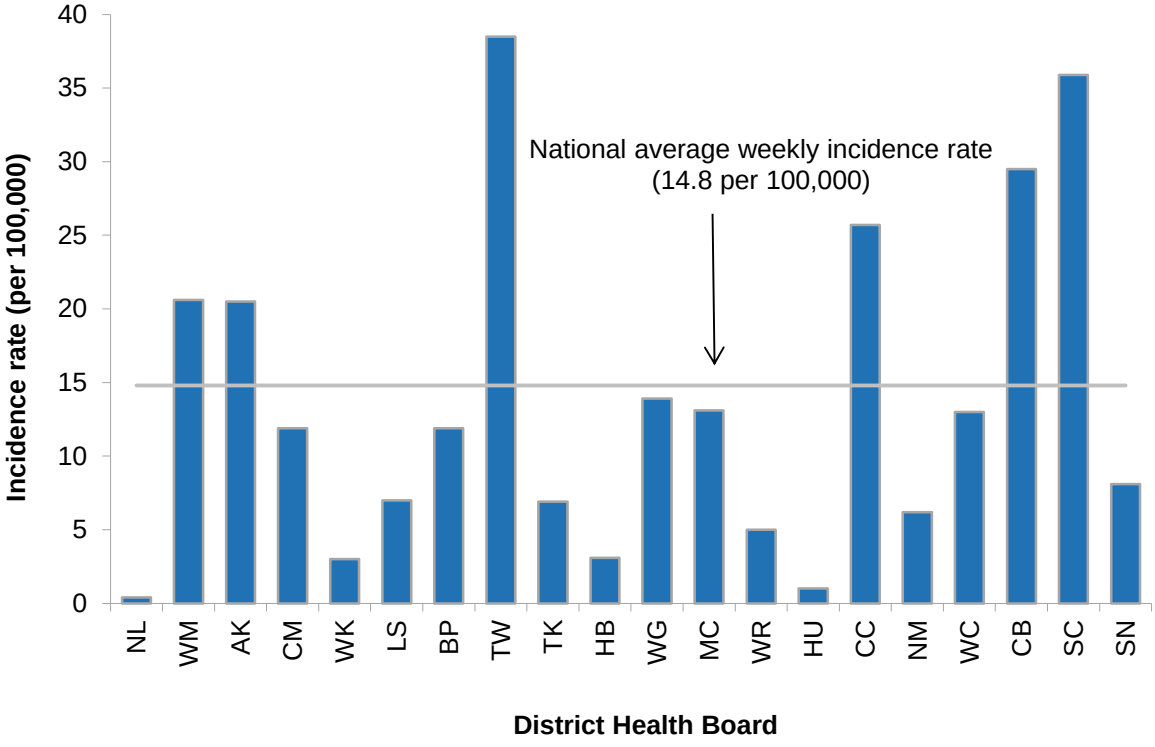


Table 3. DHB codes and descriptions

DHB code	DHB	DHB code	DHB
NL	Northland	WG	Whanganui
WM	Waitemata	MC	MidCentral
AK	Auckland	WR	Wairarapa
CM	Counties Manukau	HU	Hutt Valley
WK	Waikato	CC	Capital & Coast
LS	Lakes	NM	Nelson Marlborough
BP	Bay of Plenty	WC	West Coast
TW	Tairawhiti	CB	Canterbury
TK	Taranaki	SC	South Canterbury
HB	Hawke's Bay	SN	Southern

Figure 7 shows the distribution of sentinel influenza viruses based on the DHB from which the specimen (swab) was taken. Most viruses came from Auckland and Canterbury DHBs. Note: The Auckland, Wellington and Canterbury regions did enhanced surveillance (ie. swabbing every ILI patients seen).

Figure 7. Numbers of laboratory-confirmed influenza viruses from sentinel surveillance by DHB, May to September 2016

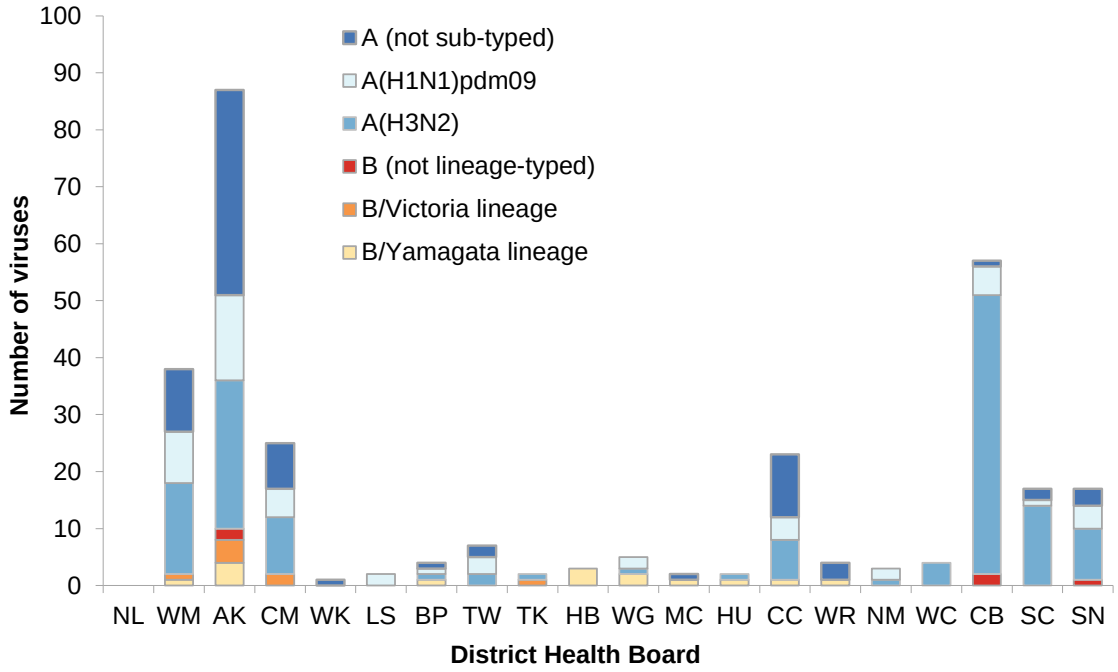
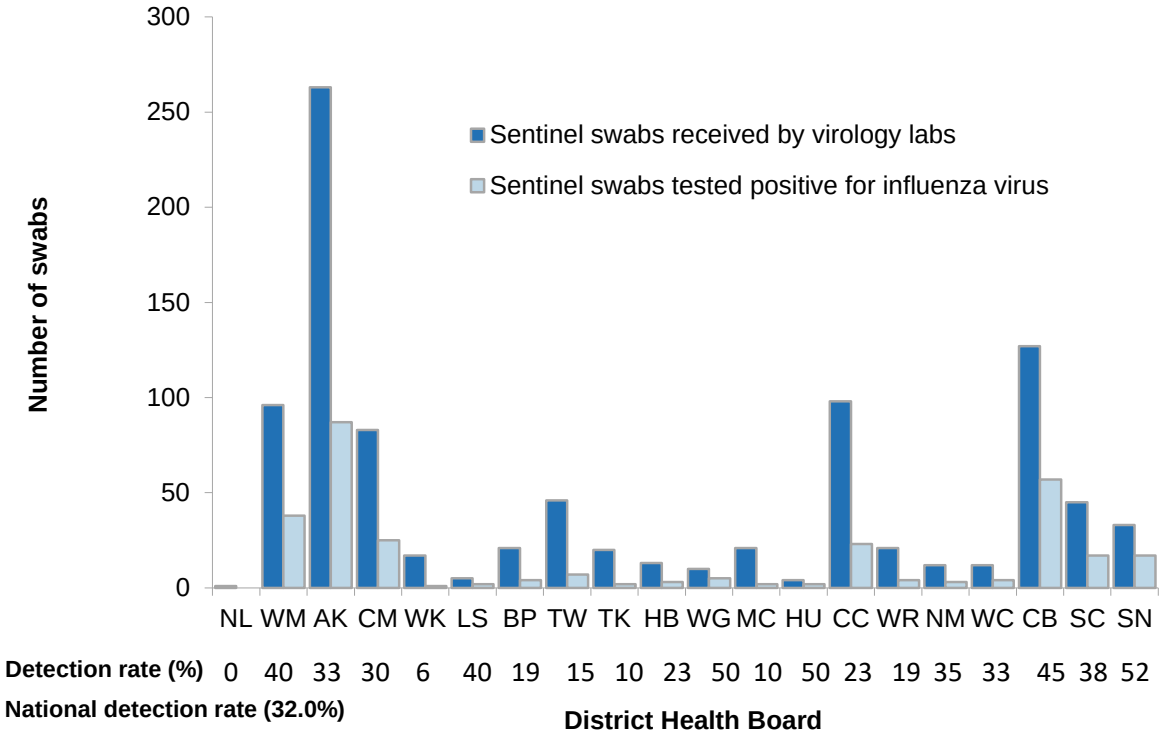


Figure 8 shows the number of swabs received and tested for influenza virus by DHB in 2016. Auckland, Wellington and Canterbury practices test all patients presenting with ILI while practices in the remaining DHBs tested the first, and in larger practices the first and second, ILI patient consulted on Monday, Tuesday and Wednesday of each week.

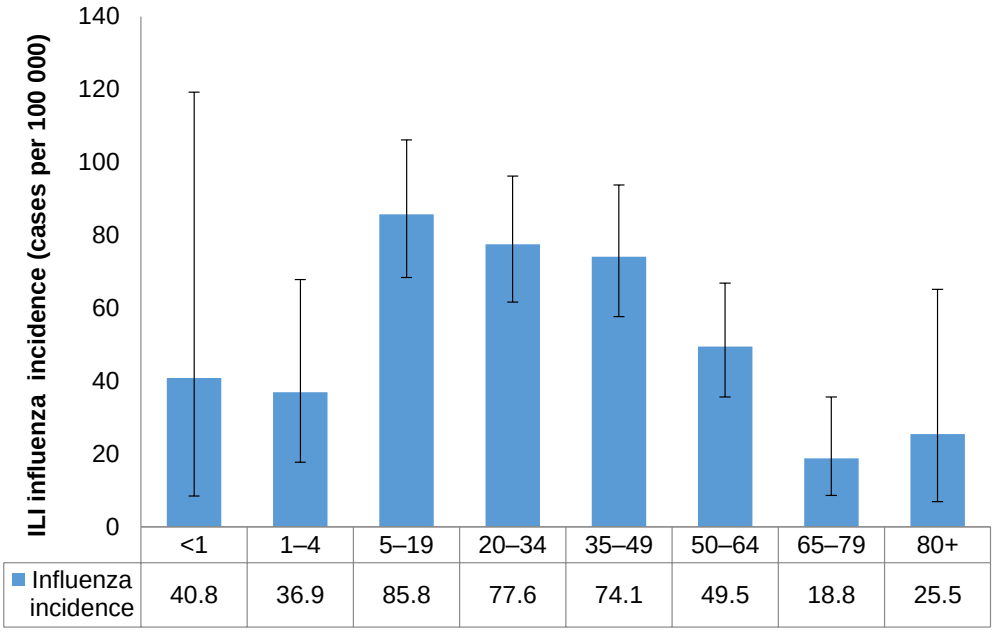
Figure 8. Sentinel swabs received and tested positive for influenza virus by DHB, 2016



Overall, 948 specimens were collected from 1557 ILI cases, giving the specimen collection rate of 60.9%. The national influenza virus detection rate for 2016 was 32.0% (303 viruses from 948 swabs received), which is lower than in 2015 (50.8%, 505 viruses from 995 swabs received), and in 2014 (37.2%, 273 viruses from 733 swabs received).

The ILI-associated influenza incidence by age group is shown in (Figure 9). Children aged 5–19 years had the highest ILI-associated influenza rates, followed by those aged 20–34 years, 35–49 years, and 50–64 years. The lowest rate was in adults aged 65–79 years and those aged 80 years and over.

Figure 9. ILI-associated influenza incidence rates by age-group, 2 May to 2 October 2016

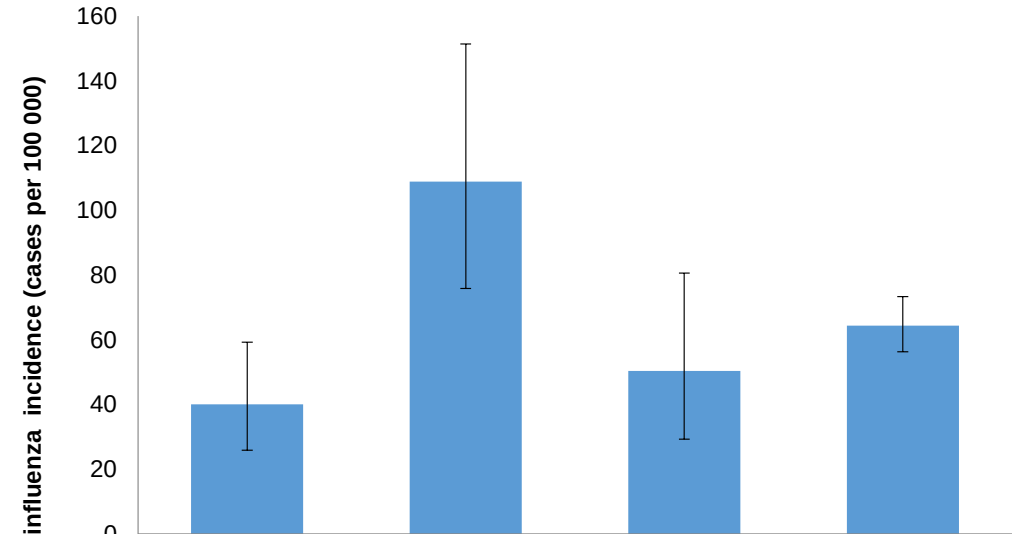


	<1	1–4	5–19	20–34	35–49	50–64	65–79	80+
Influenza incidence	40.8	36.9	85.8	77.6	74.1	49.5	18.8	25.5

The ILI-associated influenza incidence by ethnic group is shown in

Figure 10. People in the Pacific peoples and European or Other ethnic groups had higher ILI-associated influenza incidence than Asian and Māori ethnic groups.

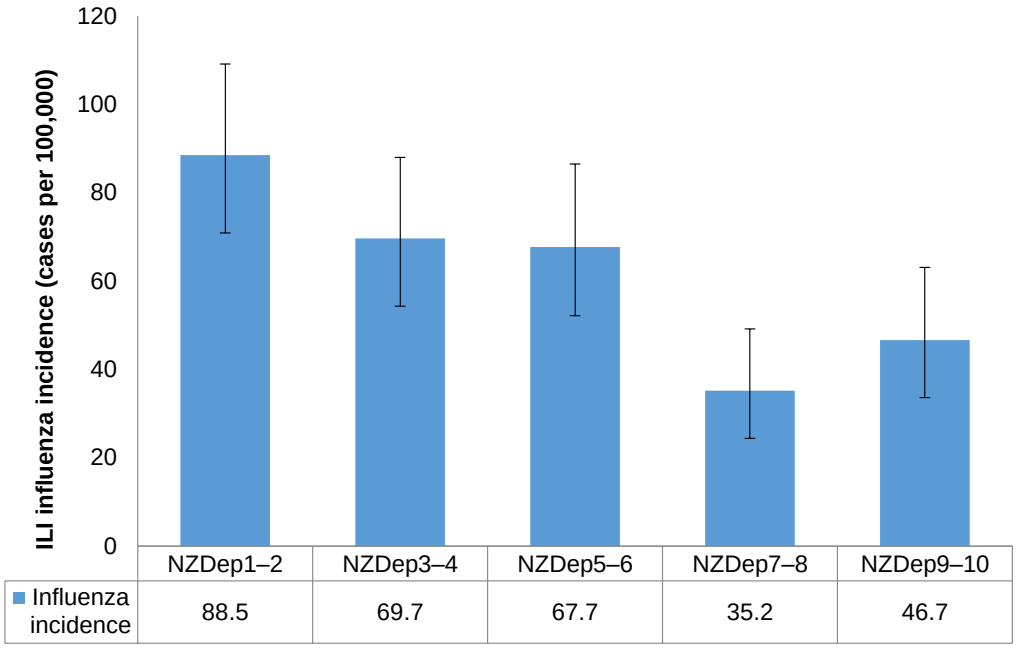
Figure 10. ILI-associated influenza incidence rates by ethnic groups, 2 May to 2 October 2016



	Māori	Pacific peoples	Asian	European or Other
Influenza incidence	40.2	108.9	50.4	64.4

The neighbourhood deprivation distribution of ILI-associated influenza cases is shown in Figure 11. The deprived quintile (NZDep7–8) had significantly lower incidence rate compared to the three less deprived quintiles (NZDep1–2, 3–4, 5–6).

Figure 11. ILI-associated influenza incidence rates by deprivation index (NZDep), 2 May to 2 October 2016



	NZDep1–2	NZDep3–4	NZDep5–6	NZDep7–8	NZDep9–10
Influenza incidence	88.5	69.7	67.7	35.2	46.7

INFLUENZA VIRUSES IDENTIFIED THROUGH ILI

From 2 May to 3 October 2016, a total of 948 specimens from patients with ILI were tested for influenza viruses, with 303 (32.0%) testing positive. The details are given in Table 4. Influenza A(H3N2) was the predominant strain.

Table 4. Influenza viruses in ILI cases, 2 May to 2 October 2016

Influenza viruses	ILI
	Cases (%)
No. of specimens tested	948
No. of positive specimens (%)[1]	303 (32.0)
Influenza A	275
A (not subtyped)	80
A (H1N1)pdm09	53
A(H1N1)pdm09 by PCR	44
A/California/7/2009 (H1N1) - like	9
A(H3N2)	142
A(H3N2) by PCR	98
A/Hong Kong/4801/2014-like	44
Influenza B	28
B (lineage not determined)	5
B/Yamagata lineage	15
B/Yamagata lineage by PCR	10
B/Phuket/3073/2013	5
B/Victoria lineage	8
B/Victoria lineage by PCR	5
B/Brisbane/60/2008 - like	3
Influenza and non-influenza co-detection (% of positives)	17 (5.6)

[1]Number of specimens positive for at least one of the listed influenza virus lineages.
(Note: A specimen may be positive for more than one influenza virus lineage.)
¥ This virus was the B vaccine component for NZ in 2016.
*This virus was the A(H1N1) vaccine component for NZ in 2016.

