SURVEILLANCE REPORT

INFLUENZA SURVEILLANCE IN NEW ZEALAND 2015

E/S/R

Prepared as part of a Ministry of Health contract for scientific services by the Health Intelligence Team, Institute of Environmental Science and Research Limited

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SUMMARY

INFLUENZA REPORT AT A GLANCE

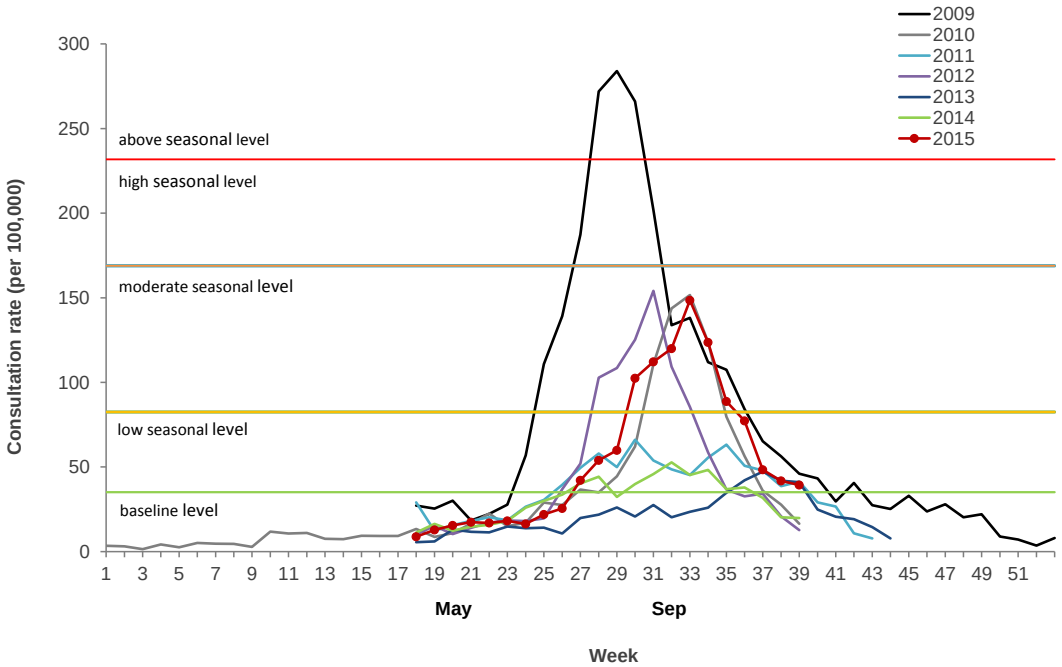
This document provides an overview of the influenza surveillance in New Zealand in 2015 (https://surv.esr.cri.nz/virology/influenza_annual_report.php). Influenza surveillance provides critical information about a virus that can rapidly change to cause substantial morbidity and mortality. The New Zealand influenza surveillance system compiles information from a variety of sources to guide public health action and policy with essential information on disease burden, epidemiology, aetiology, risk factors, clinical spectrum 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.

2015 Influenza Activity

NZ 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, 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 Maori or Pacific ethnicities are more likely to be admitted in hospital but less likely to be seen at GPs.

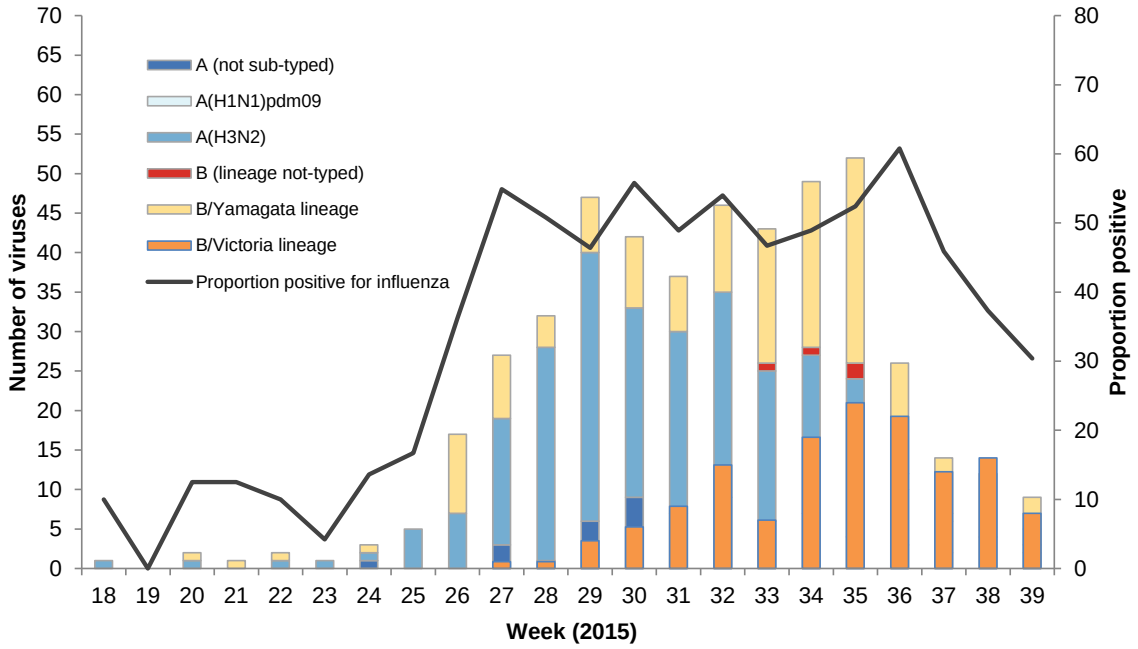
Visits to the GP (Figure 1) and hospital for acute respiratory illnesses were at a moderate level during 2015. However, the number of influenza-positive acute respiratory illnesses in both settings were at high levels. In the national ILI system, ILI consultation rates varied greatly across District Health Boards (DHBs), with the highest rates reported from South Canterbury and Tairawhiti DHBs.

Figure 1. Weekly consultation rates for Influenza-like Illness (ILI) in New Zealand, 2009–2015



Influenza A(H3N2) was the predominant 2015 influenza virus among subtyped and lineage-typed viruses; however, two lineages of influenza B viruses (Yamagata and Victoria) also circulated (Figure 2). The influenza B (Victoria lineage) was not included in the 2015 trivalent influenza vaccine. The influenza B (Victoria lineage) virus will be added to the 2016 trivalent and quadrivalent influenza vaccines. More details on 2016 influenza vaccine recommendations are here: https://surv.esr.cri.nz/virology/influenza_vaccine.php.

Figure 2. Temporal distribution of the number and proportion of influenza viruses from ILI specimens by type and week, 27 April to 27 September 2015



Influenza in Populations at Elevated Risk

Groups at increased risk for infection with 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 are all eligible for free seasonal influenza vaccine. http://www.influenza.org.nz/eligibility-criteria

Pregnant women: Pregnant women were five times (95% Confidence Interval [CI]: 2-11) as likely as other similarly aged women (15–45 years old) to be hospitalised with influenza.

Adults with underlying medical conditions: Of the nearly 200 adults (15 years or older) who were hospitalised with influenza during 2015, many (60%) had underlying medical conditions or prior respiratory hospitalisation with cardiovascular disease, asthma and diabetes being the most common.

Children: Around a third (36%) of children under 15 years old hospitalised with influenza had any underlying conditions or prior respiratory hospitalisation.

Vaccine Coverage, Vaccine Effectiveness and Antiviral Resistance in 2015

In 2015, a reported 26% 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. Influenza vaccine coverage was also low (<30%) among SARI patients who are eligible for free vaccine (ie. those >=65 years, those <65 years with underlying conditions, and children with prior respiratory hospitalisations).

The 2015 seasonal influenza vaccine was 36% (95% CI: 11-54) effective at preventing influenza-related general practice consultations and 50% (95% CI: 20-68) effective at preventing influenza-associated hospitalisations. Even with moderate vaccine effectiveness (35-65%), influenza vaccine can not only help protect those who are vaccinated but can also help protect their close contacts from getting ill with influenza (http://www.cdc.gov/flu/about/qa/vaccineeffect.htm). The circulating influenza viruses were all sensitive to oseltamivir and zanamivir (antiviral agents).

INTRODUCTION

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 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].

Three active influenza surveillance systems in New Zealand combine epidemiological and virological investigations for influenza:

1. National sentinel GP-based surveillance.

   This system was established in 1989 and is part of the World Health Organization's (WHO) Global Influenza Programme.

   The purpose of this surveillance system is to:

   - improve knowledge of the incidence and distribution of influenza in the community to assist in developing strategies to control influenza through immunisation;
   - enable early detection of influenza epidemics within the community to guide the development and implementation of appropriate public health control measures; and
   - provide an indication of the predominant strains of influenza virus in the community to help in planning for the most effective influenza vaccine for the subsequent year [3].

2. SHIVERS sentinel GP-based ILI surveillance.

   In October 2011, led by the Institute of Environmental Science and Research (ESR), a multiagency and multidisciplinary project 'Southern Hemisphere Influenza and Vaccine Effectiveness Research and Surveillance' (SHIVERS) was established for a 5-year period (2012–2016) as a result of the award received from US-CDC [4]. This collaboration is between ESR, Auckland District Health Board (ADHB), Counties Manukau District Health Board (CMDHB), University of Auckland, University of Otago, WHO Collaborating Centre at St Jude Children's Research Hospital and US-CDC.

   SHIVERS sentinel GP-based ILI surveillance has been conducted every winter season since 29 April 2013. This is an active, prospective, population-based surveillance system for ILI cases consulted 16 sentinel general practices in the central, east and south Auckland region (population 97,000).

   The aims of SHIVERS sentinel GP-based ILI surveillance are to:

   - measure the burden of disease that influenza and other respiratory viruses cause in the community;
   - monitor trends in disease that influenza and other respiratory viruses cause in the community;
   - identify at-risk groups that should be prioritised for prevention and control;
   - monitor the antigenic, genetic and antiviral characteristics of influenza viruses associated with influenza-like illness;
   - provide a study base to estimate the effectiveness of the influenza vaccine in prevention of ILI-associated influenza consultations.

3. SHIVERS 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 aims of SARI surveillance are to:

   - establish enhanced, prospective, longitudinal, population-based surveillance for hospitalised SARI cases, intensive care unit (ICU) admissions and deaths caused by influenza and other respiratory pathogens in Auckland, support global influenza surveillance [5];
   - measure the incidence, prevalence, demographic characteristics (including age, sex, ethnic group and socioeconomic status (SES)), clinical spectrum and outcomes for SARI cases, ICU admissions and deaths;
   - identify aetiologies of SARI cases, including ICU admissions and deaths attributable to influenza and other respiratory viruses (respiratory syncytial virus (RSV), human metapneumovirus, adenovirus, parainfluenza types 1–3, rhinovirus, enterovirus); monitor the antigenic, genetic and antiviral characteristics of influenza viruses associated with SARI;
   - determine the accuracy and validity of the data generated from New Zealand's existing hospital discharge coding by comparing it with estimates of influenza and pneumonia etiology and incidence obtained from this study;
   - describe any possible increased risk of influenza-related hospitalisation, ICU admissions and deaths associated with conditions such as asthma, pregnancy, diabetes and high BMI (body mass index) among population sub-groups defined by age, gender, ethnic group and SES;
   - contribute directly to some of the other specific aims and objectives of the SHIVERS project by using the data generated from this surveillance;
   - provide a study base to estimate the effectiveness of the influenza vaccine in prevention of SARI-associated influenza hospitalisations.

This report summarises the results from influenza surveillance in New Zealand in 2015. It provides information on community-based ILI and related influenza disease (obtained from national and SHIVERS GP-based ILI surveillance). It also describes hospital-based influenza morbidity and mortality (obtained from SHIVERS 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 antiviral susceptibility and genetic data as well as influenza immunisation coverage data obtained from the Ministry of Health.

METHODS

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METHODS

NATIONAL SENTINEL GENERAL PRACTICE BASED INFLUENZA SURVEILLANCE

The national sentinel GP-based surveillance system (also referred as ESR's sentinel GP surveillance) began in 1989, and is part of the WHO's Global Influenza Programme. It is operated nationally by the ESR and locally by influenza surveillance co-ordinators in the public health services (PHS). Sentinel surveillance usually operates in the winter from May to September (weeks 18–39). 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).

GPs record on a standardised form the number of consultations for influenza-like illness (ILI) each week with the age (<1, 1–4, 5–19, 20–34, 35–49, 50–64, 65 years and over) of each consulting patient who meets the case definition for ILI.

For sentinel surveillance, ILI is defined as "*an acute upper respiratory tract infection characterised by an abrupt onset and two of the following: fever, chills, headache, and myalgia*"[6].

During the season, each participating practice collects respiratory samples (ie, a nasopharyngeal or throat swab) 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. Practices forward samples either to the WHO National Influenza Centre (NIC) at ESR or to hospital virology laboratories in Auckland, Waikato or Christchurch for virus characterisation. Laboratory identification includes molecular detection using the polymerase chain reaction (PCR), isolation of the virus, or direct detection of viral antigens. Influenza viruses were typed and sub-typed and lineage-typed as A, B, A(H3N2) or A(H1N1)pdm09, B/Yamagata, or B/Victoria lineage.

Weekly, local co-ordinators forward information on the number of ILI consultations and swabs sent from each DHB to ESR. ILI consultation data is received by Wednesday of the following week. Likewise, virology laboratories report the total number of swabs received from each DHB and the influenza viruses identified to ESR weekly, 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 registered patient populations of the participating practices as a denominator. From 1989 to 2009, the denominator for the age-specific ILI rate calculation was based on New Zealand census data. The assumption was that the age distribution of the practice patient population was the same as the New Zealand population. Participating practices did not provide age-specific patient population data. From 2010 to 2015 however, age-specific patient population denominators were available from practices for the consultation rate calculations.

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

SHIVERS SENTINEL PRACTICE BASED SURVEILLANCE FOR INFLUENZA-LIKE ILLNESS

SHIVERS sentinel practices are based in Auckland and Counties Manukau DHBs (ADHB and CMDHB respectively) [4]. In these practices, GPs and/or practice nurses screened every patient who is seeking medical attention for an ILI. The SHIVERS ILI case definition is "*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 a GP consultation*". If a patient meets this definition, a respiratory specimen (nasopharyngeal or throat swab) is collected and tested for influenza and other respiratory pathogens. Information on the patient's demography, clinical history, co-morbidities, vaccination history, regular medication and pregnancy status is also collected from both the patient, and the patient management system.

Together with total practice consultations and registrations, population-based incidence of ILI and ILI-associated influenza incidence is calculated for overall and sub-populations within the two DHBs.