NON-INFLUENZA RESPIRATORY VIRUSES IDENTIFIED THROUGH ILI

From 2 May to 3 October 2016, a total of 941 ILI specimens were tested for non-influenza viruses and 286 (30.4%) tested positive (Table 11). Higher numbers of RSV and rhinovirus were detected compared to other non-influenza respiratory viruses.

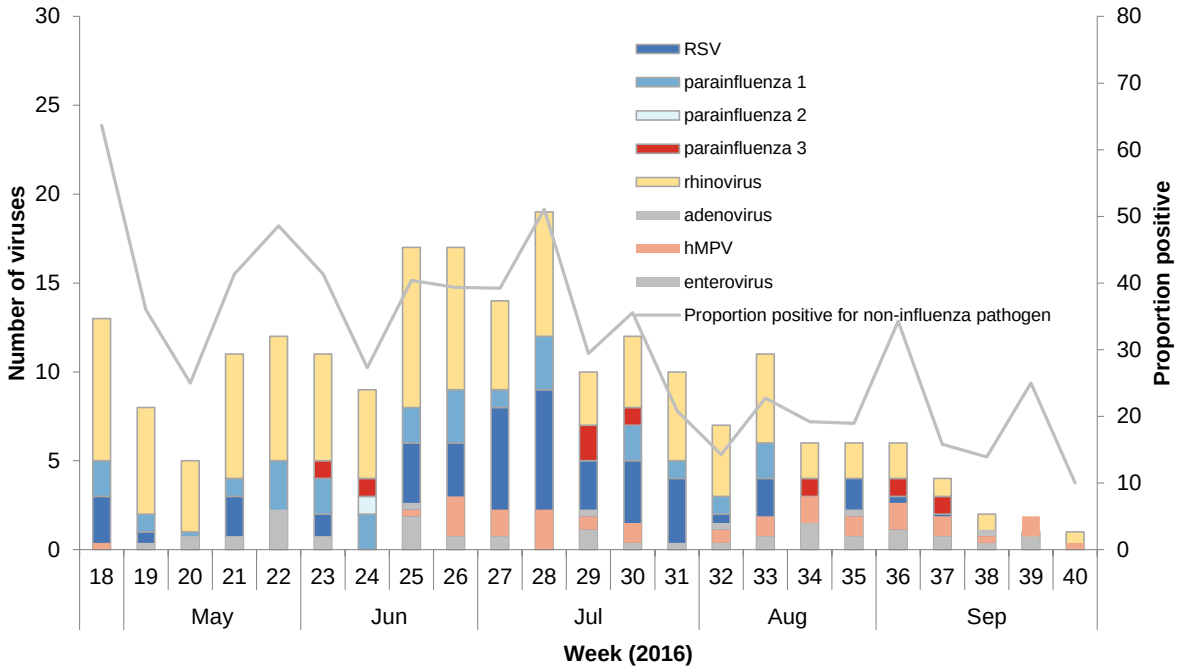
Table 5. Non-influenza respiratory viruses among ILI cases, 2 May to 2 October 2016

Non-influenza respiratory viruses	ILI Cases
No. of specimens tested	941
No. of positive specimens (%)[1]	286 (30.4)
Respiratory syncytial virus (RSV)	70
Parainfluenza 1 (PIV1)	28
Parainfluenza 2 (PIV2)	2
Parainfluenza 3 (PIV3)	9
Rhinovirus (RV)	103
Adenovirus (AdV)	37
Human metapneumovirus (hMPV)	47
Single virus detection (% of positives)	12 (4.2)
Multiple virus detection (% of positives)	265 (92.7)
Multiple virus detection (% positives)	21 (7.3)

[1]Number of specimens positive for at least one of the listed viruses.(Note: A specimen may be positive for more than one virus.)

The temporal distribution of the number and proportion of non-influenza viruses is shown in Figure 12. High RSV activity was recorded from week 25 (ending 26 June) to week 28 (ending 10 July). The proportion of rhinovirus among all non-influenza viruses remained at a constant level throughout the study period.

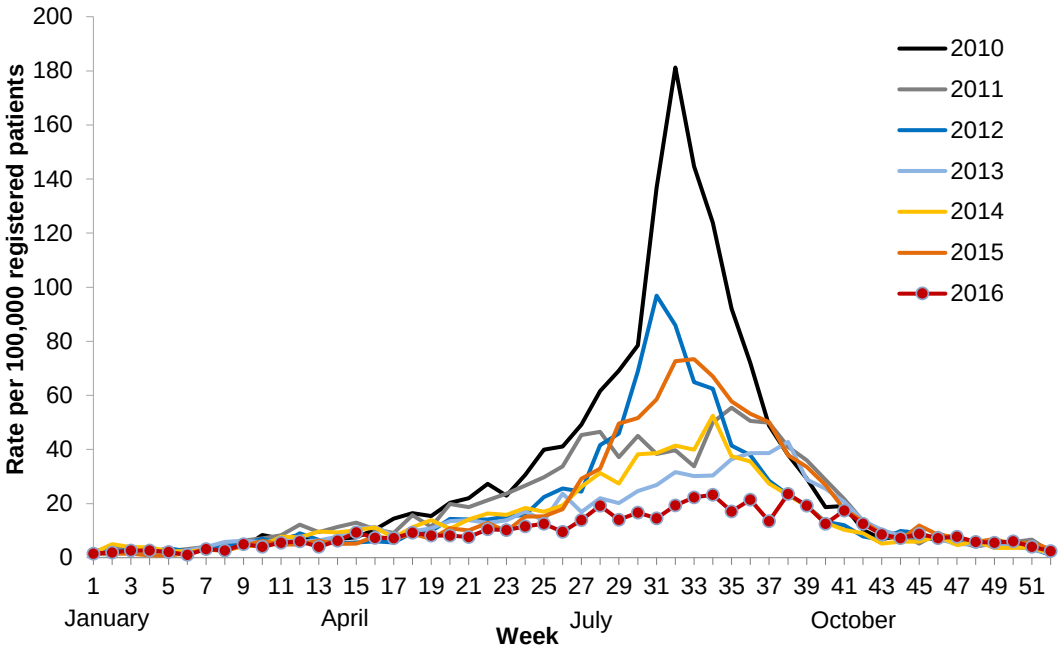
Figure 12. Temporal distribution of the number and proportion of non-influenza viruses from ILI specimens by type and week, 2 May to 2 October 2016



HEALTHSTAT GP-BASED SURVEILLANCE

Figure 13 shows the weekly rate of ILI consultations per 100,000 general practice patients collected by HealthStat sentinel GPs from 2010 to 2016. The ILI rate in 2016 was similar to the yearly rate in 2013.

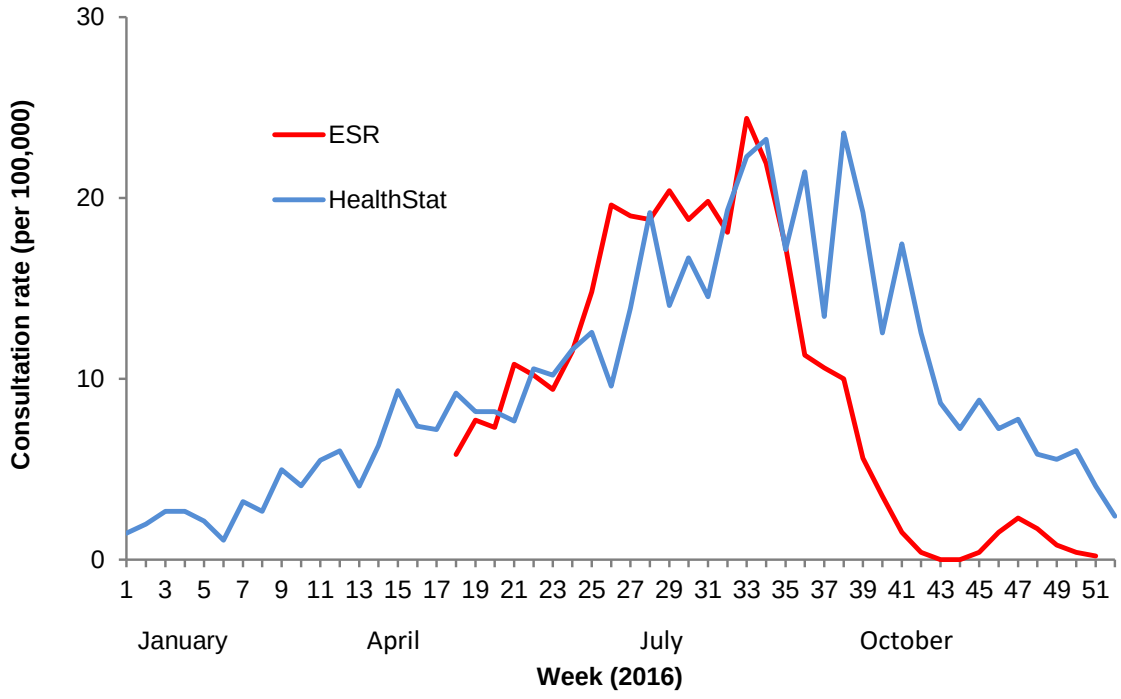
Figure 13. HealthStat ILI consultation rates by week from 2010–2016



Data source: From responding practices of original HealthStat GP practice panel.

Overall, the trend of the 2016 HealthStat data is similar to ESR's sentinel GP surveillance (Figure 14).

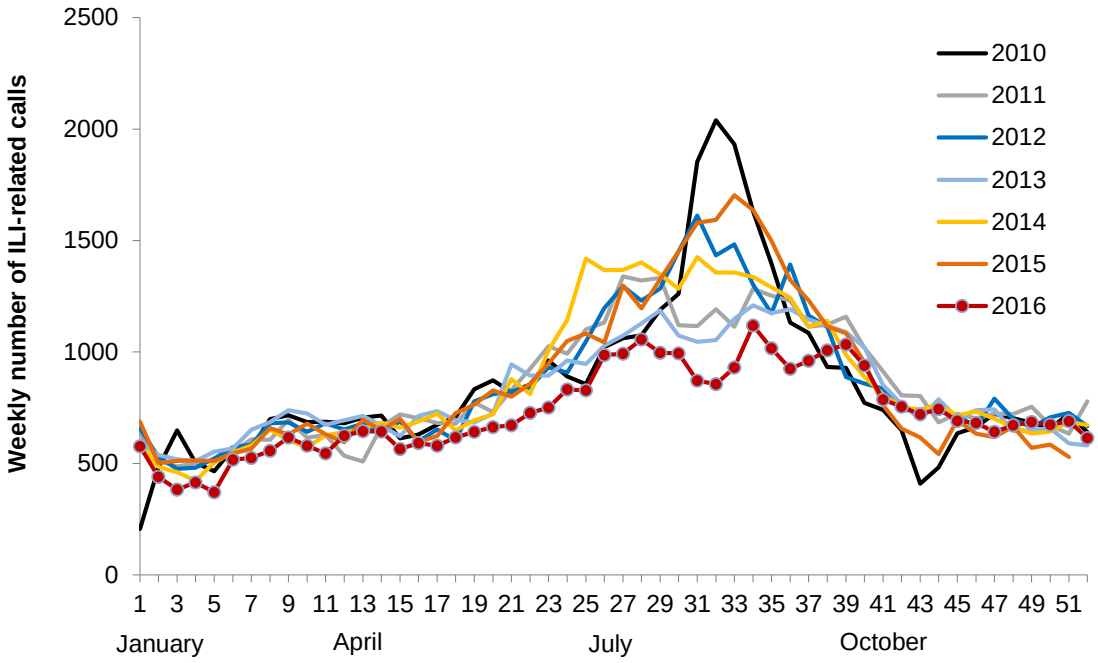
Figure 14. ESR and HealthStat ILI consultation rates, 2016



HEALTHLINE

Figure 15 shows the weekly number of calls to Healthline for ILI from 2010 to 2016. The number of calls in 2016 was lower than the number in 2015. In 2016, Healthline calls peaked in week 34 (ending 28 August), with 1119 ILI-related calls.

Figure 15. Weekly numbers of ILI related calls to Healthline in 2010–2016



Data source: Healthline New Zealand.

HOSPITAL-BASED SURVEILLANCE

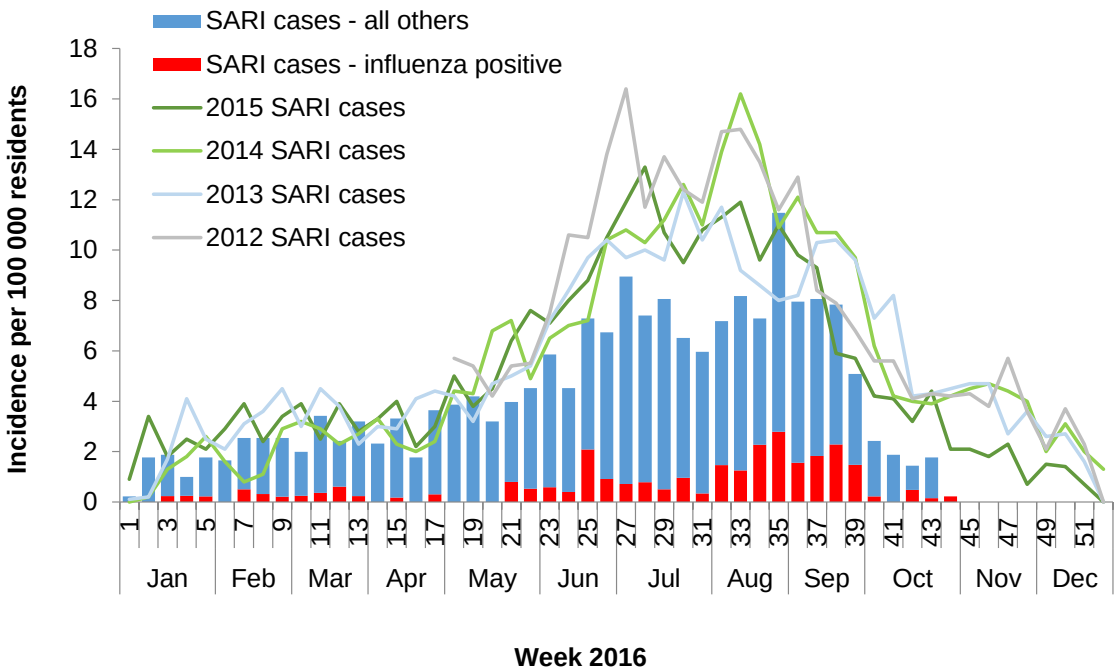
HOSPITAL-BASED SURVEILLANCE FOR SEVERE ACUTE RESPIRATORY INFECTIONS

During the SARI surveillance period, from 4 January 2016 to 30 October 2016, there were 117,455 acute admissions to ADHB and CMDHB hospitals. A total of 5174 (4.4%) patients with suspected respiratory infections were assessed in these hospitals (Appendix Table 14). Of these, 1922 (37.1%) patients met the SARI case definition. Among these SARI patients, 1196 (62.2%) had a laboratory PCR test for influenza. Of these, 178 (14.9%) had an influenza virus detected.

Of the 5174 patients with suspected respiratory infection, 3252 (62.9%) did not meet the SARI case definition. A total of 1512 (46.5%) of these non-SARI respiratory cases were also tested for influenza viruses. Among the tested non-SARI respiratory cases, 82 (5.4%) had influenza viruses detected.

In 2016, there were 13.8 SARI cases per 1000 acute hospitalisations, which is lower than the 19.1 per 1000 hospitalisations during the same period in 2015.The temporal distribution of SARI influenza cases (those meeting the SARI definition and positive for influenza) and non-influenza SARI cases in 2016 is shown in Figure 16.

Figure 16. Weekly SARI and influenza incidence, 2016



The overall SARI activity in 2016 was at a low level. This is based on SARI hospitalisation rates during 2012–2015 and using the MEM to define the start and intensity level of the influenza season. Among SARI cases reported in 2016, 1717 (88.6%) were residents of ADHB and CMDHB, giving a cumulative SARI incidence of 189.8 per 100,000 population (95% CI: 181.0, 199.0) (Figure 17). This was lower than the 269.6 cases per 100,000 (95% CI: 238.3, 304.2) population during 2015. The weekly SARI rate peaked at 11.5 per 100,000 (week 35, ending 4 September) within the

range of the low intensity level (8.0-12.1 per 100,000). Figure 17 shows the weekly SARI rate for 2016 in relation to the intensity levels during 2012–2015.

The overall SARI-associated influenza activity during 2016 was at a low seasonal level using the MEM to define the start of influenza season and intensity level of the SARI. Of the 178 SARI-associated influenza cases, 161 (90.4%) were residents of ADHB or CMDHB, which gives a cumulative influenza incidence of 18.0 (95% CI: 15.3, 21.0) per 100,000 population (Figure 18). This SARI-associated influenza rate is lower than the 38.4 (95% CI: 34.5, 42.7) per 100,000 population recorded in 2015. The weekly SARI associated influenza rate peaked at 2.8 per 100,000 (week 35, ending 4 September), within the low intensity level (0.8-3.1 per 100,000). Figure 17 and Figure 18 demonstrate that the 2016 season had low SARI and influenza-associated SARI intensity.