SHIVERS HOSPITAL-BASED SURVEILLANCE FOR SEVERE ACUTE RESPIRATORY INFECTIONS

SHIVERS hospital-based surveillance for SARI operates in Auckland and Counties Manukau DHBs [9]. Inpatients with suspected respiratory infections admitted overnight to any of the four DHB hospitals (Auckland City Hospital and the associated Starship Children's Hospital, Middlemore Hospital and the associated Kidz First Children's Hospital) in the two DHBs, 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 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 for SHIVERS: "*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 Moving Epidemic Method (MEM) based on WHO's interim guidance for influenza severity assessment [7, 8], which is described in more detail below.

If a patient with suspected respiratory infection 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 as SHIVERS results during 2013-2014 indicated that SARI case definition missed out those influenza cases that did not meet the SARI case definition. Thus, eligibility for ICU patients for specimen collection is expanded: for an ICU patient with suspected respiratory infection, a respiratory sample is collected for testing no matter the patient meeting the SARI case definition or not.

The total number of all new hospital inpatient acute overnight admissions and newly assessed and tested 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*" (ie, the same case definition as for national sentinel GP-based surveillance). 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 had three sensitivity thresholds—high, medium and low. If the daily consultation count exceeded 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 NON-SENTINEL SURVEILLANCE—FOR OUTPATIENTS AND HOSPITAL INPATIENTS

In addition to influenza viruses identified from sentinel GP-based surveillance, year-round laboratory-based passive surveillance of influenza (and other viruses) is carried out by the regional virus diagnostic laboratories at Auckland, Middlemore, Waikato, PathLab Tauranga, Wellington, Christchurch, Dunedin hospitals, and by the National Influenza Centre at ESR. This type of surveillance is referred to as non-sentinel surveillance. Each week, all viral identifications, including influenza (largely from outpatient clinics and inpatient hospitals during routine laboratory diagnostic investigation), are reported to the National Influenza Centre, which then collated and reported virology surveillance data nationally.

MOVING EPIDEMIC METHOD (MEM)

The start of influenza season and intensity level of the influenza epidemics is defined by using the Moving Epidemic Method (MEM) based on WHO's interim guidance for influenza severity assessment [7, 8]. Briefly, MEM has three main steps. In the first step, for each season separately, the length of the epidemic period is estimated as the minimum number of consecutive weeks with the maximum accumulated percentage rates, splitting the season into three periods: a pre-epidemic, an epidemic, and a post-epidemic period. In the second step, MEM calculates the epidemic threshold as the upper limit of the 95% one-sided confidence interval of 30 highest pre-epidemic weekly rates, the n highest for each season taking the whole training period, where n = 30/number of seasons. In the third step, medium, high, and extra-ordinary intensity thresholds were estimated as the upper limits of the 40%, 90%, and 97.5% one-sided confidence intervals of the geometric mean of 30 highest epidemic weekly rates, the n highest for each season taking the whole training period, where n = 30/number of seasons. Five categories are used to set thresholds and define intensity level:

- no activity or below seasonal threshold: Below the seasonal threshold
- low: between seasonal threshold and upper limit of the 40% one sided confidence interval of the geometric mean
- moderate: between the upper limit of the 40% and 90% one sided confidence interval of the geometric mean
- high: between the upper limit of the 90% and 97.5% one sided confidence interval of the geometric mean
- extra-ordinary: above the upper limit of the 97.5% one sided confidence intervals of the geometric mean

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 influenza		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 servaillance 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 activity range (/100,000)			
Method	Below seasonal threshold	low	moderate	high	above seasonal
MEM	<8.0	8.0-12.1	12.1-15.0	15.0-16.5	>16.5

SHIVERS SARI-associated influenza		Seasonal activity range (/100,000)			
Method	Below seasonal threshold	low	moderate	high	above seasonal
MEM	<0.8	0.8-3.1	3.1-4.8	4.8-5.9	>5.9

IMMUNISATION COVERAGE

Immunisation benefit claims data from the 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 2015 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 have yielded viral isolates.

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NATIONAL SENTINEL GENERAL PRACTICE-BASED SURVEILLANCE

In 2015, 64 practices were recruited from 18 of New Zealand's 20 DHBs for sentinel GP-based surveillance. No practices were recruited from Auckland or Counties Manukau DHBs since 16 GPs from these two DHBs participated in the SHIVERS ILI surveillance. In 2015, national ILI surveillance commenced on 27 April 2015. All 18 participating DHBs began reporting by the fourth week of surveillance (24 May 2015). Some sentinel practices did not report every week. The average number of practices participating each week was 58, with an average patient roll of 320,266 – approximately 7.0% of the New Zealand population.

During the 2015 influenza season (May to September), a total of 3854 sentinel consultations for ILI were reported. Based on this, the cumulative incidence rate of ILI consultations was 1203.4 per 100,000 (95% CI: 1136.3, 1272.5) patient population. This rate is higher than the cumulative incidence rates for 2014 (660.1 per 100,000 (95% CI: 610.8, 712.1)) and in 2013 (572.5 per 100,000 (95% CI: 527.2, 621.8)). The average national weekly consultation rate in 2015 was 56.3 per 100,000 (95% CI: 42.3, 72.7) patient population. This rate is higher than the average weekly rates for 2014 (30.6 per 100,000 (95% CI: 21.1, 44.0)) and 2013 (21.6 per 100,000 (95% CI: 13.8, 33.3)).

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 55,304 New Zealanders during the 2015 influenza season (1.2% of total population). This is higher than the estimated number of people affected in 2014 (29,768, 0.7% of total population) and in 2013 (25,598, 0.6% of total population).

Figure 1 presents the weekly consultation rates for ILI for 2009–2015. Consultation rates peaked slightly later in 2015 compared to previous years. Using the MEM to define the start of and intensity level of the influenza season, the overall influenza-like illness activity in 2015 was at a moderate level (Figure 1).

Figure 1. Weekly consultation rates for ILI in New Zealand, 2009–2015

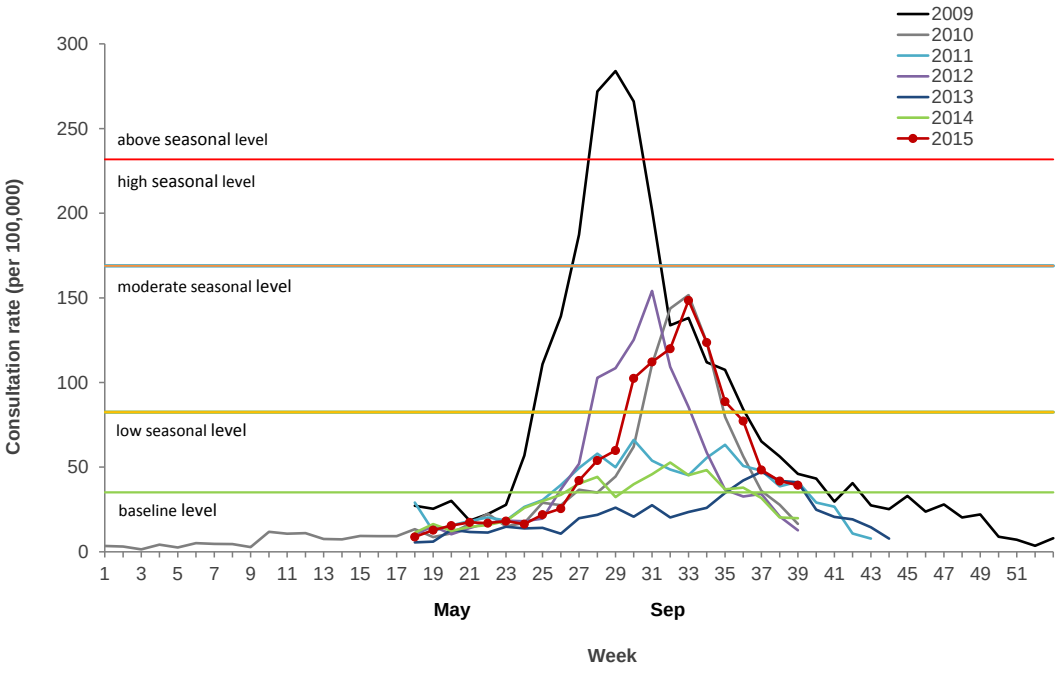
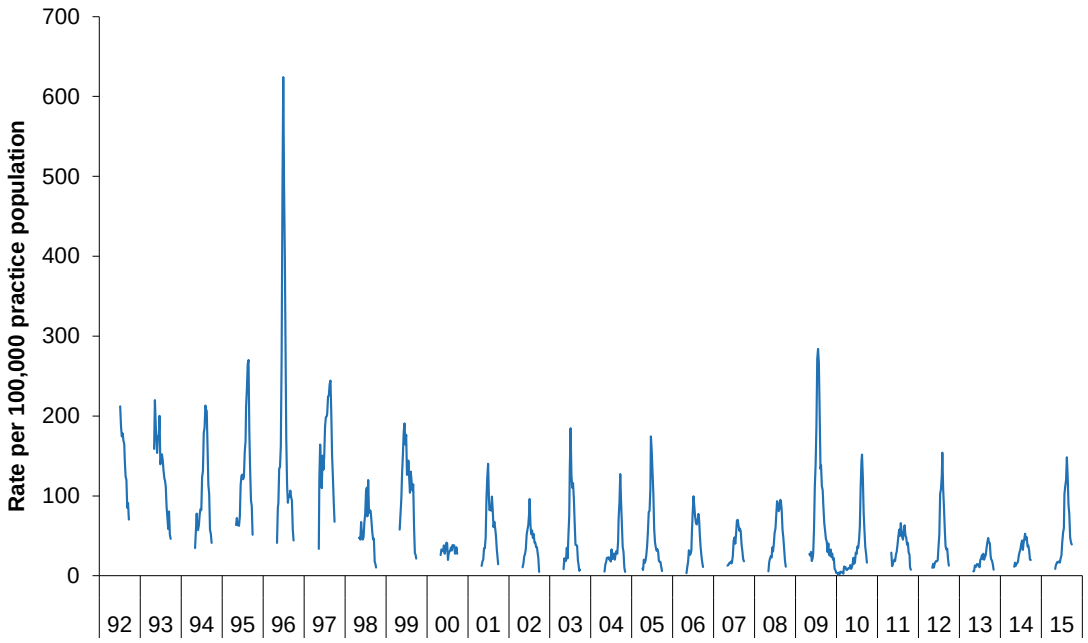


Figure 2 compares the weekly consultation rates for ILI in 2015 with the weekly consultation rates for ILI in 1992–2014. The peak ILI rate in 2015 was the thirteenth highest during the period 1992–2015 (the highest was in 1996, and the second highest in 2009 and the lowest in 2000).

Figure 2. Weekly consultation rates for ILI in New Zealand, 1992–2015



Cumulative ILI consultation rates by age group were calculated for the sentinel surveillance system (Figure 3). The highest cumulative consultation rates for ILI were in children aged 1–4 years (2130.3 per 100,000 patient population) and 5–19 years (1559.4 per 100,000 patient population). Older people (aged 65 years and older) had the lowest ILI consultation rate of 431.3 per 100,000 patient population.

Figure 3. Sentinel cumulative consultation rates for ILI by age group, 2015

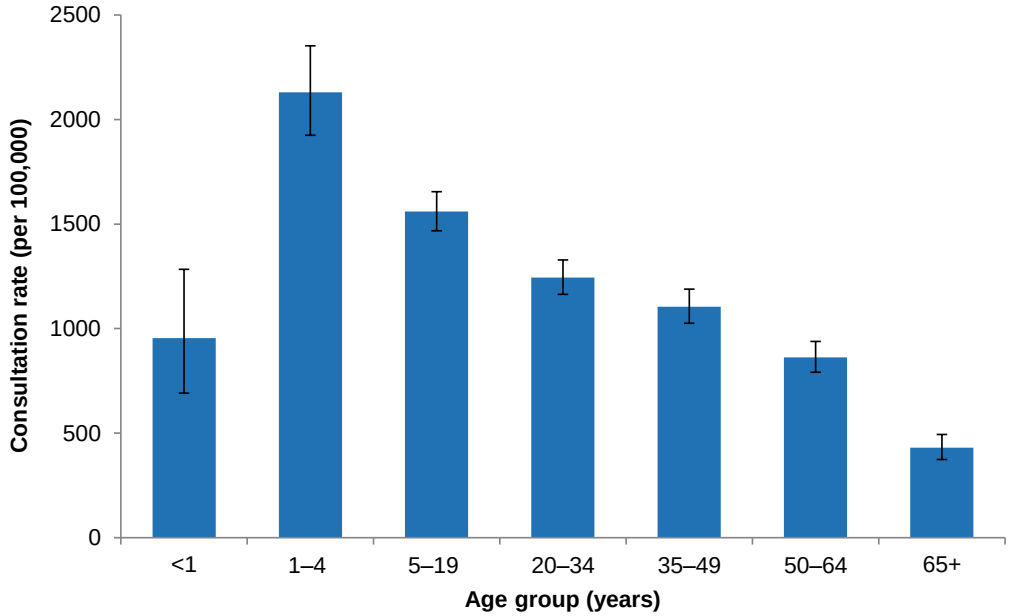
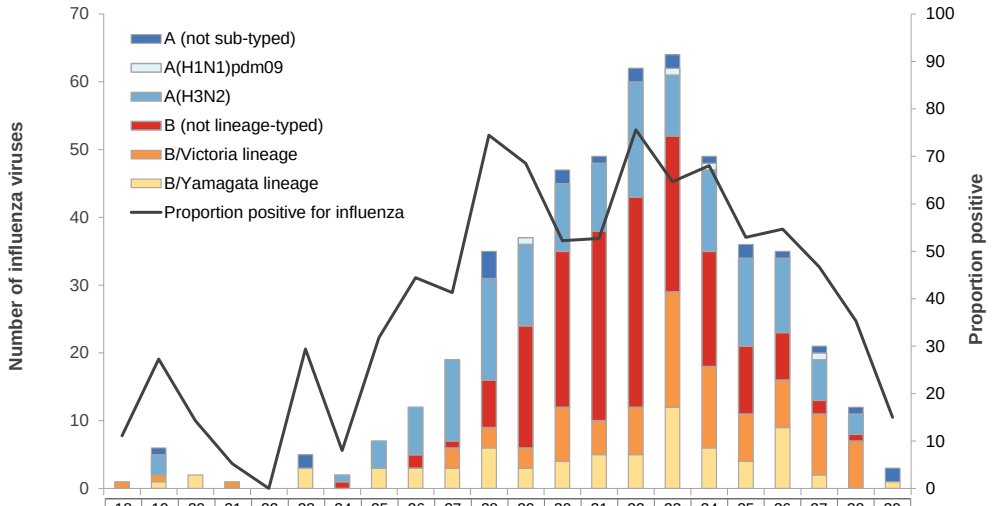


Figure 4 shows the temporal distribution of influenza viruses from sentinel surveillance from weeks 18–39. Peak influenza virus detection from sentinel surveillance occurred in week 33 (64 viruses). Influenza B viruses predominated much of the 2015 influenza season (weeks 28–39) with a peak in week 33 (10–16 August), comprising 81% of all viruses detected.