Figure 17. Weekly hospitalisation rates for SARI in 2016 compared to 2012–2015

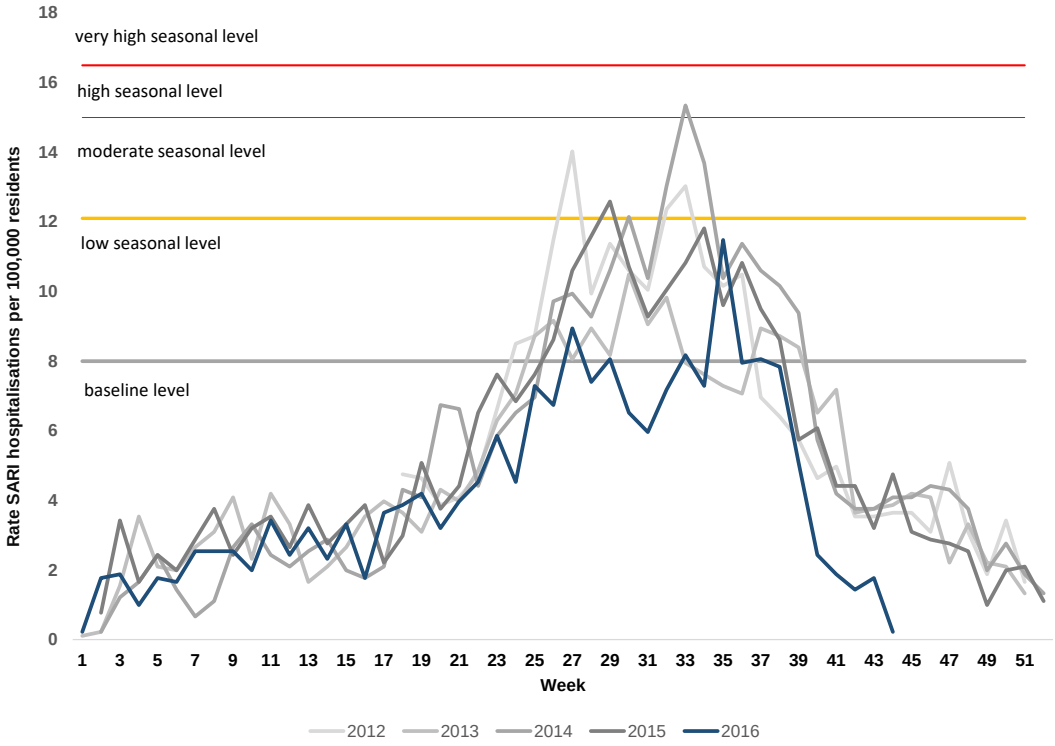
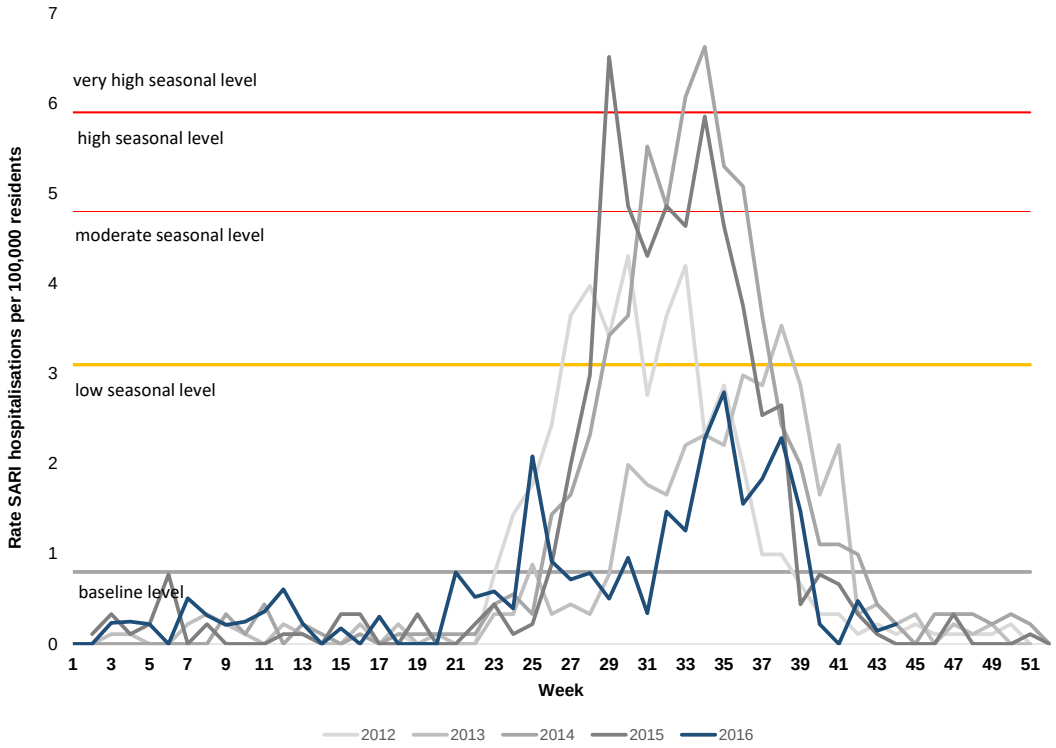


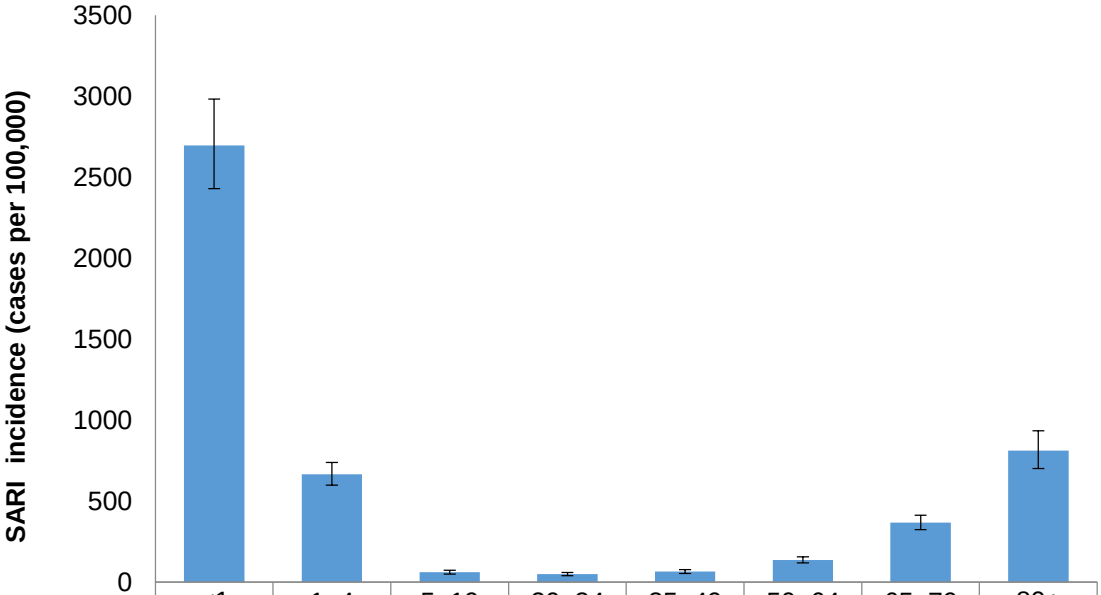
Figure 18. Weekly hospitalisation rates for SARI-associated influenza in 2016 compared to 2012–2015



Extrapolating SARI and related influenza hospitalisations obtained in 2016 from the ADHB and CMDHB population to the New Zealand, it is estimated that in 2016 there were 8,902 New Zealanders hospitalised with SARI of which 844 would have been influenza positive.

The cumulative SARI incidence by age group for 2016 is shown in Figure 19. The highest rate of SARI hospitalisation was recorded in infants aged <1 year (2695.1 per 100,000) followed by those aged 80 years and over (810.9 per 100,000). In comparison Infants and elderly have the lowest rate of ILI consultations overall or influenza associated ILI incidence Figure 19.

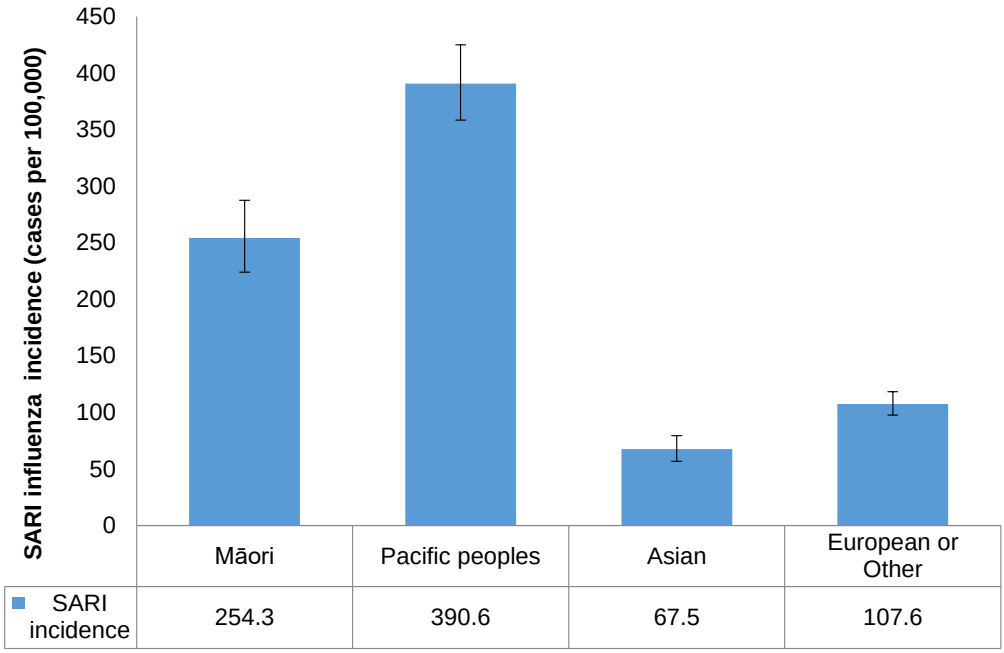
Figure 19. Cumulative SARI hospitalisation incidence rates by age group, 2016



	<1	1–4	5–19	20–34	35–49	50–64	65–79	80+
SARI incidence	2695.1	665.7	60.2	48.5	64.4	136.2	366.7	810.9

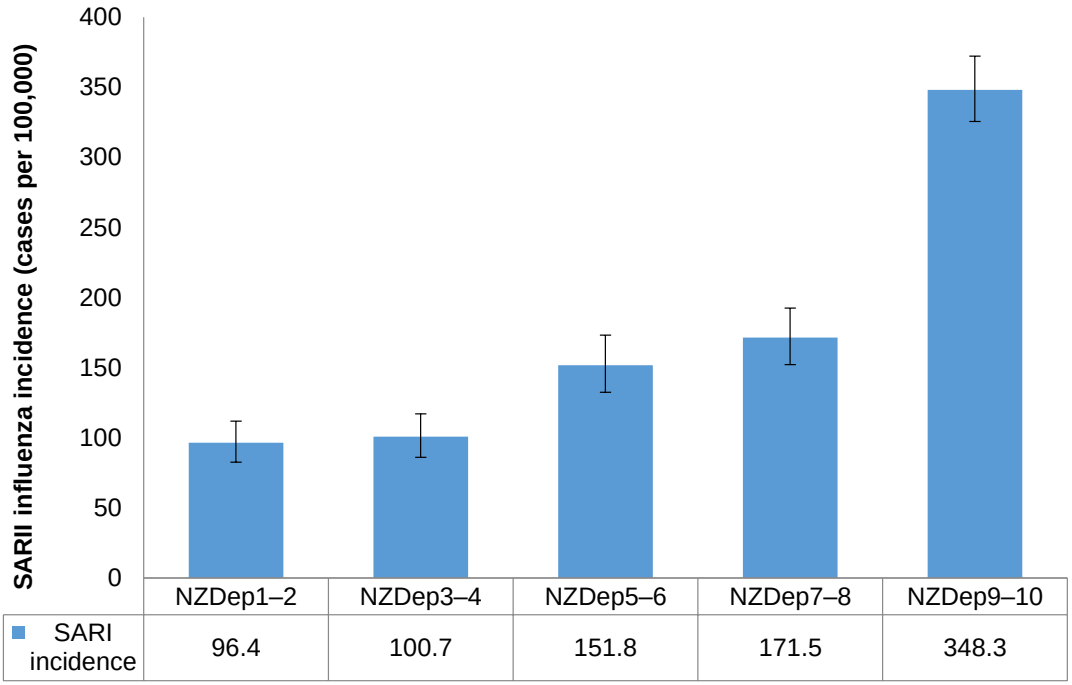
The cumulative SARI-associated influenza incidence by ethnic group for 2016 is shown in Figure 20. Pacific peoples had the highest hospitalisation rate. This was followed by Māori, European or Other and Asian ethnic groups. Overall, Pacific peoples and Māori ethnic groups had significantly higher SARI-associated influenza incidence rates compared to Asian and European or Other ethnic groups. This rate for Pacific people was almost twice as high as that of Māori people.

Figure 20. SARI-associated influenza hospitalisation incidence rates by ethnic group, 2016



Rates of influenza incidence among SARI cases by deprivation index (NZDep) are shown in Figure 21. Cases in the most deprived quintile (NZDep9–10) had a significantly higher rate compared to all other quintiles, which is similar to the 2015 and 2014 results.

Figure 21. SARI-associated influenza hospitalisation incidence rates by NZDep, 2016



	NZDep1–2	NZDep3–4	NZDep5–6	NZDep7–8	NZDep9–10
SARI incidence	96.4	100.7	151.8	171.5	348.3

INTENSIVE CARE UNIT (ICU) ADMISSIONS AND DEATHS (SEVERE HOSPITAL OUTCOMES)

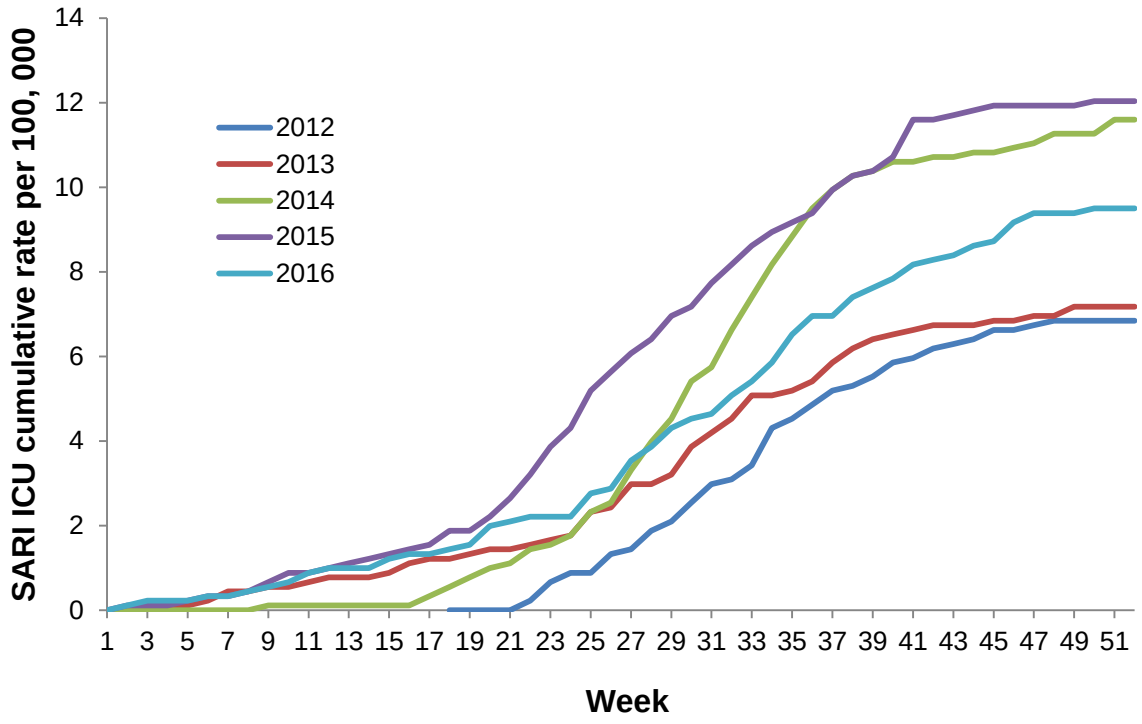
A measure of the severity of an acute hospitalisation is an admission to an ICU, or death recorded while in ADHB and CMDHB hospitals. In 2016, 317 (36.4%) of the 872 ICU admissions had acute respiratory illness (ARI). The cumulative incidence rate of the ICU patients with ARI was 21.6 per 100,000 (Appendix Table 15). A total of 15 (5.5%, 15/274 of tested) of the ICU patients with ARI were positive for influenza viruses. The influenza incidence rate of the ICU patients with ARI among Auckland residents was 1.0 per 100,000 (95% CI: 0.5, 1.9).

Of the 317 assessed ICU patients with ARI, 151 (47.6%, 151/317) met the SARI case definition (Appendix Table 14). The proportion of the ICU patients with SARI among total ICU admissions was 17.3% (151/872), higher than the 15.7% in 2015. The cumulative incidence rate of the ICU patients with SARI was 9.5 per 100,000, lower than the 12.0 per 100,000 in 2015. A total of 14 (10.4%, 14/135 of tested) of the ICU patients with SARI were positive for influenza viruses. The influenza incidence of the ICU patients with SARI was 0.9 per 100,000 (95% CI: 0.4, 1.7), lower than the 1.7 per 100,000 in 2015.

The proportion of the ICU patients with SARI among total SARI cases was 7.9% (151/1922), higher than the 6.6% in 2015.

The cumulative incidence rates of the ICU patients with SARI during 2016 was compared to the previous years 2012–2015 (Figure 22). The 2016 and 2015 cumulative incidence rates were higher than 2012 and 2013.

Figure 22. Cumulative incidence rates of ICU cases with SARI among ADHB and CMDHB residents, 2016



The influenza incidence rate for the ICU patients with SARI was about two times higher among Māori compared to the Other ethnic group, and concentrated among young children and older adults. The same finding was observed in 2015.

During 2016, in ADHB and CMDHB a total of 918 hospital deaths were recorded from all causes. Of these, 62 (6.8%, 62/918) died from ARI. Of these 62 deaths with ARI, 22 were at ADHB and 40 at CMDHB. Of the 62 deaths with ARI, 22 had been tested for influenza virus with 2 found to be positive (9.1%, 2/22 tested). The influenza incidence rate of the deaths with ARI was 0.2 per 100,000 (95% CI: 0.0, 0.8).