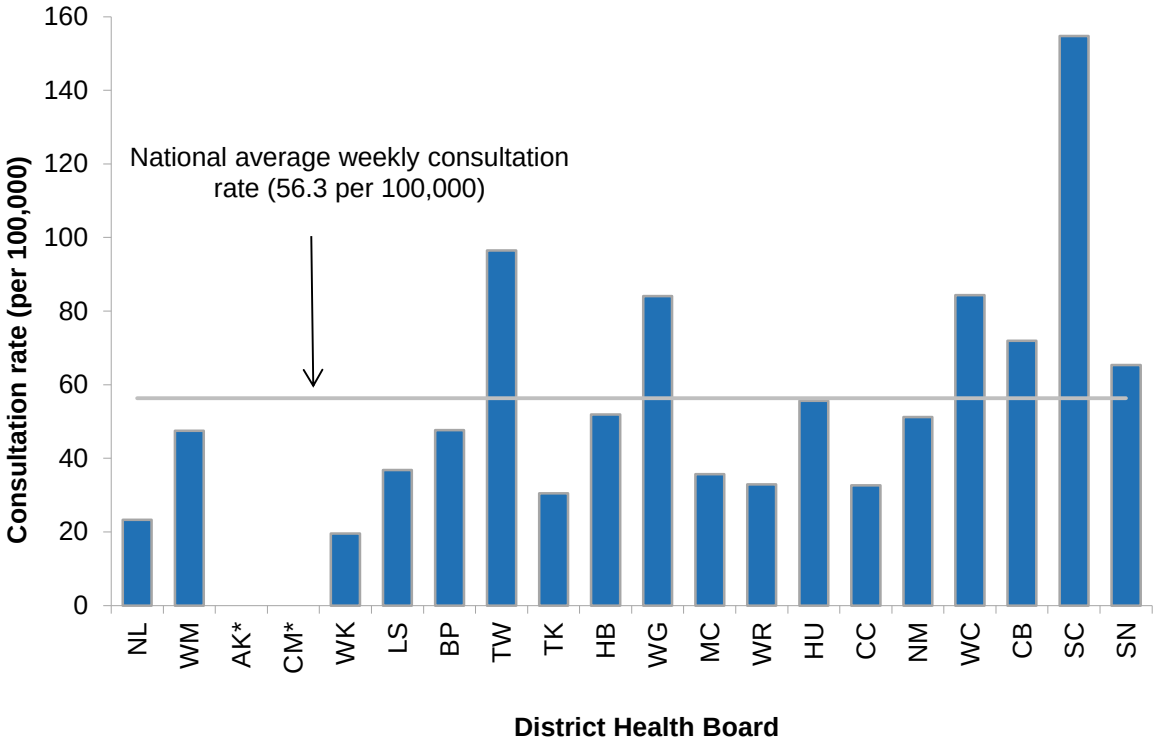
Figure 4. Influenza viruses from sentinel surveillance by type and week reported, 2015



	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
A (not sub-typed)	0	1	0	0	0	2	0	0	0	0	4	0	2	1	2	2	1	2	1	1	1	2
A(H1N1)pdm09	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
A(H3N2)	0	3	0	0	0	0	1	4	7	12	15	12	10	10	17	9	12	13	11	6	3	0
B (not lineage-typed)	0	0	0	0	0	0	1	0	2	1	7	18	23	28	31	23	17	10	7	2	1	0
B/Victoria lineage	1	1	0	1	0	0	0	0	0	3	3	3	8	5	7	17	12	7	7	9	7	0
B/Yamagata lineage	0	1	2	0	0	3	0	3	3	3	6	3	4	5	5	12	6	4	9	2	0	1

Figure 5 shows the average weekly sentinel consultation rates for each DHB from May to September 2015. Weekly ILI consultation rates per 100,000 patient population varied among DHBs, with rates above the national average in South Canterbury (154.7), Tairawhiti (96.4), West Coast (84.4), Whanganui (84.1), Canterbury (72.0), and Southern (65.4).

Figure 5. Sentinel average weekly consultation rates for influenza by DHB from North to South, 2015



Note: DHBs marked * did not participate in the national influenza sentinel surveillance, but did participate in the SHIVERS sentinel practice based surveillance. For details, see SHIVERS sentinel GP-based ILI surveillance section.

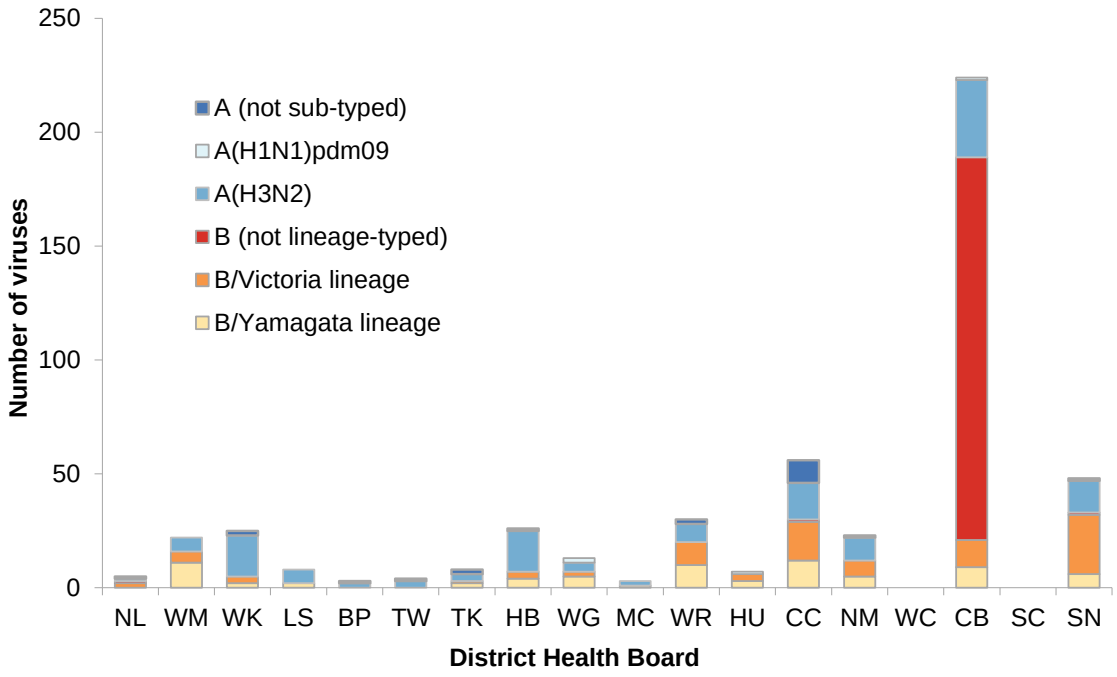
See Table 3 for the DHB abbreviations.

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 6 shows the distribution of sentinel influenza viruses based on the DHB from which the specimen (swab) was taken. Most viruses came from Canterbury, Capital & Coast and Southern DHBs.

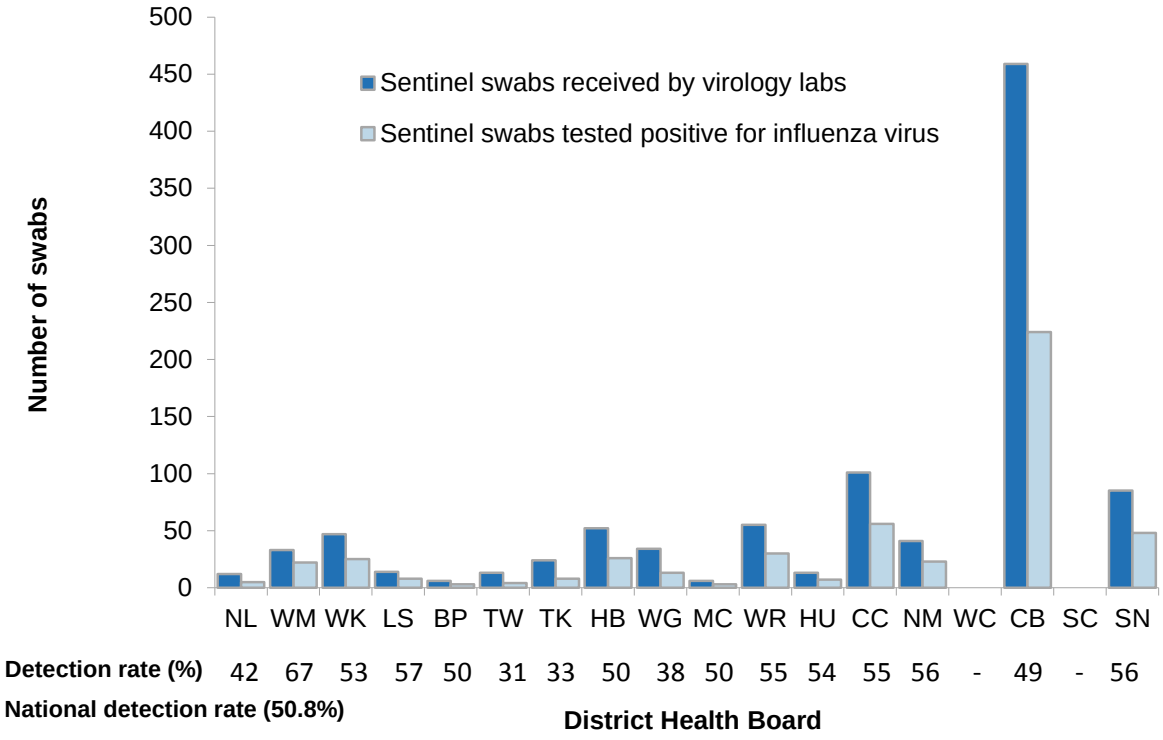
Figure 6. Numbers of laboratory-confirmed influenza viruses from sentinel surveillance by DHB, May to September 2015



Note: Auckland and Counties Manukau DHBs did not participate in the national influenza sentinel surveillance. They participated in SHIVERS sentinel GP-based surveillance. For details, see see SHIVERS sentinel GP-based ILI surveillance section.

Figure 7 shows the number of swabs received and tested for influenza virus by DHB in 2015. Canterbury practices test all patients presenting with ILI, which is different than the procedure followed by practices in other DHBs.

Figure 7. Sentinel swabs received and tested positive for influenza virus by DHB, 2015



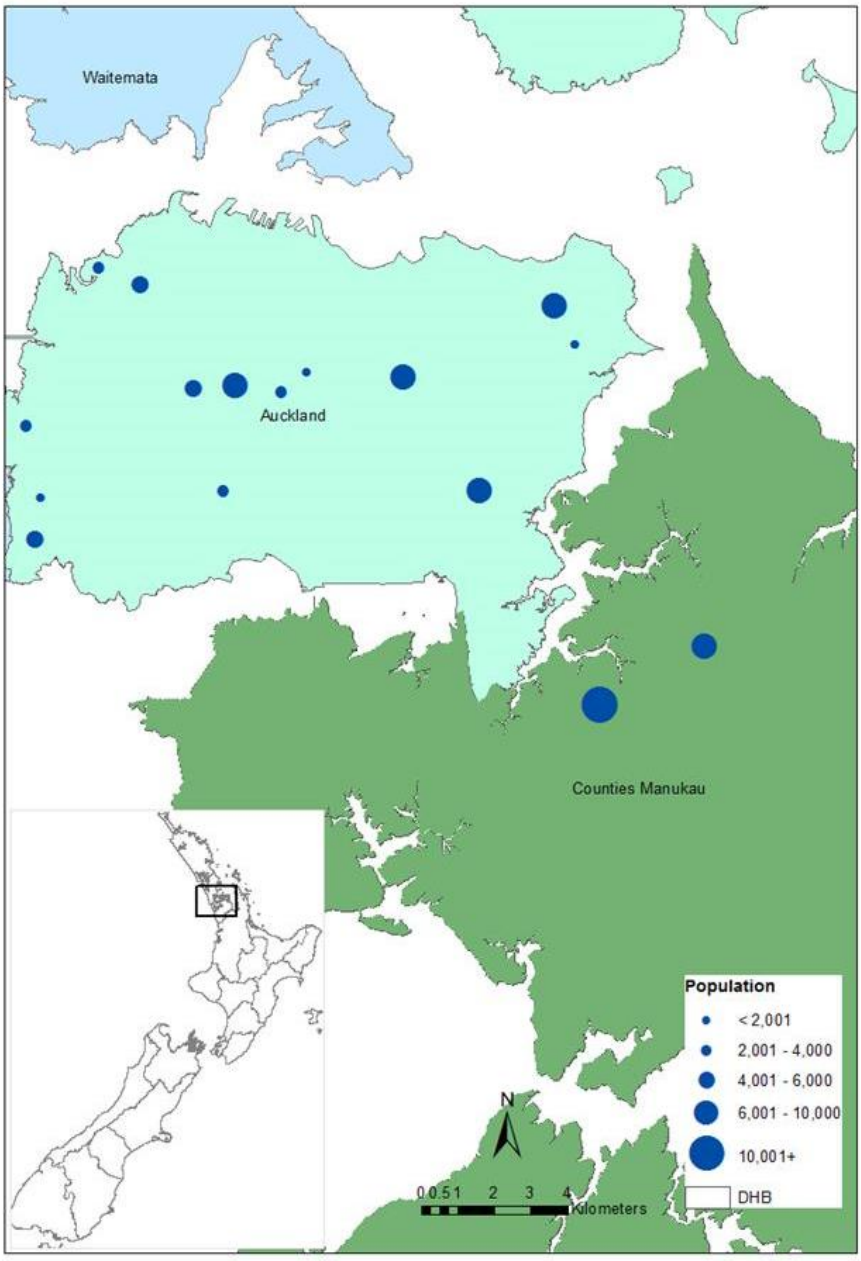
Note: The swabs from the West Coast, South Canterbury were reported under Canterbury DHB.

The national influenza virus detection rate for 2015 was 50.8% (505 viruses from 995 swabs received), which is higher than in 2014 (37.2%, 273 viruses from 733 swabs received), and in 2013 (32.6%, 196 viruses from 602 swabs received).

SHIVERS SENTINEL GENERAL PRACTICE-BASED ILI SURVEILLANCE

The SHIVERS sentinel general practices were based in two DHBs in the Auckland region. The ADHB and CMDHB serve a combined population of 905,634 residents. Of this population, 97,291 patients were enrolled at the 16 sentinel general practices (Figure 8). This is approximately 10.7% of the total ADHB and CMDHB population.