Of the 62 assessed deaths with ARI, 12 (19.4%, 12/62) met the SARI case definition. The proportion of the deaths with SARI among total hospital deaths was 1.3% (12/918), which is lower than 2015 (4.3%). The proportion of deaths among SARI cases was 0.6% (12/1922), which is higher than 2015 (1.5%). Of the 5 SARI deaths with viral testing, 1 (20.0%) was positive for an influenza virus. The influenza incidence rate of the deaths with SARI was 0.1 per 100,000 (95% CI: 0.0, 0.6), which is lower than the rate (0.3 per 100,000) in 2015.

UNDERLYING CONDITIONS

During 2016, among all consented children aged <15 years admitted to hospital with SARI, 87.9% (401/456) did not have a reported underlying condition. In children with SARI-associated influenza, 9.8% (4/41) had at least one reported underlying condition (Table 6); whereas, 12.3% (51/415) of the children without influenza had at least one underlying condition.

Table 6. Underlying conditions among the SARI children (<15 years) with or without influenza, 2016

Underlying conditions (Children aged <15 years)	Influenza positive SARI hospitalisations		Influenza negative SARI hospitalisations	
	N	(%)	N	(%)
Total	41	(100.0)	415	(100.0)
Asthma	0	(0.0)	10	(2.4)
Chronic respiratory disease	2	(4.9)	11	(2.7)
Cardiovascular conditions	0	(0.0)	11	(2.7)
Neurological/Cerebrovascular	2	(4.9)	15	(3.6)
Diabetes	0	(0.0)	1	(0.2)
Renal conditions	0	(0.0)	3	(0.7)
Liver conditions	0	(0.0)	1	(0.2)
Cancer	0	(0.0)	3	(0.7)
Immune-compromised	0	(0.0)	2	(0.5)
None of the above conditions	37	(90.2)	364	(87.7)

During 2016, among all consented SARI adults aged ≥ 15 years admitted to hospital, 68.0% (244/359) reported at least one underlying condition. Of all SARI adults with influenza, 69.2% (54/78) had at least one underlying condition, while of all adults without influenza, 67.6% (190/281) reported having at least one underlying condition (Table 7). Cardiovascular conditions were the most commonly reported underlying conditions in both adults with influenza (30.8%, 24/78) and those without (34.9%, 98/281).

Table 7. Underlying conditions among the SARI adults with or without influenza, 2016

Underlying conditions (adults aged ≥15 years)	Influenza positive SARI hospitalisations		Influenza negative SARI hospitalisations	
	N	(%)	N	(%)
Total	78	(100.0)	281	(100.0)
Asthma	22	(28.2)	56	(19.9)
Chronic respiratory disease	15	(19.2)	80	(28.5)
Cardiovascular conditions	24	(30.8)	98	(34.9)
Cerebrovascular	3	(3.8)	6	(2.1)
Diabetes	13	(16.7)	60	(21.4)
Renal conditions	7	(9.0)	25	(8.9)
Liver conditions	1	(1.3)	9	(3.2)
Cancer	4	(5.1)	16	(5.7)
Immune-compromised	1	(1.3)	10	(3.6)
None of the above conditions	24	(30.8)	91	(32.4)

INFLUENZA VIRUSES IDENTIFIED IN HOSPITAL PATIENTS

In 2016, 1391 specimens from SARI patients were tested and 197 (14.2%) were positive for influenza viruses, including 171 for influenza A and 26 for influenza B viruses (Table 8).

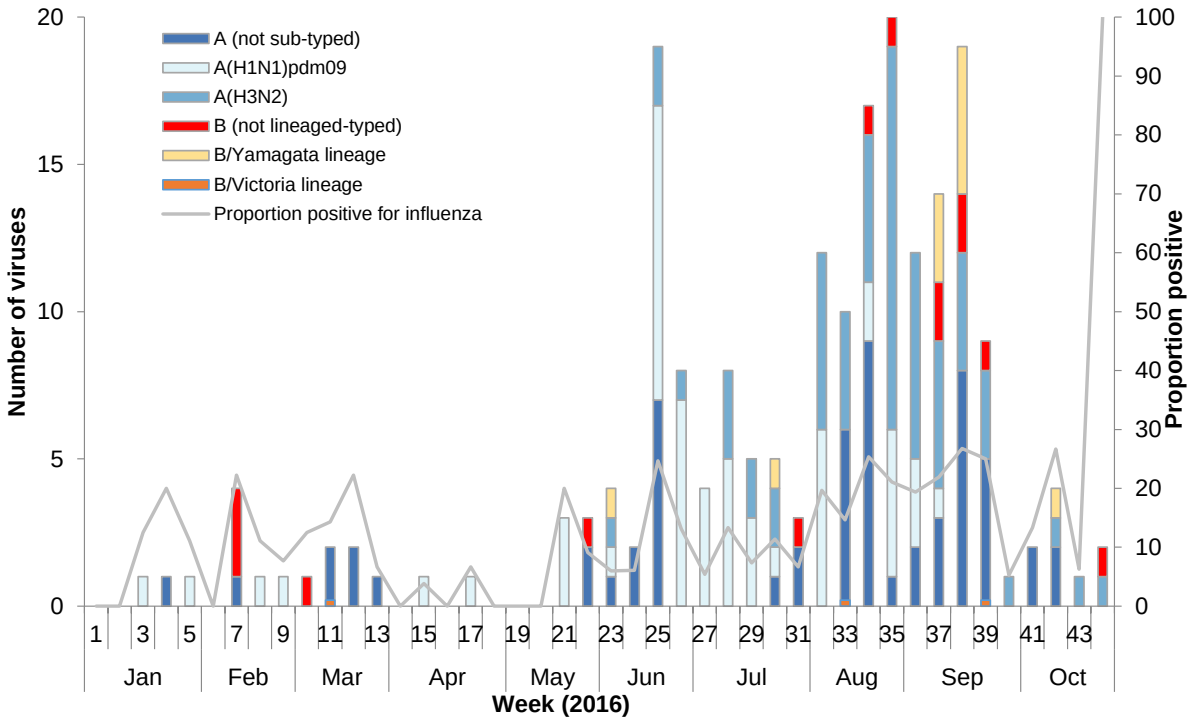
Table 8. Influenza viruses among SARI cases, 2016

Influenza viruses	SARI	ARI	
	Cases (%)	ICU (%)	Deaths (%)
No. of specimens tested	1391	135	5
No. of positive specimens (%)[1]	197 (14.2)	15 (11.1)	1 (20.0)
Influenza A	171	13	0
A (not subtyped)	56	8	0
A(H1N1)pdm09	57	2	0
A(H1N1)pdm09 by PCR	45	1	0
A/California/7/2009 (H1N1)pdm09 - like	12	1	0
A(H3N2)	58	3	0
A(H3N2) by PCR	50	3	0
A/Hong Kong/4801/2014 (H3N2) - like	8	0	0
Influenza B	26	2	1
B (lineage not determined)	13	1	0
B/Yamagata lineage	10	1	1
B/Yamagata lineage by PCR	3	1	1
B/Phuket/3073/2013 - like	7	0	0
B/Victoria lineage	3	0	0
B/Victoria lineage by PCR	0	0	0
B/Brisbane/60/2008 - like	3	0	0
Influenza and non-influenza co-detection (% +ve)	18 (9.1)	3 (20.0)	0 (0.0)

[1]Number of specimens positive for at least one of the listed influenza virus lineages.
(Note: A specimen may be positive for more than one influenza virus lineage.)
¥ This virus was the B vaccine component for NZ in 2016.
*This virus was the A(H1N1) vaccine component for NZ in 2016.

The temporal distribution of the number and proportion of the influenza viruses from SARI patients is shown in Figure 23. Influenza A(H1N1)pdm09 was the predominant strain from week 25 (ending 26 June) to week 32 (ending 14 August). From week 33 (ending 21 August) influenza A(H3N2) became the predominant strain. The highest numbers of SARI-associated influenza viruses were detected in weeks 25 (ending 26 June), 35 (ending 4 September) and 39 (ending 2 October).

Figure 23. Temporal distribution of the number and proportion of influenza viruses from SARI specimens by type and week, 2016



NON-INFLUENZA RESPIRATORY VIRUSES IDENTIFIED IN HOSPITAL PATIENTS

In addition to testing for influenza viruses, specimens from the SARI surveillance were also tested for the presence of eight non-influenza viruses. In 2016, 1056 SARI specimens were tested for non-influenza respiratory viruses. Of these, 492 (46.6%) were positive. Details are given in Table 9.

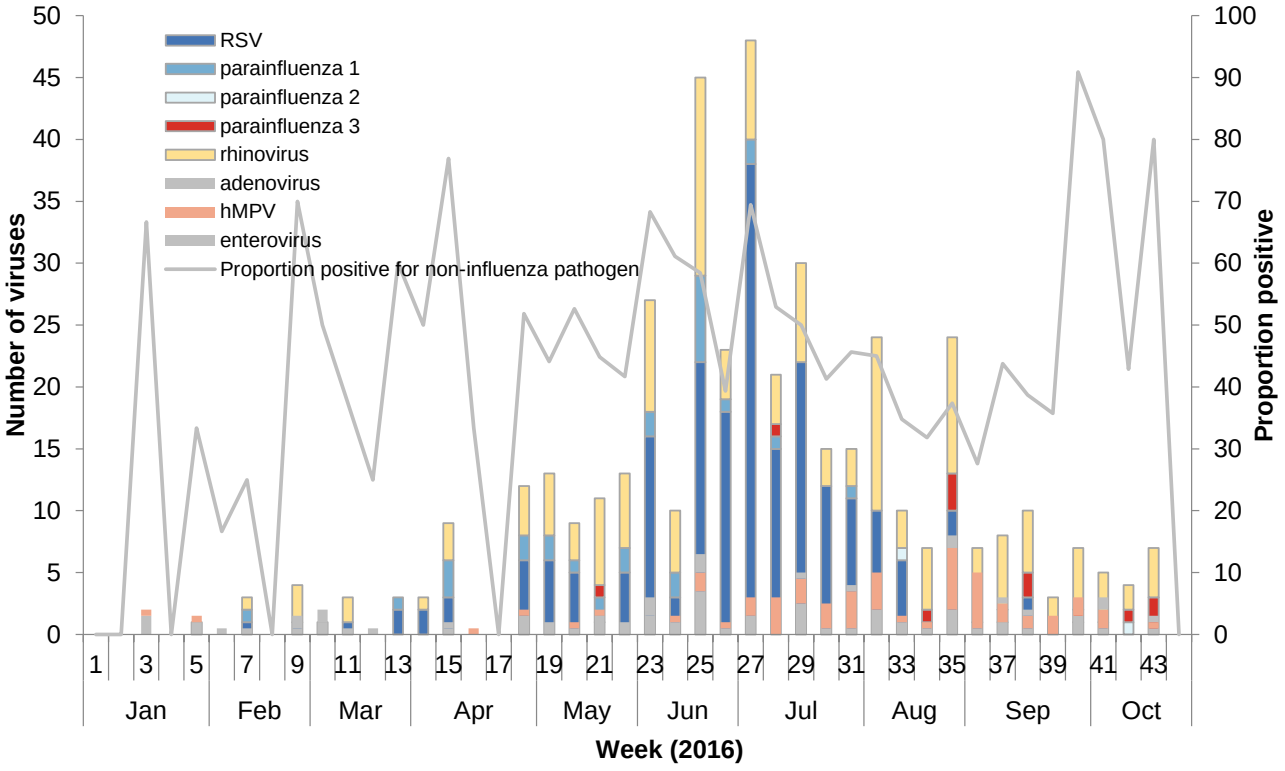
Table 9. Non-influenza respiratory viruses among SARI cases, 2016

Non-influenza respiratory viruses	SARI	ARI	
	Cases (%)	ICU (%)	Deaths (%)
No. of specimens tested	1056	180	16
No. of positive specimens (%)[1]	492 (46.6)	103 (57.2)	3 (18.8)
Respiratory syncytial virus (RSV)	224	36	2
Parainfluenza 1 (PIV1)	31	4	0
Parainfluenza 2 (PIV2)	2	0	0
Parainfluenza 3 (PIV3)	8	6	0
Rhinovirus (RV)	147	46	1
Adenovirus (AdV)	60	19	0
Human metapneumovirus (hMPV)	69	10	0
Enterovirus	19	10	0
Single virus detection (% of positives)	431 (87.6)	78 (75.7)	0 (-)
Multiple virus detection (% of positives)	60 (12.2)	24 (23.3)	0 (-)

[1]Number of specimens positive for at least one of the listed viruses. (Note: A specimen may be positive for more than one virus.)

The temporal distribution of the number and proportion of non-influenza respiratory viruses is shown in Figure 24. High RSV activity occurred between weeks 23 (ending 12 June) and 32 (ending 14 August). RSV activity peaked in week 27 (ending 10 July). The proportion of rhinovirus remained approximately constant from May to September with a peak in week 25 (ending 26 June).

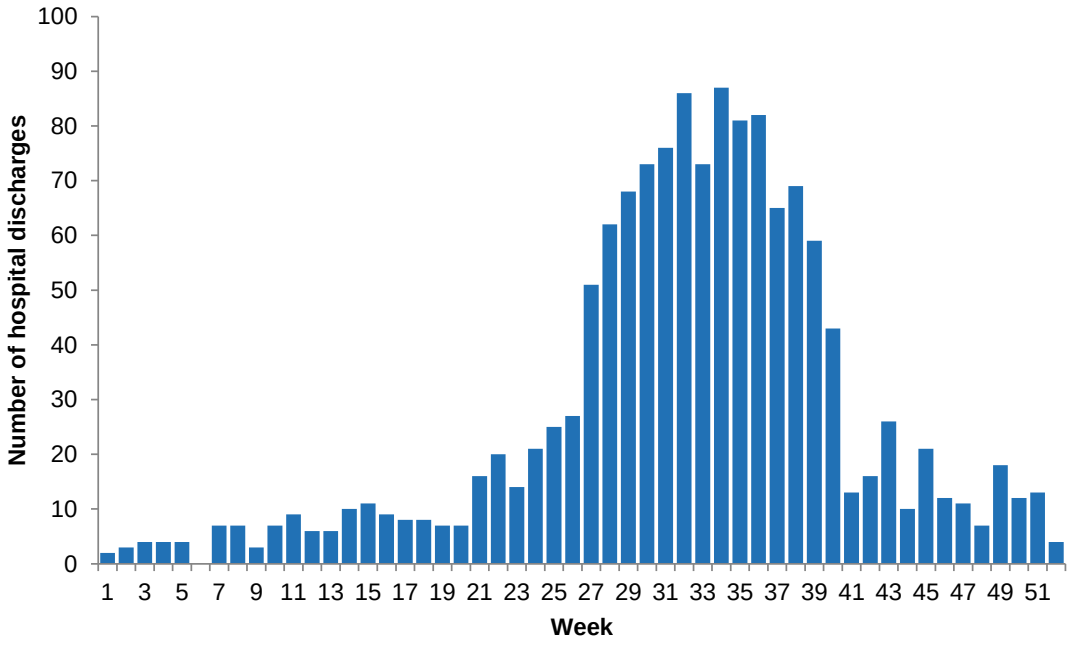
Figure 24. Temporal distribution of the number and proportion of non-influenza viruses from SARI specimens by type and week, 2016



MINISTRY OF HEALTH DATA ON PUBLICLY FUNDED HOSPITAL DISCHARGES

Influenza hospitalisations by week discharged are shown in Figure 25 and indicate that 70.5% (975) of influenza hospitalisations occurred from weeks 27–40. The highest number of hospitalisations (363) occurred in August (weeks 31–35). Hospitalisations peaked in weeks 32 and 34—similar to national sentinel virus peak (week 34) and national sentinel ILI consultations (week 33). Laboratory-based virus detections peaked in weeks 33 and 34.

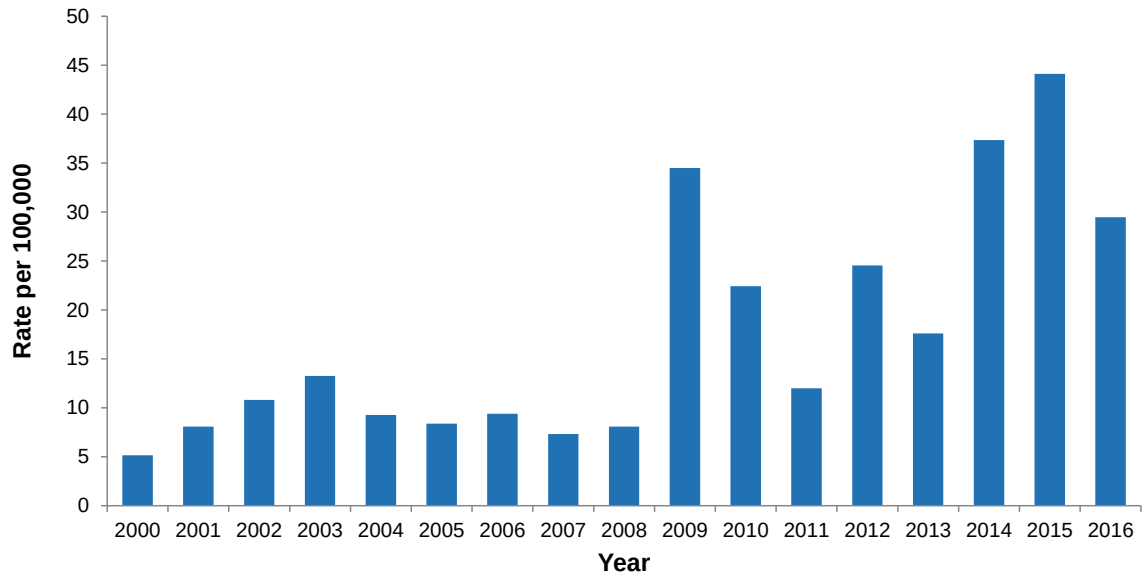
Figure 25. Influenza hospital discharges by week, 2016



Data source: Ministry of Health, NMDS (Hospital Events).

The number of influenza hospitalisations in 2016 ranked the fourth highest during the period from 2000 to 2016 (Figure 26). In 2016, there were 1383 (29.5 per 100,000) hospitalisations for influenza compared with 2028 (44.1 per 100,000) hospitalisations in 2015 and 1684 (37.3 per 100,000) in 2014.