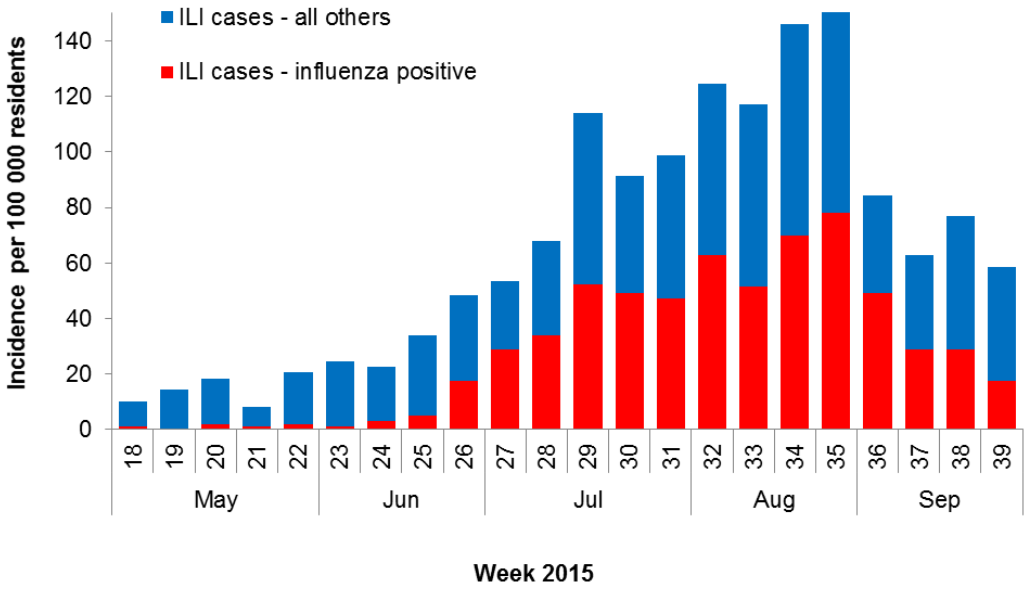
Figure 8. Geographical distribution of SHIVERS sentinel practices in ADHB and CMDHB



The populations of these DHBs are slightly different in composition. The population in ADHB is slightly older, more European ethnicity and higher SES than the CMDHB population, which is slightly younger, has a higher proportion of Pacific peoples and Asian ethnicity and a lower SES.

The SHIVERS ILI surveillance operated between 27 April and 27 September 2015. During this period at the 16 sentinel practices 1416 (1.2%) of the 120,867 GP consultations met the ILI case definition (Figure 9). Among the patients that met the ILI case definition, 1371 (96.8%) had a specimen tested for influenza. Of these, 614 (44.8%) cases had influenza virus detected. Influenza peaked in week 35 (ending 30 August). Appendix Figure 42 and Appendix Figure 43 demonstrate that the 2015 season had moderate ILI activity and influenza associated ILI crossed into high intensity.

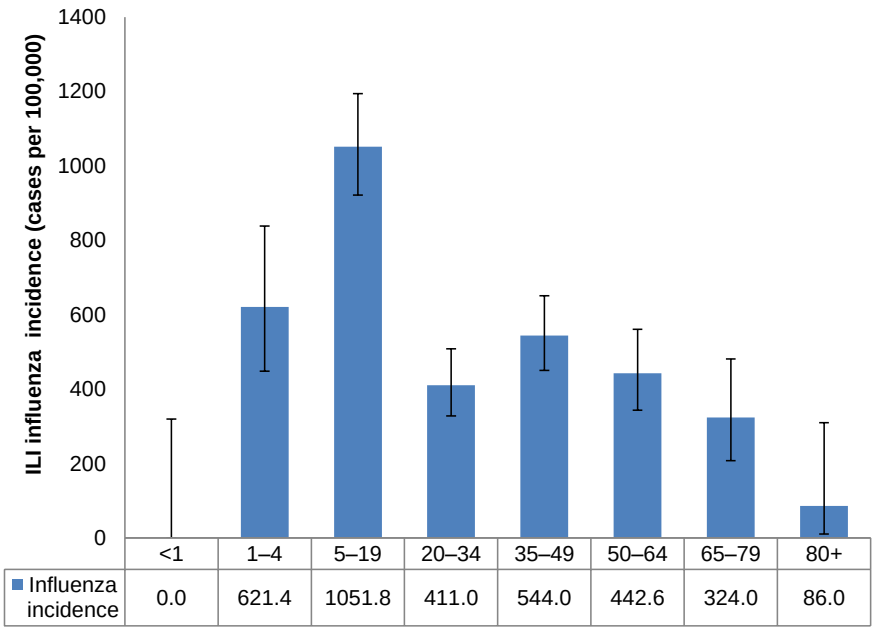
Figure 9. Weekly ILI and influenza positive incidence, 27 April to 27 September 2015



Of the 1416 ILI cases identified through SHIVERS, 1311 were enrolled patients residing in ADHB or CMDHB. This gives an ILI incidence rate of 1347.5 per 100,000 (95% CI: 1277.4, 1421.4) patient population (Appendix Table 14). A total of 571 cases from ADHB and CMDHB residents were positive for influenza viruses. This gives an ILI-associated influenza incidence of 586.9 per 100,000 (95% CI: 539.9, 636.9) patient population, which is higher than the rates in 2014 (465.6 per 100,000) and 2013 (461.7 per 100,000).

The SHIVERS ILI-associated influenza incidence by age group is shown in Figure 10. Children aged 5–19 years had the highest ILI-associated influenza rates, followed by those aged 1–4 years, 35–49 years, and 50–64 years. There were no ILI-associated influenza cases in the less than one year age group, and the next lowest rate was in adults aged 80 years and above.

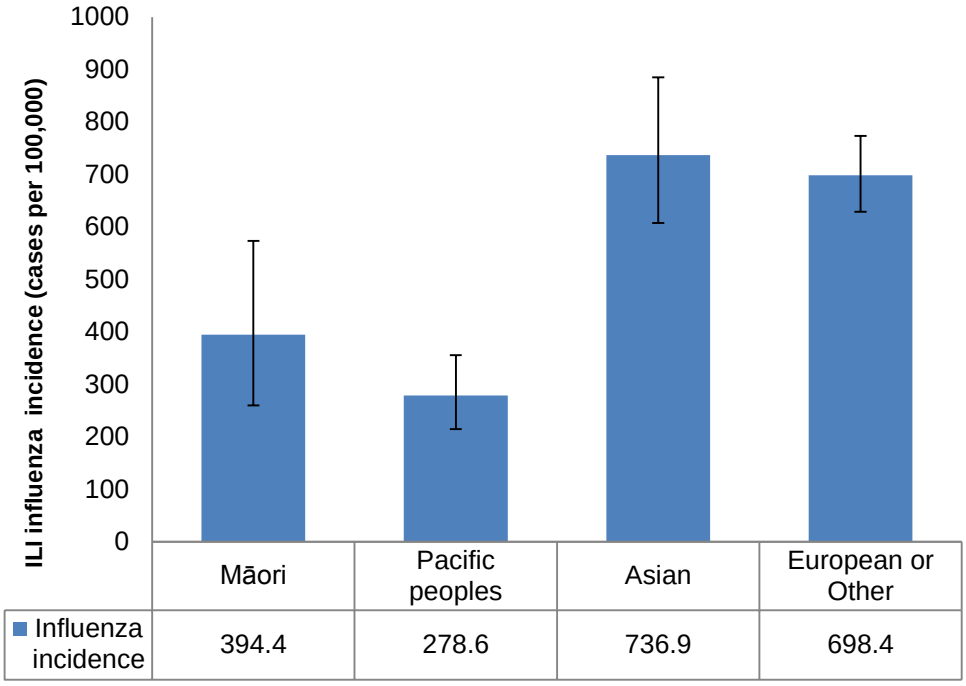
Figure 10. SHIVERS ILI-associated influenza incidence rates and 95% CIs by age-group, 27 April to 27 September 2015



	<1	1–4	5–19	20–34	35–49	50–64	65–79	80+
Influenza incidence	0.0	621.4	1051.8	411.0	544.0	442.6	324.0	86.0

The ILI-associated influenza incidence by ethnic group in SHIVERS is shown in Figure 11. People in the Asian and European or Others ethnic groups had significantly higher ILI-associated influenza incidence than Pacific peoples and Māori ethnic groups.