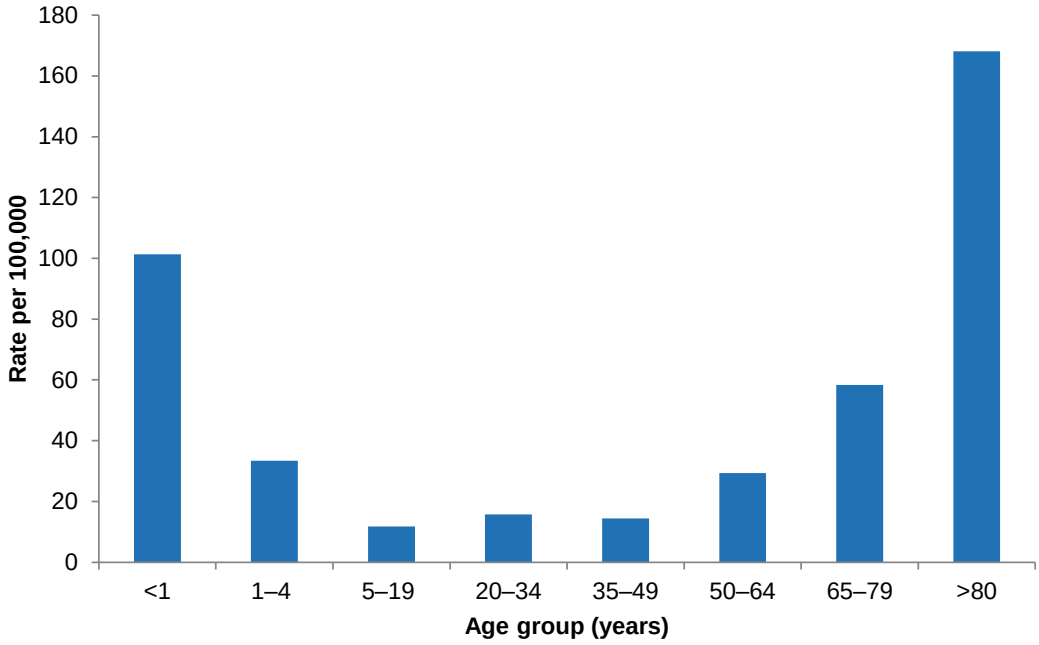
Figure 26. Influenza hospital discharge rates, 2000–2016



Data source: Ministry of Health, NMDS (Hospital Events).

Figure 27 stratifies influenza hospitalisation rates in 2016 by age group. In 2016, by far the highest hospitalisation rates occurred in adults aged 80 years and over (168.1 per 100,000 patient population). This was almost two times the next highest rate of 101.3 per 100,000 for children aged less than one year.

Figure 27. Influenza hospital discharge rates by age group, 2016

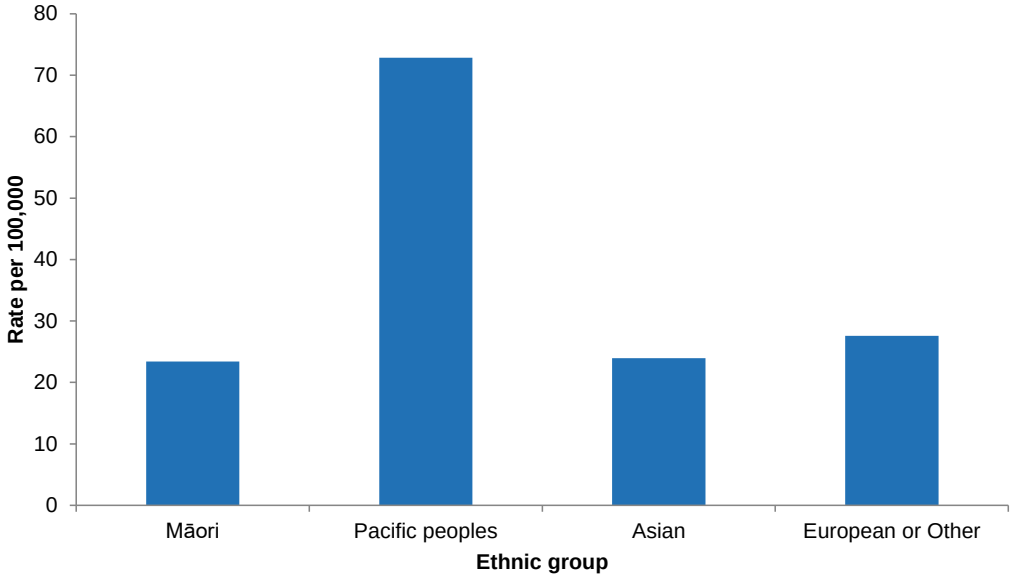


Data source: Ministry of Health, NMDS (Hospital Events).

The ethnic distribution of influenza hospitalisations in 2016 is shown in Figure 28. Pacific peoples had the highest hospitalisation rate (72.8 per 100,000), followed by European or Other (27.6 per

100,000). Māori (23.4 per 100,000) and Asian (24.0 per 100,000) ethnic groups had the lowest rates of hospitalisations.

Figure 28. Hospital discharge rates by ethnic group in 2016



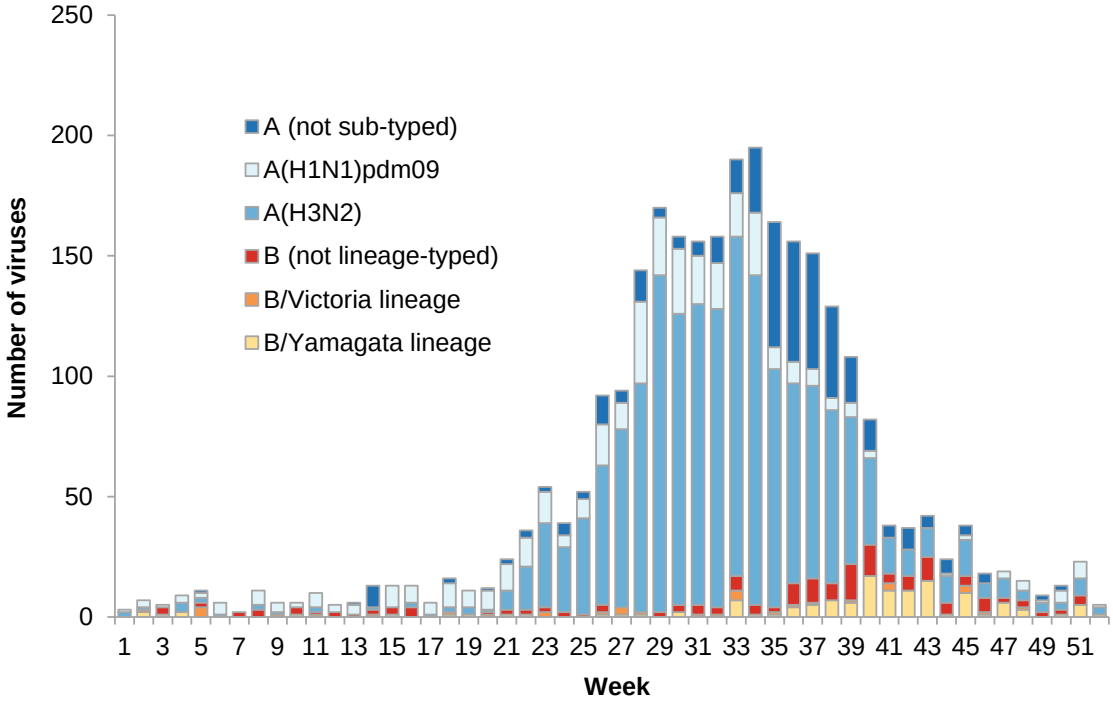
Data source: Ministry of Health, NMDS (Hospital Events).

LABORATORY-BASED SURVEILLANCE

Laboratories, between January and December 2016, tested a total of 11,128 specimens from both surveillance and non-surveillance systems. Of these, 2804 (25.2%) specimens tested positive for influenza viruses. This number is lower in comparison to the 4938 and 3871 viruses identified through laboratory-based surveillance in 2015 and 2014 respectively.

Figure 29 shows the temporal distribution of influenza viruses reported by type and sub-type from laboratory-based surveillance in 2016. Influenza viruses peaked in weeks 33 and 34 (15–22 August 2016). A(H3N2) peaked in week 33 and influenza B peaked in week 40.

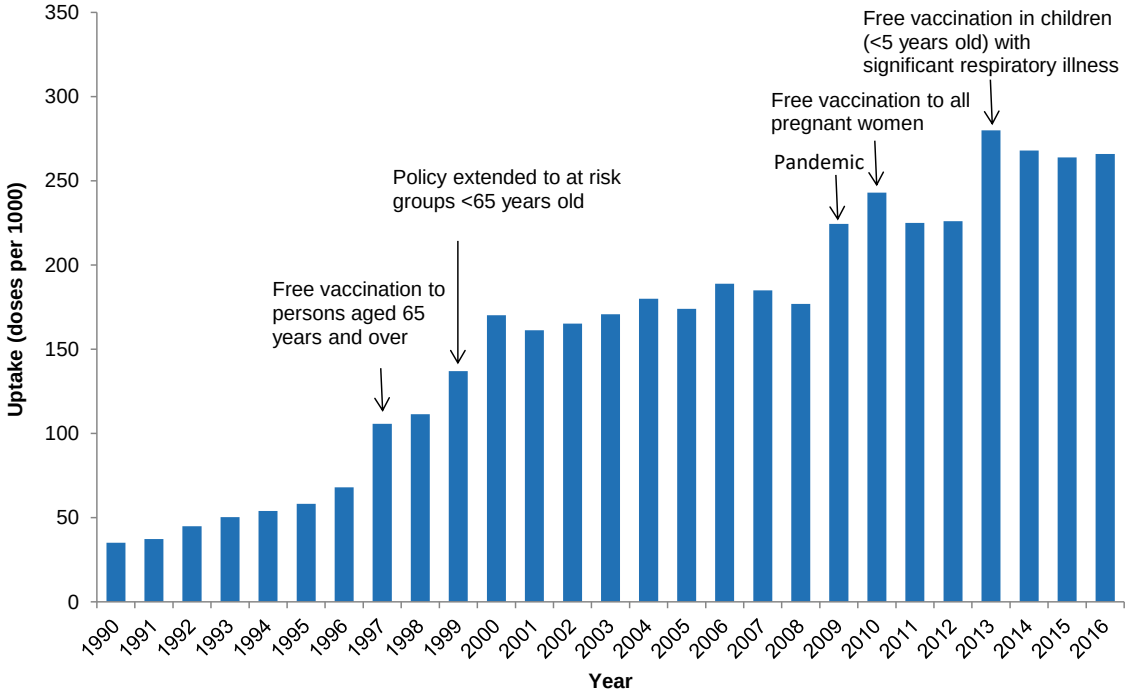
Figure 29. Total influenza viruses by type and week specimen taken, 2016



IMMUNISATION COVERAGE

Based on influenza vaccine distribution data (which does not truly represent the number of doses administered), influenza vaccine coverage maintained the third highest level in 2016 (Figure 30). At least 1,245,934 doses of the seasonal trivalent influenza vaccine were distributed in New Zealand in the 2016 season. The coverage rate of influenza vaccine (both publicly and privately funded) as estimated by vaccine distribution figures during the 2016 seasonal influenza immunisation programme was 266 doses per 1000 population, similar to the 264 doses per 1000 population administered in 2015.

Figure 30. Influenza vaccine coverage[1], 1990–2016



[1] Estimated by vaccine distribution figures.

The coverage for people 65 years and older was 66.7%; similar to the coverage of 67.3% achieved in 2015 (Immunisation Benefit Claims Data, Sector Services, Ministry of Health).

Table 10 shows the estimated number of people who received the publicly funded influenza vaccine in seven age groups. No data is available on privately funded immunisations.

Table 10. Influenza coverage by age group, 2016

Age group (years)	Total vaccines received
<1	313
1–4	5,782
5–19	22,847
20–34	30,996
35–49	49,155
50–64	115,242
65+	448,894
Total	**673,229**

Data source: Immunisation benefits claims data, Sector Services, Ministry of Health.

VIRUS STRAIN CHARACTERISATION

CIRCULATING VIRAL STRAINS IN 2016

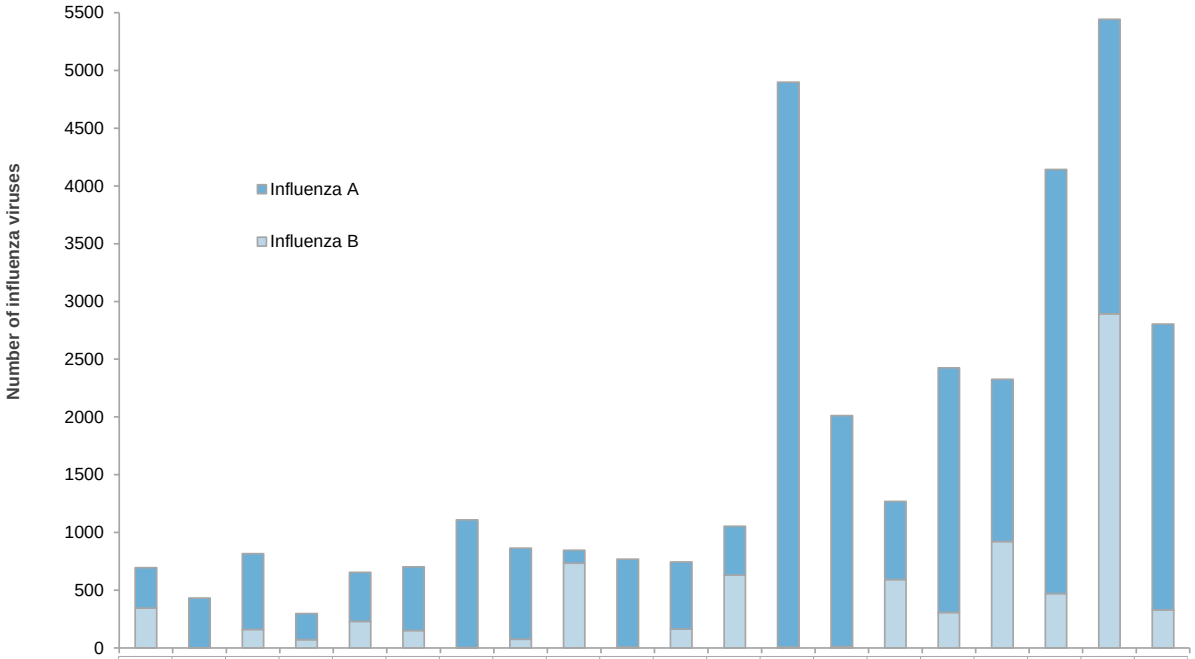
A total of 2804 influenza viruses were detected and reported through any surveillance system in 2016, with influenza A representing 88.3% (2475/2804) and influenza B 11.7% (329/2804) of all influenza viruses (Table 11). Among the influenza A viruses sub-typed, 81.2% (1698/2092) were A(H3N2) virus and 18.8% (394/2092) were A(H1N1) virus. Among B lineage-typed, 78.7% (129/164) were Yamagata lineage and 21.3% (35/164) were Victoria lineage.

Table 11. Influenza virus identifications by type and sub-type and lineage-typed, 2016

Viruses	All viruses (%)	Sub-typed and lineage-typed (%)
Influenza A	**2475 (88.3)**	**2092**
Influenza A (not sub-typed)	**383 (13.7)**	
Influenza A(H1N1)pdm09	**394 (14.1)**	**394 (18.8%)**
A(H1N1)pdm09 by PCR	328 (11.7)	328 (83.2)
A/California/7/2009 (H1N1)-like	66 (2.4)	66 (16.8)
Influenza A(H3N2)	**1698 (60.6)**	**1698 (81.2%)**
A(H3N2) by PCR	1444 (51.5)	1444 (85.0)
A/Hong Kong/4801/2014 (H3N2)-like	251 (9.0)	251 (14.8)
A/Switzerland/9715293/2013 (H3N2)-like	3 (0.1)	3 (0.2)
Influenza B	**329 (11.7)**	**164**
Influenza B (not lineage-typed)	**165 (5.9)**	
B/Yamagata lineage	**129 (4.6)**	**129 (78.7%)**
B/Yamagata lineage by PCR	32 (1.1)	32 (24.8)
B/Phuket/3073/2013-like	97 (3.5)	97 (75.2)
B/Victoria lineage	**35 (1.2)**	**35 (21.3%)**
B/Victoria lineage by PCR	9 (0.3)	9 (25.7)
B/Brisbane/60/2008-like	26 (0.9)	26 (74.3)
Total	**2804 (100.0)**	**2256**

Figure 31 shows the number and percentage of typed influenza viruses from 1997 to 2016. Influenza A is the most frequent predominant influenza type. Of 20 influenza seasons during 1997–2016, influenza A predominated in 16 seasons whereas influenza B only predominated in three seasons (2005, 2008 and 2015). There was one season (1997) with equal proportion of influenza A and B circulation.

Figure 31. Influenza viruses by type, 1997–2016

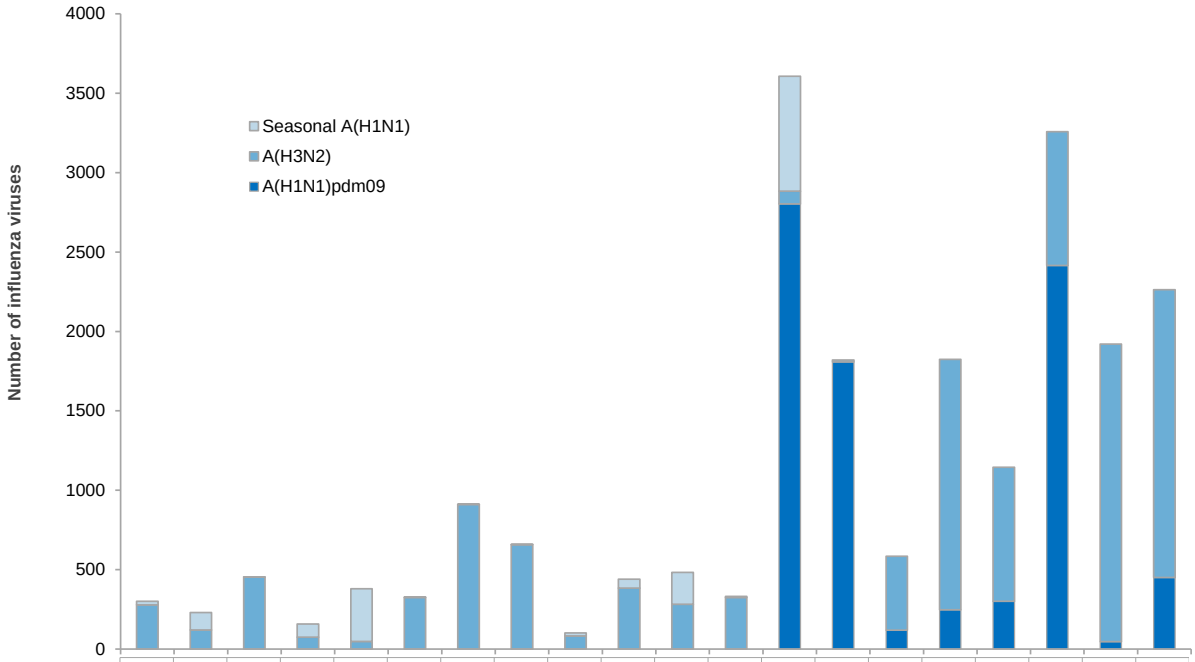


	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Influenza A (%)	50	100	80	76	65	78	100	91	13	99	78	40	100	100	53	87	60	89	47	88
Influenza B (%)	50	0	20	24	35	22	0	9	87	1	22	60	0	0	47	13	40	11	53	12

Figure 32 shows the number and percentage of all sub-typed influenza A viruses from 1997 to 2016 (excluding influenza A not sub-typed). Overall, the patterns of the predominant influenza A subtypes among all sub-typed A viruses during 1997–2016 are described below:

- Influenza A(H3N2) strain predominated for 15 seasons (1997, 1998, 1999, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2011, 2012, 2013, 2015 and 2016). A/Fujian/411/02 (H3N2)-like strain predominated in 2003 with the highest recorded hospitalisations for the period 1990–2008.
- Influenza A(H1N1)pdm09 strain has become the predominant strain for three seasons in 2009, 2010 and 2014.
- Seasonal influenza A(H1N1) strain predominated in two seasons (2000 and 2001) with associated relatively low hospitalisations (228 in 2000 and 379 in 2001). It has not been detected in New Zealand since 2010.

Figure 32. Influenza A viruses by subtypes 1997–2016

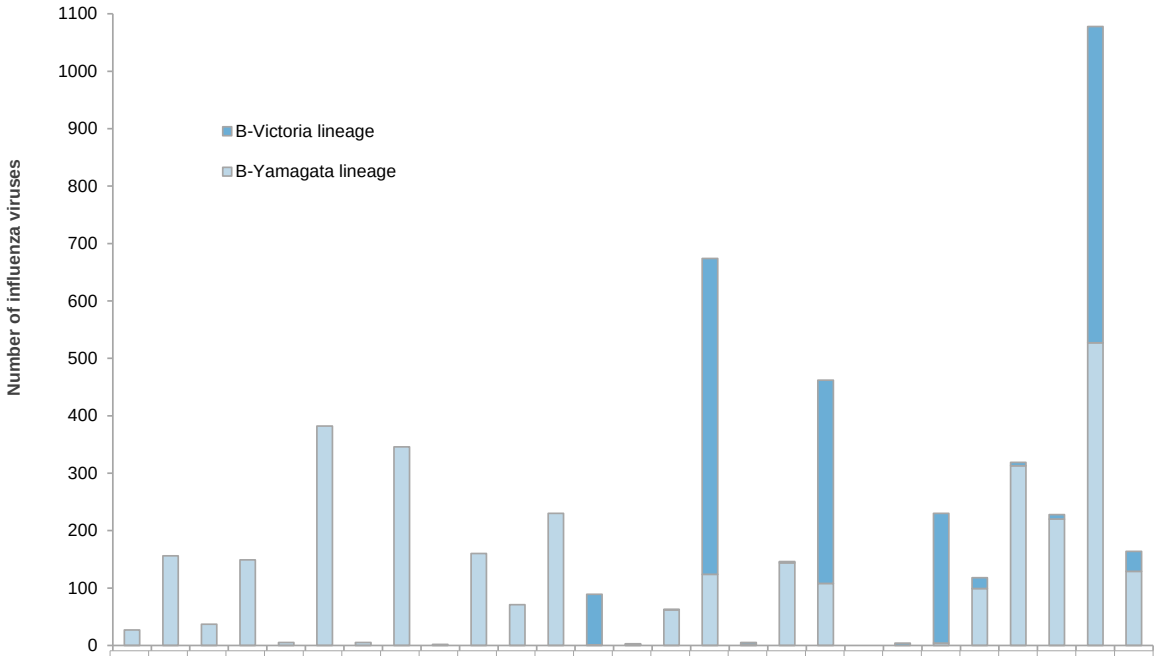


	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Seasonal A(H1N1)	8	48	0	52	87	1	0	0	18	13	42	2	20	0	0	0	0	0	0	0
A(H3N2)	92	52	100	48	13	99	100	100	82	87	58	98	2	1	80	86	74	26	98	80
A(H1N1)pdm09	0	0	0	0	0	0	0	0	0	0	0	0	78	99	20	14	26	74	2	20

Figure 33 shows the number and percentage of all B viruses from 1990 to 2016 (excluding influenza B not lineage-typed). Overall, the patterns of the predominant influenza B among all lineage-typed B viruses during 1990–2016 are described below:

- Influenza B/Yamagata lineage was the only lineage circulating in New Zealand during 1990–2001. Relatively high number of influenza B viruses were recorded in 1995 and 1997.
- Since the introduction of the B/Victoria lineage viruses into New Zealand in 2002, this lineage has co-circulated with B/Yamagata lineage viruses. During 2002–2011, B/Victoria lineage viruses predominated over the B/Yamagata lineage viruses in every 3-4 years in New Zealand (2002, 2005, 2008, 2011 and 2015). In 2005, the disease burden was high in children aged 5–19 years with associated deaths in 3 children.
- B/Yamagata lineage viruses was the predominant lineage over B/Victoria lineage virus during 2012–2014 and 2016.

Figure 33. Influenza B viruses by lineages, 1990–2016



	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
B/Victoria lineage (%)	0	0	0	0	0	0	0	0	0	0	0	0	99	33	2	82	60	1	77	0	100	98	16	2	4	51	21
B/Yamagata lineage (%)	100	100	100	100	100	100	100	100	100	100	100	100	1	67	98	18	40	99	23	0	0	2	84	98	96	49	79

IMPACT OF VIRUS TYPE AND SUBTYPE ON AGE GROUPS

SHIVERS ILI and SARI surveillance has provided reliable numerators and denominators which are used to calculate virus type and subtype and lineage type related age-specific incidence rates. ILI and SARI related influenza A(H3N2), B/Victoria and B/Yamagata lineages by age groups for 2016 are shown in Figure 34 and Figure 35. SARI-related A(H3N2) incidence rates were high in the youngest (0–4 year olds) and the oldest (65–79 years and ≥ 80 years). Influenza B also affected these groups more – particularly influenza B/Yamagata in children. The highest incidence rates for ILI-associated A(H3N2), B/Victoria or B/Yamagata lineage viruses were for school-aged children (5–19 years) (Figure 35). Although less disparate, ILI-related A(H3N2) incidence rates were higher in most age groups than those for B/Yamagata or B/Victoria.

Figure 34. SARI related A(H3N2), B/Victoria and B/Yamagata by age groups, 2016

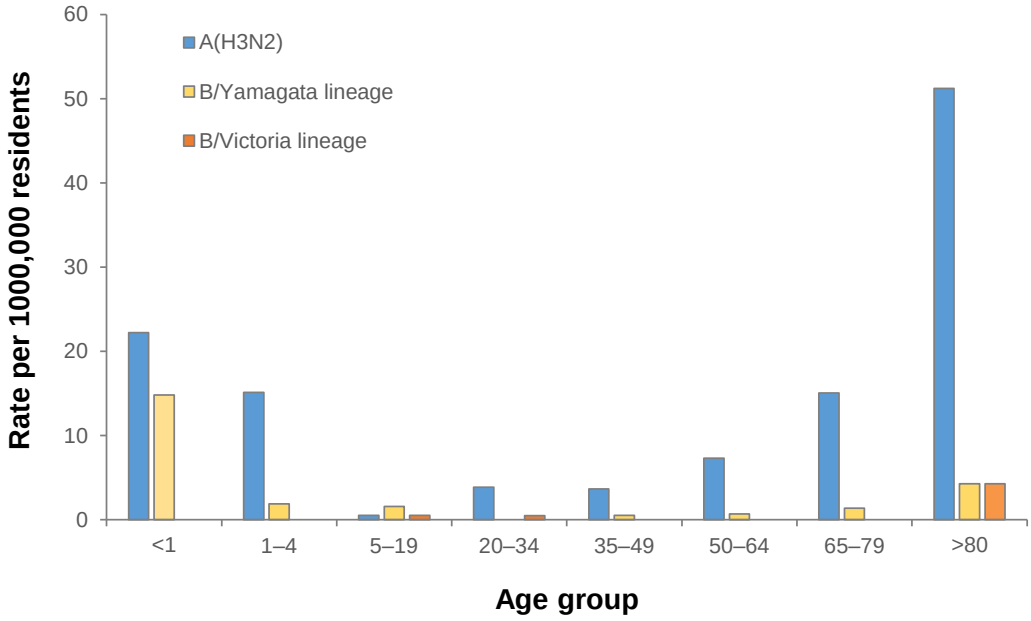
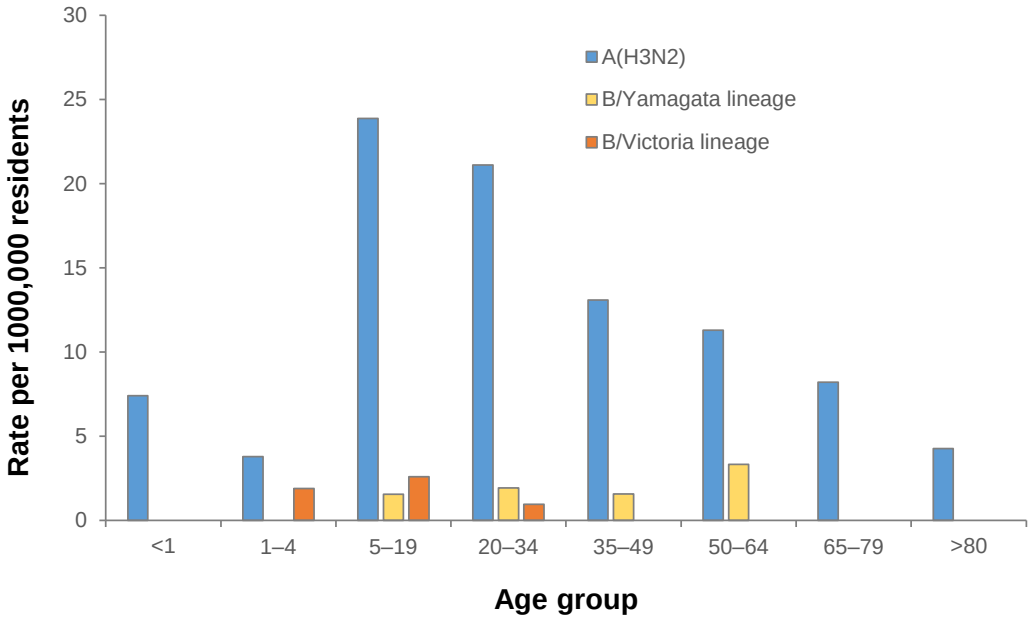


Figure 35. ILI related A(H3N2), B/Victoria and B/Yamagata by age groups, 2016



INFLUENZA A(H1N1)PDM09

In 2016, 66 representative influenza A(H1N1)pdm09 isolates were antigenically typed in New Zealand. The results from the NIC and WHOCC-Melbourne indicated that most of the currently circulating influenza A(H1N1)pdm09 viruses were in genetic clade 6B.1 with a small proportion in clade 6B.2 (CDC designation, Appendix A).

INFLUENZA A(H3N2)

In 2016, 254 representative seasonal influenza A(H3N2) isolates were antigenically typed in New Zealand. The results indicated that most of the New Zealand isolates, as well as isolates from Australia and other countries, were antigenically similar to the vaccine strain A/HongKong/4801/2014-like viruses. However, genetically most of NZ isolates belonged to the genetic clade 3C.3a whereas most of Australian isolates in genetic clade 3C.2a (CDC designations, Appendix B).

INFLUENZA B

In 2016, 26 representative seasonal influenza B/Victoria lineage isolates (B/Brisbane/60/2008-like, the current vaccine strain) and 97 B/Yamagata lineage isolates (B/Phuket/3073/2013-like) were antigenically typed. The results indicated that both B/Yamagata and B/Victoria isolates from New Zealand, as well as isolates from Australia and other countries, were antigenically closely related to the vaccine strain B/Brisbane/60/2008 viruses and also B/Phuket/3073/2013-like viruses. The results of the genetic analysis of the HA gene of influenza B viruses indicated that the B/Yamagata and B/Victoria lineage viruses fell into groups Y3 and V1A respectively (CDC designations, Appendices C and D). It appears that these genetic changes have not resulted in significant antigenic changes.

OSELTAMIVIR RESISTANCE MONITORING

In 2016, 515 influenza viruses were tested for resistance to oseltamivir and 514 for resistance to zanamivir by a phenotypic assay (fluorometric neuraminidase inhibition). All viruses were found to be sensitive to oseltamivir (Table 12) and all viruses were sensitive to zanamivir (Table 13).

Table 12. Antiviral susceptibility to oseltamivir for influenza viruses in New Zealand, 2014–2016

Influenza	NA inhibition to Oseltamivir*	Fold change in IC50 of test viruses (No. of viruses)**		
		2014	2015	2016
A(H1N1)pdm09	Normal	0-9 (665)	0-2 (12)	0-5 (69)
	Reduced	35 (1)	-	-
	Highly reduced	356 (1)	-	-
A(H3N2)	Normal	0-8 (164)	0-5 (110)	0-10 (320)
	Reduced	-	-	-
	Highly reduced	-	-	-
Influenza B	Normal	0-4 (167)	0-5 (730)	0-3 (126)
	Reduced	-	-	-
	Highly reduced	-	-	-

*Neuraminidase inhibition was defined as:

Normal inhibition = IC_{50} values which are within or close to the median IC_{50} of the type/subtype matched viruses as detailed in the table above.

Reduced inhibition = IC_{50} values which are 10 to 100 fold above the median value of viruses with normal inhibition (5 to 50 fold for influenza B viruses)

Highly reduced inhibition = IC_{50} values which are greater than 100 fold above the median value of viruses with normal inhibition (above 50 fold for influenza B viruses)

**Fold change determined by dividing IC50 of test viruses by median IC50 for virus type/subtype

Table 13. Antiviral susceptibility to zanamivir for influenza viruses, 2014–2016

Influenza	NA inhibition to Zanamivir*	Fold change in IC50 of test viruses (No. of viruses)**		
		2014	2015	2016
A(H1N1)pdm09	Normal	0-6 (671)	0-2 (12)	0-4 (69)
	Reduced	-	-	-
	Highly reduced	-	-	-
A(H3N2)	Normal	0-7 (157)	0-4 (110)	0-7 (319)
	Reduced	-	-	-
	Highly reduced	-	-	-
Influenza B	Normal	0-5 (168)	0-4 (735)	0-5 (126)
	Reduced	-	-	-
	Highly reduced	-	-	-

*Neuraminidase inhibition was defined as:

Normal inhibition = IC_{50} values which are within or close to the median IC_{50} of the type/subtype matched viruses as detailed in the table above.

Reduced inhibition = IC_{50} values which are 10 to 100 fold above the median value of viruses with normal inhibition (5 to 50 fold for influenza B viruses)

Highly reduced inhibition = IC_{50} values which are greater than 100 fold above the median value of viruses with normal inhibition (above 50 fold for influenza B viruses)

**Fold change determined by dividing IC50 of test viruses by median IC50 for virus type/subtype

VACCINE EFFECTIVENESS

Interim analysis was conducted regarding effectiveness of seasonal influenza vaccine in preventing influenza related primary care visits and hospitalisation [1, 12]. The proportion vaccinated did not change throughout the season from 2 May to 2 October 2016. For influenza-confirmed ILI cases, after adjustment for age, week of presentation and any underlying health condition, the preliminary results for influenza vaccine effectiveness was 23% (95% CI: -24 to 52). For influenza-confirmed SARI cases, after adjustment for age, week of admission and any underlying health condition, the estimated VE was 12% (95% CI: -122 to 65). The VE estimates in 2016 were not robust with wide confidence intervals, in part due to low influenza activity with a low number of PCR-confirmed influenza cases.

SOUTHERN HEMISPHERE VACCINE STRAIN RECOMMENDATIONS

In October 2016, the Australian Influenza Vaccine Committee (AIVC), which includes a New Zealand representative, met to decide on the composition of the influenza vaccine for the 2017 winter season for New Zealand, Australia and South Africa. During these discussions, the following trends were noted.

INFLUENZA A(H1N1)

The epidemiological data from the New Zealand 2016 influenza season, along with most other southern hemisphere countries, indicated that the current circulating influenza A(H1N1)pdm09 viruses are antigenically similar to the vaccine strain A/California/7/2009 (H1N1) using post-infection ferret antisera. However, human post-vaccination sera could distinguish the recent A(H1N1)pdm09 from the vaccine virus A/California/7/2009 with reduced reactivity. As a result, A/Michigan/45/2015 (H1N1)pdm09-like strain was selected as the H1 component of the 2017 vaccines. AIVC accepted this recommendation.

INFLUENZA A(H3N2)

Influenza A(H3N2) has been frequently associated with severe disease and excess mortality in high-risk groups. This sub-type has also shown the greatest tendency for antigenic drift, as illustrated by the frequency of vaccine formulation changes recommended by the WHO and the AIVC.

The majority of influenza A(H3N2) viruses from New Zealand and other southern hemisphere countries in 2016 were antigenically similar to cell-propagated vaccine virus A/Hong Kong/4801/2014. Based on all of the epidemiological, antigenic, genetic and serological data, the WHO Consultative Group recommended the H3 component of the vaccines containing an A/Hong Kong/4801/2014 - like strain. AIVC accepted this recommendation.

INFLUENZA B

Two distinct lines of influenza B have co-circulated in many countries during recent years. During the1980s, B/Yamagata/16/88 lineage and its further variants (the most recent representative strain being B/Phuket/3073/2013-like strain) spread worldwide. During the same period B/Victoria/2/87 lineage viruses continued to circulate in Asia and subsequently underwent independent evolution as an antigenically distinct lineage, with the most recent representative strain being B/Brisbane/60/2008. For reasons not wholly understood, these remained geographically restricted to Asia until 2001. In 2002, the B/Victoria lineage strains spread to the rest of the world.

Both recent B/Victoria-like strains and B/Yamagata-like strains continued to be isolated worldwide in 2016. Varying proportions of the two lineages were seen with an increase of the proportion of B/Victoria lineage viruses in many southern hemisphere countries. The majority of B/Yamagata and B/Brisbane lineage isolates were antigenically closely related to B/Phuket/3073/2013-like strain and B/Brisbane/60/2008-like strain respectively. As viruses of the B/Victoria lineage predominated in many countries, the WHO Consultative Group recommended vaccines containing

B/Brisbane/60/2008-like strain as the B component of the trivalent influenza vaccine for the southern hemisphere for the following year. AIVC accepted this recommendation.

In summary, the AIVC agreed to adopt the recommendations of the WHO Consultative Group as shown.

The recommended influenza vaccine formulation for New Zealand in 2017 is:

A(H1N1)	**an A/Michigan/45/2015 (H1N1)pdm09-like virus**
A(H3N2)	**an A/Hong Kong/4801/2014 (H3N2)-like virus**
B	**a B/Brisbane/60/2008-like virus (belonging to B/Victoria lineage)**

Quadrivalent vaccines contain the above three viruses plus one more vaccine component: B/Phuket/3073/2013-like virus (belonging to B/Yamagata lineage)

DISCUSSION

Historically, influenza surveillance has focused on virological monitoring and collection of specimens to guide vaccine strain selection. The 2009 influenza A(H1N1)pdm09 pandemic provided a test of global preparedness to assess the epidemiology of a pandemic and to respond appropriately and rapidly. The world was ill prepared to respond to a severe influenza pandemic or to any similarly global, sustained and threatening public-health emergency [13]. One fundamental constraint highlighted during the pandemic was the limited understanding of the epidemiology and severity of the pandemic, which in turn hampered international efforts to mount an appropriate response[14]. It was recognised from the 2009 pandemic that there was the need to expand influenza surveillance and to include more epidemiological information, particularly on influenza associated severe disease to complement the virological data. In 2014, WHO published "global epidemiological surveillance standards for influenza" [2] which provided objectives for influenza monitoring to assure a better understanding of risk factors for severe disease, the seasonal variation of influenza types/subtypes and severity of disease, the burden of disease related to influenza, and other factors critical to public health decision-making. New Zealand has worked to be a world leader in influenza surveillance, which provides comprehensive and timely monitoring of influenza and other respiratory viruses locally in addition to providing information to the international community.

INFLUENZA-LIKE ILLNESS AND ASSOCIATED INFLUENZA INFECTIONS IN PATIENTS CONSULTING GENERAL PRACTITIONERS

In 2016, ILI activity in New Zealand was at a low level compared to previous years. The 2016 influenza season had the lowest cumulative consultation rate (324.6/100,000) and average weekly consultation rate (14.8/100,000) in the past 25 years (1992–2016). Based on these rates, an estimated 15,221 individuals or 0.3% of the population visited a GP with ILI. Average ILI consultation rates varied greatly across the country with the highest rates reported in South Canterbury (25.7), Tairawhiti (25.4) and Canterbury (19.2). Variability in DHB-level rates could result from small numbers of participating practices, small registered patient populations, or variations in individual diagnostic practices. Specimens were collected from 60.9% of ILI cases for which 32% of the specimens were positive for influenza, which is lower than in previous years (50.8% in 2015 and 37.2% in 2014). ILI surveillance showed highest influenza-positive ILI consultation rates among school aged children (5–19 years old), Pacific peoples and the least deprived population subgroup.

An enhanced ILI (eILI) surveillance platform was successfully established in 2016 by building on the previous systems of NZ's longitudinal sentinel GP influenza surveillance and SHIVERS ILI surveillance with enhanced data collection and sample testing. This eILI platform provides real-time monitoring with comprehensive and timely information on disease burden, epidemiology, viral etiology and transmission of community based influenza and other respiratory viruses, as well as, a rapid assessment of the effectiveness of the seasonal influenza vaccine. This eILI surveillance platform needs to continue as it provides important information for seasonal influenza control by assisting in the early detection of influenza epidemics, informing vaccination policy, vaccine strain selection and other public health measures. It is also important for pandemic preparedness as it

provides a timely assessment of virus transmissibility (one of the three critical indicators for pandemic influenza severity assessment) as well early detection of potential influenza pandemics.

SEVERE ACUTE RESPIRATORY ILLNESS AND INFLUENZA IN HOSPITALISED PATIENTS

In 2016, the overall severe acute respiratory illness activity was at a low level as measured by the cumulative SARI hospitalisation rate (189.8/100,000) and SARI-associated influenza rate (18.0/100,000) as well as weekly peak rates when compared to previous years (2012–2015). Based on these rates, an estimated 8,902 New Zealanders were hospitalised with SARI of which 844 had influenza infections. Because the SARI case definition is restricted to those patients with acute onset of cough and fever, it may under-estimate influenza associated hospitalisations by not capturing those influenza cases who presented non-cough or non-fever. The timing of sample collection may also affect the likelihood of detecting influenza.

NZ hospital-based surveillance provides real-time monitoring capacity for severe clinical presentations with seasonal influenza and other respiratory viruses (e.g. RSV, non-seasonal influenza A(H7N9), MERS-CoV), the means to track populations known to be at particularly high risk for severe outcomes (infants, elderly and those with underlying risk conditions), evidence for adequate staffing and resources available in hospitals for potential outbreak/pandemics, estimates of vaccine effectiveness for influenza related hospitalisation and provisions of vaccine strains matching well with co-circulating strains. SARI surveillance, as recommended by WHO, is also vital instrument for pandemic preparedness as it provides a timely assessment of seriousness of influenza disease and its impact (two critical indicators of pandemic influenza severity assessment). Severity assessment provides scientific measurement of the timing, scale, and intensity of epidemics, which helps to prepare for a pandemic response. This SARI surveillance system infrastructure has become part of NZ's national infrastructure for seasonal influenza control and pandemic preparedness.

Real-time hospital-based SARI surveillance in Auckland is complemented by non-sentinel laboratory-based surveillance and analysis of administrative hospital discharge codes for influenza based on national minimum datasets (NMDS) at the national-level. These additional systems confirm trends seen in Auckland and can be used to identify anomalies for further investigation and record geographic distribution. However, limitations of these systems include temporal lags, variability in coding (discharge data), non-standardization in criteria (case ascertainment, inclusion and testing) and lack of denominators (laboratory-based surveillance).

Influenza-associated ICU admissions

In 2016, roughly 8% (14/176) of all patients hospitalised with influenza-positive SARI were admitted to the ICU. The overall ICU admission incidence rate for influenza-positive SARI was lower than 2015 and 2014. ICU surveillance in 2016 included all ICU admissions with acute respiratory illness, not just those meeting the SARI case definition. This expansion will capture nearly all of the influenza burden among those with most severe respiratory infections. In 2016, influenza-positive ICU admission rates among all respiratory patients were also lower than 2015 and 2014. Influenza-associated ICU admission is a good outcome measure of severity caused by influenza. Such surveillance should continue as it provides historical baseline data on severity for

previous seasons and a valuable instrument in pandemic preparedness by comparing for changes in the behaviour of influenza viruses.

Influenza-associated hospitalisations in individuals at increased risk

Individuals living with certain chronic health-related conditions (cardiovascular conditions, asthma) are at an increased risk for poor outcomes with influenza infection [16-20]. Understanding the burden of influenza in these high-risk groups can inform policy and clinical decisions regarding prevention and treatment. The 2016 SARI surveillance confirmed these risks with over half of the adults hospitalised with influenza having an underlying condition. Cardiovascular conditions, asthma and chronic respiratory disease were the most commonly reported underlying conditions. Influenza vaccine coverage was low (<30%), as in previous years, among these SARI patients, who are eligible for free vaccine.

HOSPITAL VS. GENERAL PRACTICE BASED SURVEILLANCE FOR INFLUENZA

In NZ, hospital and GP-based surveillance systems monitor the full spectrum of clinical disease related to influenza from fairly mild presentations to the GP to the most severe hospitalisations that result in ICU admission. Due to differences in care seeking, the combination of these systems also allows for a better representation of the burden on influenza in New Zealand. Influenza-associated hospitalisation rates are highest in the very young (0–4 years: 74 per 100,000 in <1 year and 59 per 100,000 in 1–4 years) and older people (≥ 65 years: 90 per 100,000 in > 80 years and 41 per 100,000 in 65–79 years). Influenza-associated GP consultation rates, however, show the opposite pattern, with a higher rate in school-aged children and adults, and very low rates among infants (<1 year) and older people (≥ 65 years). The differences in hospitalisation and GP consultation rates by age are well documented [22, 23]. Differences in care-seeking are not limited to age differences, Māori experienced the second highest rates of influenza-associated hospitalisations but the lowest rates of general practice consultations, while Pacific peoples, Asian and Europeans ethnic group showed similar trend in both influenza-associated hospitalisations and GP consultations. When NZDep was evaluated, the most deprived populations (NZDep 9–10) were found to have the highest rates of influenza-associated hospitalisations but the second lowest rates of influenza-associated GP consultations. Higher hospitalisation rates from seasonal and pandemic influenza have been reported in indigenous groups in New Zealand, as well as the United States and Australia [24, 25]. However, it is unclear if this was a result of genetic factor, or health condition or environmental factor. Further research is required to understand the independent and synergistic effects of these factors.

IMPACT OF INFLUENZA TYPE AND SUBTYPE ON AGE GROUPS

Certain influenza subtypes and lineages differentially impact specific age groups with higher attack rates and greater severity of disease. The predominant influenza virus in 2016 was influenza A (H3N2 which is associated with highest influenza associated hospitalisations in the elderly people (≥ 80 years). The highly age-specific impact of viral strains and unpredictability of predominant strains highlights the need for routine assessment of circulating viral type, subtype, lineage and antigenic strain on the timing and magnitude of age-specific morbidity and mortality in order to inform annual vaccine strain selection and targeted vaccination strategies.

VACCINE COVERAGE, VACCINE EFFECTIVENESS, AND ANTIVIRAL RESISTANCE

Over many years, the recommendation and funding of influenza vaccines in NZ have evolved to cover: those aged 65 years or older (added in 1997), those with underlying chronic conditions under 65 years old (1999), pregnant women (2010), and most recently in 2013 to children aged less than five who have had significant respiratory illness [36, 37, 38]. Vaccine coverage estimates in each of these groups are not available. In 2016, among people aged 65 years and older, influenza vaccination coverage was 67%, which is still below the target of 75% for this age group.

Influenza vaccine strain selection requires annual consultations and frequent updates to match the antigenic drift of the circulating viral strains. Influenza vaccine effectiveness (VE) data are valuable to evaluate how well the current vaccine works and subsequently, whether there is a need to change in the vaccine strain in the context of current and projected circulating viruses. Since 2012, influenza vaccine effectiveness data have been taken into consideration by the WHO consultative group to decide annual vaccine strain compositions. New Zealand's VE data has been considered important data by WHO in the vaccine strain selection process as very few countries in the southern hemisphere have such capacity. In 2016, an interim assessment of the seasonal influenza vaccine effectiveness was conducted by NZ and WHO with the SARI and ILI surveillance data [34, 35]. The 2016 influenza VE (visits as of 3 October 2016) was 23% (95% CI: -24 to 52) for ILI related GP consultations and 12% (95% CI: -122 to 65) for SARI related hospitalisations. The VE estimate in 2016 was not robust, due to the low influenza activity and low number of influenza-confirmed ILI/SARI cases.

No resistance to influenza antivirals was detected in 2016. However, oseltamivir-resistant seasonal influenza A(H1N1) viruses were detected in 2008 and 2009. In addition, oseltamivir-resistant influenza A(H1N1)pdm09 viruses were also detected in 2012. It is important to maintain a national antiviral monitoring programme in New Zealand to provide timely surveillance information to assist clinicians in selecting antiviral medications and public health officials in making decisions on pandemic stockpiling.

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APPENDIX

Appendix Table 14. Demographic characteristics of SARI patients, 2016

Characteristics	All acute admissions	SARI & influenza cases among all hospital patients			SARI & influenza cases among ADHB & CMDHB residents	
		SARI Cases	Cases per 1000 hospitalisations	Influenza positive (%*)	SARI incidence rate per 100 000	Influenza incidence rate per 100 000 (95%CI)
Overall	**117455**	**1922**	**16.4**	**178 (14.9)**	**189.8 (181.0, 199.0)**	**18.0 (15.3, 21.0)**
Age group (years)						
<1	4160	421	101.2	12 (4.1)	2695.1 (2428.5, 2982.3)	74.0 (35.5, 136.1)
1–4	7872	420	53.4	32 (13.9)	665.7 (598.1, 738.7)	58.6 (39.8, 83.2)
5–19	13493	138	10.2	11 (14.9)	60.2 (49.7, 72.2)	4.7 (2.1, 8.9)
20–34	23463	108	4.6	20 (24.1)	48.5 (39.5, 58.9)	8.2 (4.8, 13.1)
35–49	17879	126	7.0	19 (22.4)	64.4 (53.5, 76.8)	9.9 (6.0, 15.5)
50–64	20266	226	11.2	30 (18.3)	136.2 (118.2, 156.1)	17.3 (11.3, 25.3)
65–79	18723	290	15.5	32 (18.4)	366.7 (324.2, 413.2)	41.0 (27.7, 58.6)
>80	11599	193	16.6	22 (23.9)	810.9 (700.1, 934.2)	89.6 (55.5, 137.0)
Unknown	0	0		0 (.)		
Ethnicity						
Māori	15436	296	19.2	26 (11.8)	254.3 (224.0, 287.6)	21.1 (13.1, 32.3)
Pacific Peoples	24791	579	23.4	60 (13.4)	390.6 (358.4, 424.9)	42.0 (31.9, 54.3)
Asians	19381	153	7.9	21 (17.2)	67.5 (56.9, 79.6)	9.5 (5.8, 14.7)
European and others	57098	492	8.6	70 (17.5)	107.6 (97.7, 118.2)	15.7 (12.1, 20.1)
Unknown	713	402	563.8	1 (16.7)	627.2 (563.7, 695.9)	1.8 (0.0, 9.9)
Hospitals						
ADHB	68957	1015	14.7	109 (17.0)	190.7 (178.0, 204.1)	22.2 (18.0, 27.1)
CMDHB	48498	907	18.7	69 (12.5)	189.0 (176.8, 201.9)	14.1 (10.9, 17.9)
Sex						
Female	62086	909	14.6	89 (15.3)	175.6 (163.8, 188.1)	17.6 (14.0, 21.9)
Male	55366	1013	18.3	89 (14.5)	204.8 (191.7, 218.6)	18.4 (14.6, 22.9)
Unknown	3	0	0.0	0 (.)		
NZ Dep						
1		199		18 (16.7)	96.4 (82.5, 111.9)	9.5 (5.6, 15.3)
2		193		25 (22.1)	100.7 (86.1, 117.1)	13.8 (8.7, 20.7)
3		254		21 (13.5)	151.8 (132.5, 173.2)	12.4 (7.3, 19.5)
4		346		33 (14.0)	171.5 (152.1, 192.6)	18.1 (12.2, 25.9)
5		903		77 (13.6)	348.3 (325.6, 372.2)	28.9 (22.6, 36.4)

*Calculated as the percentage of SARI cases tested for influenza viruses, which may differ from percentage of SARI samples tested for influenza viruses.

Appendix Table 15. Demographic characteristics of SARI patients admitted to ICU, 2016

Characteristics	Total ICU admissions	All SARI cases	SARI & influenza ICU cases among all hospital patients				SARI & influenza ICU cases among ADHB & CMDHB residents			ARI & influenza ICU cases among ADHB & CMDHB residents		
			SARI ICU cases	SARI ICU per ICU admissions (per 1000)	% SARI ICU among all SARI	Influenza positive[1] (%)	SARI ICU cases	SARI ICU incidence (per 100 000) (CI)	SARI ICU influenza incidence (per 100 000) (CI)	ARI ICU cases	ARI ICU incidence (per 100 000) (CI)	ARI ICU influenza incidence (per 100 000) (CI)
Overall	1024	1922	151	147.5	7.9	14 (10.4)	86	9.5 (7.6, 11.7)	0.9 (0.4, 1.7)	196	21.6 (18.7, 24.9)	1.0 (0.5, 1.9)
Age group (years)												
<1	188	421	61	324.5	14.5	1 (1.8)	31	229.5 (156.0, 325.6)	0.0 (0.0, 27.3)	99	733.0 (596.1, 891.7)	0.0 (0.0, 27.3)
1–4	107	420	45	420.6	10.7	1 (2.7)	21	39.7 (24.6, 60.7)	1.9 (0.0, 10.5)	38	71.9 (50.9, 98.6)	1.9 (0.0, 10.5)
5–19	105	138	13	123.8	9.4	2 (20.0)	6	3.1 (1.1, 6.8)	0.0 (0.0, 1.9)	18	9.3 (5.5, 14.8)	0.0 (0.0, 1.9)
20–34	139	108	2	14.4	1.9	2 (100.0)	0	0.0 (0.0, 1.8)	0.0 (0.0, 1.8)	3	1.4 (0.3, 4.2)	0.0 (0.0, 1.8)
35–49	120	126	6	50.0	4.8	2 (33.3)	6	3.1 (1.2, 6.8)	1.0 (0.1, 3.8)	9	4.7 (2.2, 8.9)	1.6 (0.3, 4.6)
50–64	187	226	9	48.1	4.0	4 (44.4)	8	5.3 (2.3, 10.5)	2.0 (0.4, 5.8)	13	8.6 (4.6, 14.8)	2.0 (0.4, 5.8)
65–79	158	290	14	88.6	4.8	2 (14.3)	13	17.8 (9.5, 30.4)	2.7 (0.3, 9.9)	15	20.5 (11.5, 33.8)	2.7 (0.3, 9.9)
>80	20	193	1	50.0	0.5	0 (.)	1	4.3 (0.1, 23.8)	0.0 (0.0, 15.7)	1	4.3 (0.1, 23.8)	0.0 (0.0, 15.7)
Unknown	0	0	0			0 (.)	0			0		
Ethnicity												
Māori	299	296	35	117.1	11.8	4 (12.5)	14	14.1 (7.7, 23.6)	2.0 (0.2, 7.3)	43	43.2 (31.3, 58.2)	2.0 (0.2, 7.3)
Pacific peoples	242	579	48	198.3	8.3	0 (0.0)	30	21.7 (14.7, 31.0)	0.0 (0.0, 2.7)	55	39.9 (30.0, 51.9)	0.0 (0.0, 2.7)
Asians	104	153	16	153.8	10.5	2 (13.3)	11	5.2 (2.6, 9.4)	1.0 (0.1, 3.4)	23	10.9 (6.9, 16.4)	1.0 (0.1, 3.4)
European and Others	362	492	42	116.0	8.5	8 (19.5)	26	6.5 (4.2, 9.5)	1.0 (0.3, 2.6)	62	15.4 (11.8, 19.8)	1.2 (0.4, 2.9)
Unknown	17	402	10	588.2	2.5	0 (0.0)	5	8.9 (2.9, 20.7)	0.0 (0.0, 6.6)	13	23.1 (12.3, 39.5)	0.0 (0.0, 6.6)
Hospitals												
ADHB	444	1015	115	259.0	11.3	13 (12.9)	50	11.5 (8.5, 15.1)	1.6 (0.6, 3.3)	113	25.9 (21.3, 31.1)	1.8 (0.8, 3.6)
CMDHB	580	907	36	62.1	4.0	1 (2.9)	36	7.7 (5.4, 10.6)	0.2 (0.0, 1.2)	83	17.7 (14.1, 21.9)	0.2 (0.0, 1.2)
Sex												
Female	411	909	59	143.6	6.5	1 (2.0)	32	6.9 (4.7, 9.7)	0.0 (0.0, 0.8)	75	16.1 (12.7, 20.2)	0.2 (0.0, 1.2)
Male	613	1013	92	150.1	9.1	13 (15.1)	54	12.3 (9.2, 16.0)	1.8 (0.8, 3.6)	121	27.5 (22.8, 32.8)	1.8 (0.8, 3.6)
Unknown	0	0	0			0 (.)	0			0		
NZDep												
NZDep1–2		199	14		7.0	2 (20.0)	7	3.9 (1.6, 8.1)	0.6 (0.0, 3.1)	27	15.1 (10.0, 22.0)	0.6 (0.0, 3.1)
NZDep3–4		193	11		5.7	1 (10.0)	8	4.8 (2.1, 9.4)	0.0 (0.0, 2.2)	16	9.6 (5.5, 15.6)	0.0 (0.0, 2.2)
NZDep5–6		254	24		9.4	5 (21.7)	13	8.9 (4.8, 15.3)	2.7 (0.7, 7.0)	28	19.2 (12.8, 27.8)	3.4 (1.1, 8.0)
NZDep7–8		346	43		12.4	1 (2.6)	16	9.7 (5.5, 15.7)	0.0 (0.0, 2.2)	27	16.3 (10.7, 23.7)	0.0 (0.0, 2.2)
NZDep9–10		903	45		5.0	2 (4.9)	33	13.2 (9.1, 18.6)	0.4 (0.0, 2.2)	80	32.1 (25.5, 40.0)	0.4 (0.0, 2.2)

*Calculated as the percentage of SARI cases tested for influenza viruses

Appendix Table 16. Demographic characteristics of ILI and influenza cases, sentinel practices 2 May to 3 October 2016

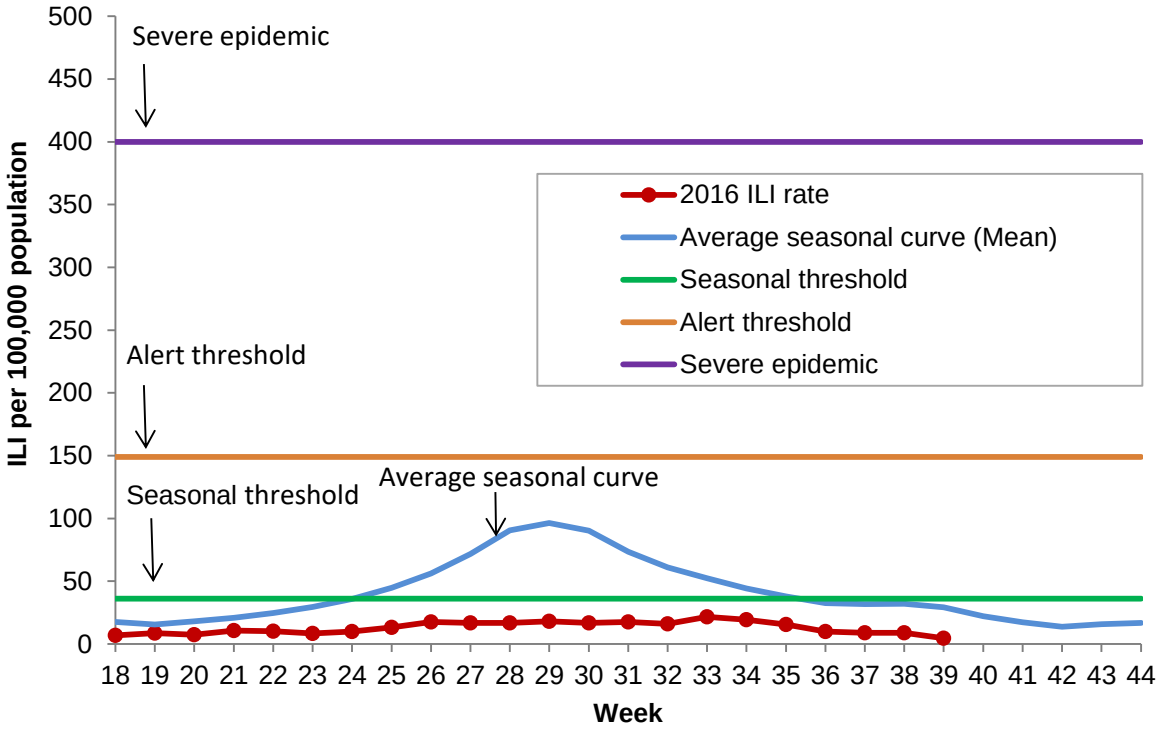
Characteristics	ILI & influenza cases among sentinel practices			
	ILI cases	Influenza positive (%*)	ILI incidence (per 100 000)	Influenza incidence (per 100 000)
Overall	**1557**	**303 (32.0)**	**324.5 (308.7, 341.1)**	**103.8 (94.9, 113.3)**
Age group (years)				
<1	12	3 (33.3)	163.3 (84.4, 285.0)	54.4 (14.8, 139.3)
1–4	97	10 (18.5)	357.9 (290.3, 436.4)	66.4 (39.4, 104.9)
5–19	347	84 (38.7)	354.4 (318.1, 393.6)	136.9 (114.7, 162.1)
20–34	450	82 (33.2)	425.6 (387.2, 466.7)	140.9 (119.2, 165.4)
35–49	302	69 (34.5)	324.4 (288.9, 363.1)	111.7 (91.3, 135.3)
50–64	235	42 (29.0)	276.9 (242.6, 314.6)	80.1 (62.2, 101.6)
65–79	93	9 (14.8)	193.9 (156.6, 237.5)	29.2 (16.0, 49.0)
>80	21	4 (26.7)	133.7 (82.8, 204.2)	38.2 (14.0, 83.1)
Unknown	0	0 (.)		
Ethnicity			. (., .)	
Māori	180	25 (22.5)	289.1 (248.5, 334.5)	65.9 (47.3, 89.3)
Pacific peoples	114	35 (38.9)	354.8 (292.7, 426.0)	136.9 (99.5, 183.8)
Asian	133	17 (19.8)	394.3 (330.2, 467.1)	77.1 (50.4, 112.9)
European and Others	1130	226 (34.2)	322.2 (303.7, 341.5)	110.1 (99.4, 121.6)
Unknown	0	0 (.)	0.0 (0.0, 419.3)	
Sex				
Female	879	178 (33.2)	351.4 (328.6, 375.4)	116.7 (103.7, 130.9)
Male	677	125 (30.3)	294.8 (273.1, 317.9)	89.3 (77.5, 102.4)
Unknown	1	0 (.)		
NZ Dep			. (., .)	
1	367	87 (35.1)	373.4 (336.2, 413.5)	131.2 (109.6, 155.9)
2	310	70 (37.4)	308.6 (275.3, 344.9)	115.5 (95.4, 138.5)
3	285	64 (34.6)	301.7 (267.7, 338.7)	104.8 (85.2, 127.6)
4	246	34 (24.1)	254.8 (224.0, 288.7)	61.1 (46.5, 78.8)
5	287	42 (23.7)	318.9 (283.1, 358.0)	75.6 (58.7, 95.8)

*Calculated as the percentage of ILI cases tested for influenza viruses, which may differ from percentage of ILI samples tested for influenza viruses.

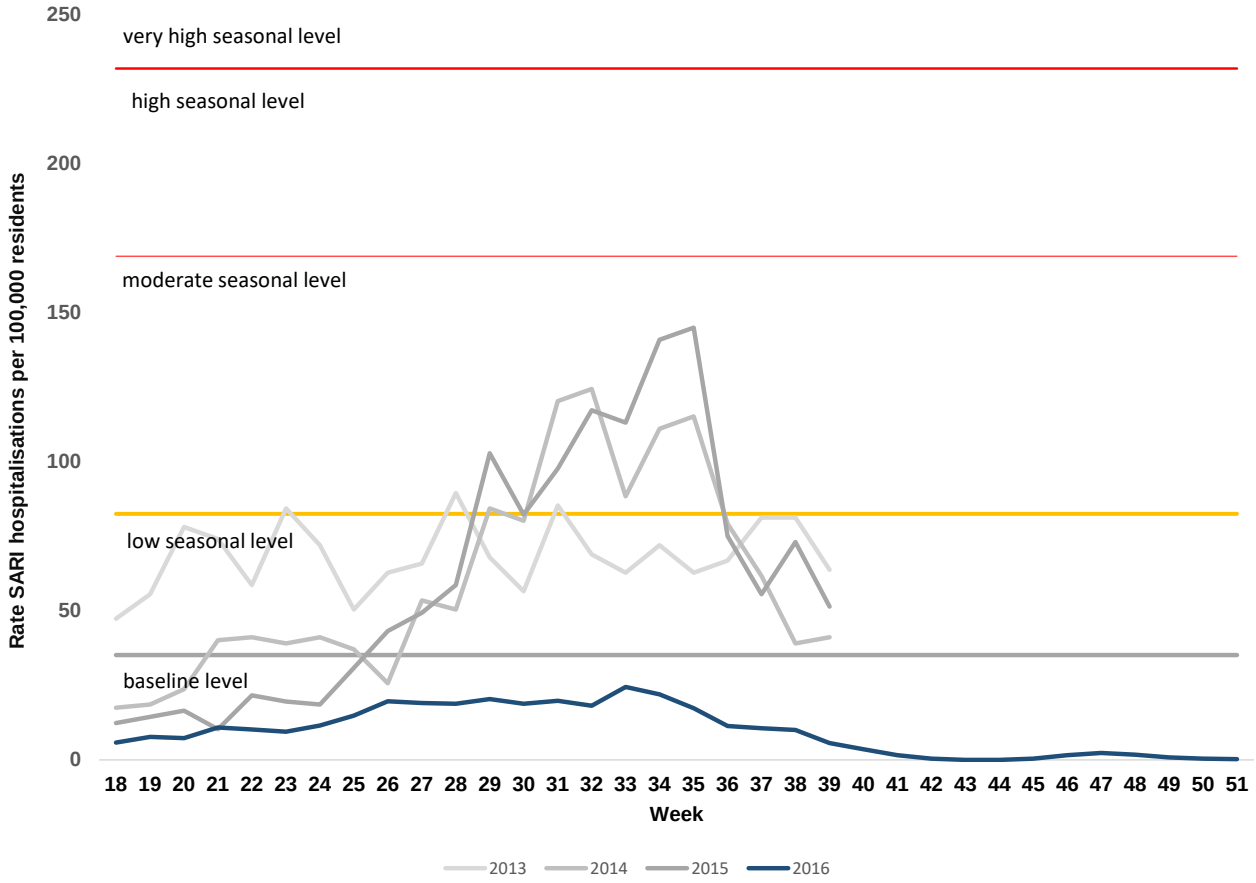
Appendix Table 17. Influenza-like illness peak rates (1992–2016) and annual consultation rates (1997–2016)

Year	Peak ILI rate	ILI annual consultation rate
1992	212.2	
1993	219.8	
1994	213.0	
1995	270.1	
1996	624.3	
1997	244.2	3123.8
1998	120.0	1327.0
1999	190.8	2354.0
2000	41.7	697.4
2001	140.3	1330.6
2002	96.3	929.2
2003	184.7	1233.9
2004	127.5	941.4
2005	174.4	1260.4
2006	99.4	994.8
2007	69.5	775.0
2008	95.2	1184.2
2009	284.0	2695.6
2010	151.6	1172.9
2011	66.1	933.8
2012	154.1	1087.0
2013	47.3	572.5
2014	52.7	660.1
2015	148.5	1203.4
2016	24.4	324.5

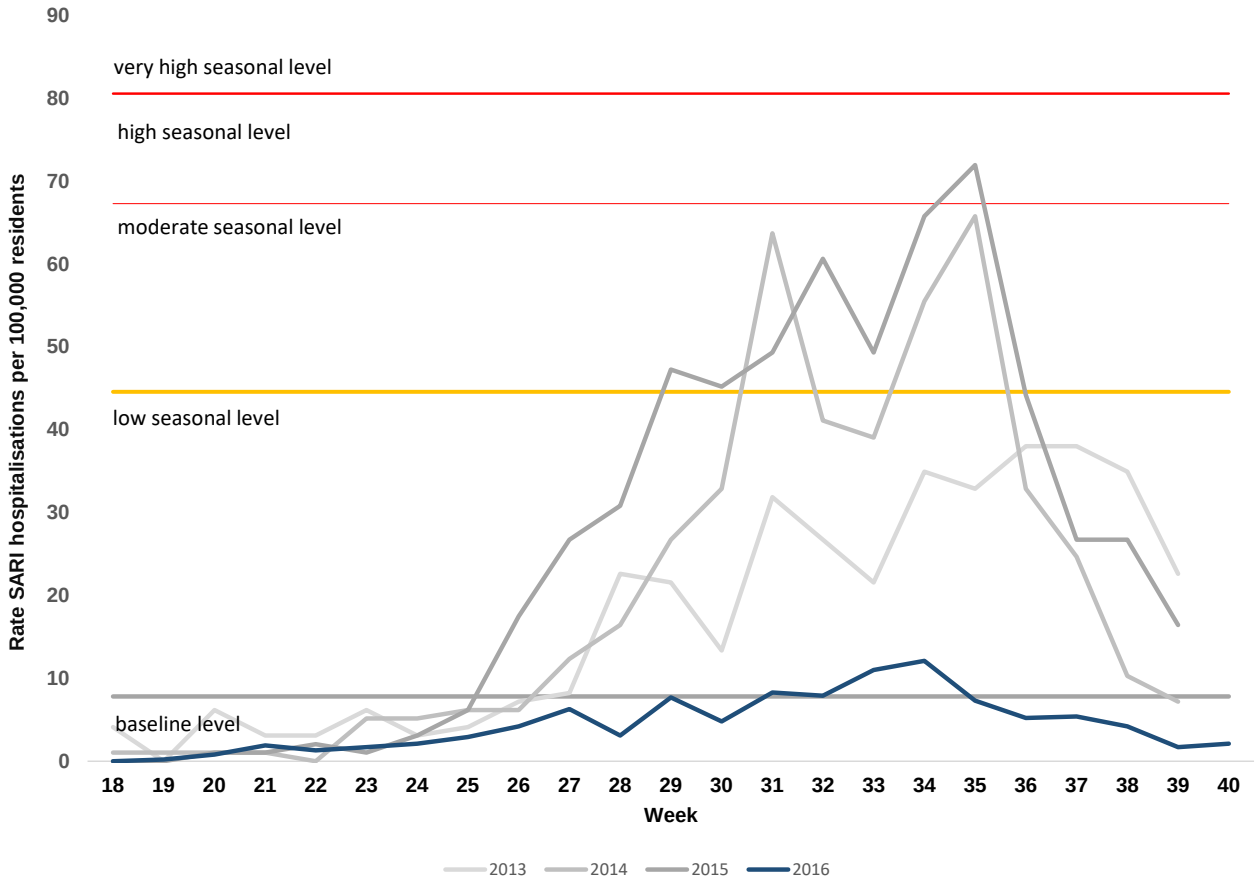
Appendix Figure 36. Weekly consultation rates for Influenza-like Illness (ILI) in New Zealand, 2009–2016



Appendix Figure 37. Weekly ILI consultation rates in 2016 compared to 2013–2015 rates (SHIVERS)



Appendix Figure 38. Weekly ILI influenza positive rates in 2016 compared to 2013–2015 rates (SHIVERS)



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