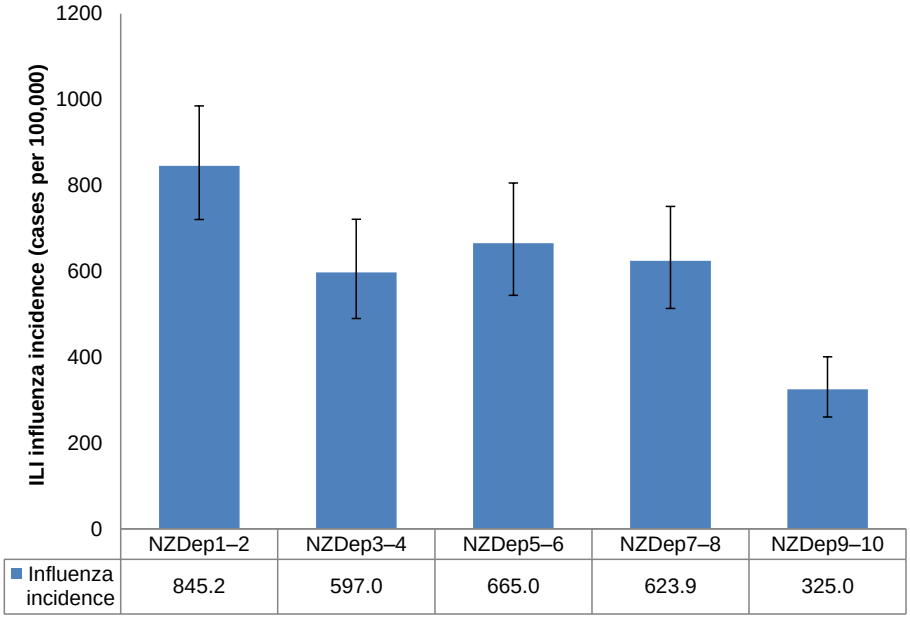
Figure 11. SHIVERS ILI-associated influenza incidence and 95% CIs by ethnic groups, 27 April to 27 September 2015



	Māori	Pacific peoples	Asian	European or Other
Influenza incidence	394.4	278.6	736.9	698.4

The neighbourhood deprivation distribution of ILI-associated influenza cases is shown in Figure 12. The most deprived quintile (NZDep9–10) had significantly lower incidence rate compared to the other four quintiles.

Figure 12. SHIVERS ILI-associated influenza incidence and 95% CIs by deprivation index (NZDep), 27 April to 27 September 2015



	NZDep1–2	NZDep3–4	NZDep5–6	NZDep7–8	NZDep9–10
Influenza incidence	845.2	597.0	665.0	623.9	325.0

INFLUENZA VIRUSES IDENTIFIED THROUGH SHIVERS ILI

From 27 April to 27 September 2015, a total of 1373 specimens from patients with ILI were tested for influenza viruses, with 614 (44.7%) testing positive. The details are given in Table 4. Influenza A(H3N2) was the predominant strain.

Table 4. Influenza viruses in ILI cases, 27 April to 27 September 2015

Influenza viruses	ILI Cases
No. of specimens tested	1373
No. of positive specimens (%)[1]	614 (44.7)
Influenza A	302
A (not subtyped)	60
A (H1N1)pdm09	0
A(H1N1)pdm09 by PCR	0
A/California/7/2009 (H1N1) - like	0
A(H3N2)	242
A(H3N2) by PCR	224
‡A/Switzerland/9715293/2013 (H3N2) - like	18
Influenza B	312
B (lineage not determined)	9
B/Yamagata lineage	157
B/Yamagata lineage by PCR	62
¥B/Phuket/3073/2013 - like	95
B/Victoria lineage	146
B/Victoria lineage by PCR	77
B/Brisbane/60/2008 - like	69
Influenza and non-influenza co-detection (% +ve)	36 (5.9)

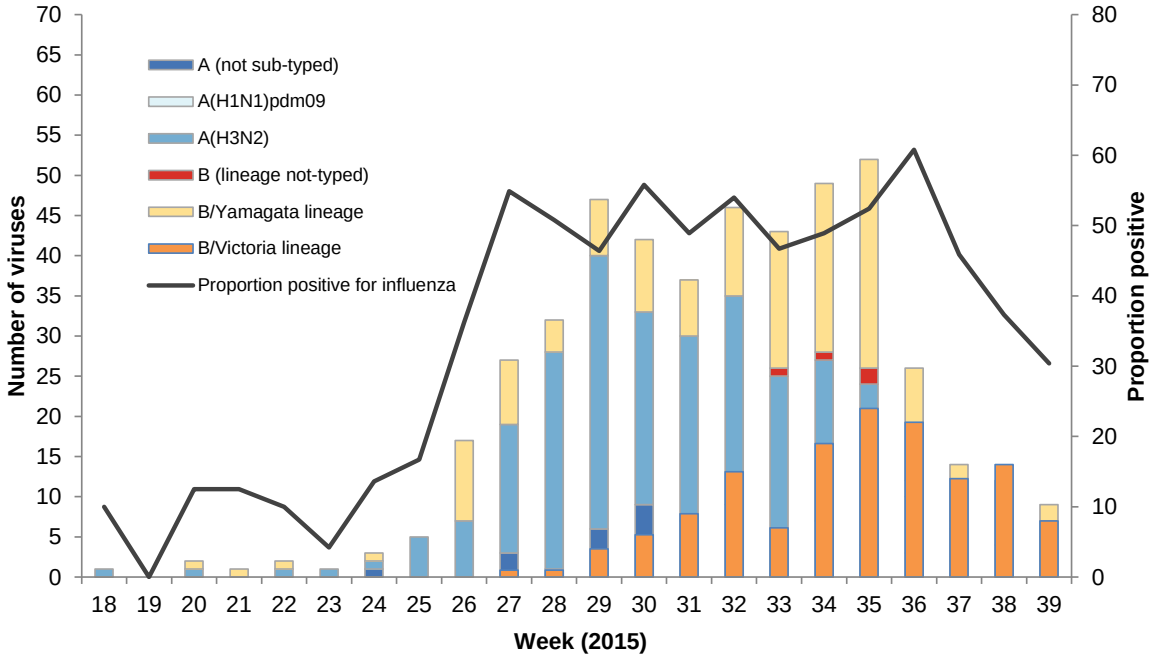
[1]Number of specimens positive for at least one of the listed influenza virus lineages. (Note: A specimen may be positive for more than one influenza virus lineage.)

‡ This virus was the A(H3N2) vaccine component for NZ in 2015.

¥ This virus was the B vaccine component for NZ in 2015.

The temporal distribution of the number and proportion of the influenza viruses identified through SHIVERS is shown in Figure 13. Influenza A(H3N2) was the predominant strain to week 33 (ending 16 August), with influenza B predominant for the rest of the season. Influenza B/Victoria lineage out-numbered B/Yamagata lineage from week 36 (ending 6 September).

Figure 13. Temporal distribution of the number and proportion of influenza viruses from ILI specimens by type and week, 27 April to 27 September 2015



NON-INFLUENZA RESPIRATORY VIRUSES THROUGH SHIVERS ILI

From 27 April to 27 September 2015, a total of 1374 ILI specimens were tested for non-influenza viruses and 327 (23.8%) tested positive (Table 5). Higher numbers of RSV and rhinovirus were detected compared to other non-influenza respiratory viruses.

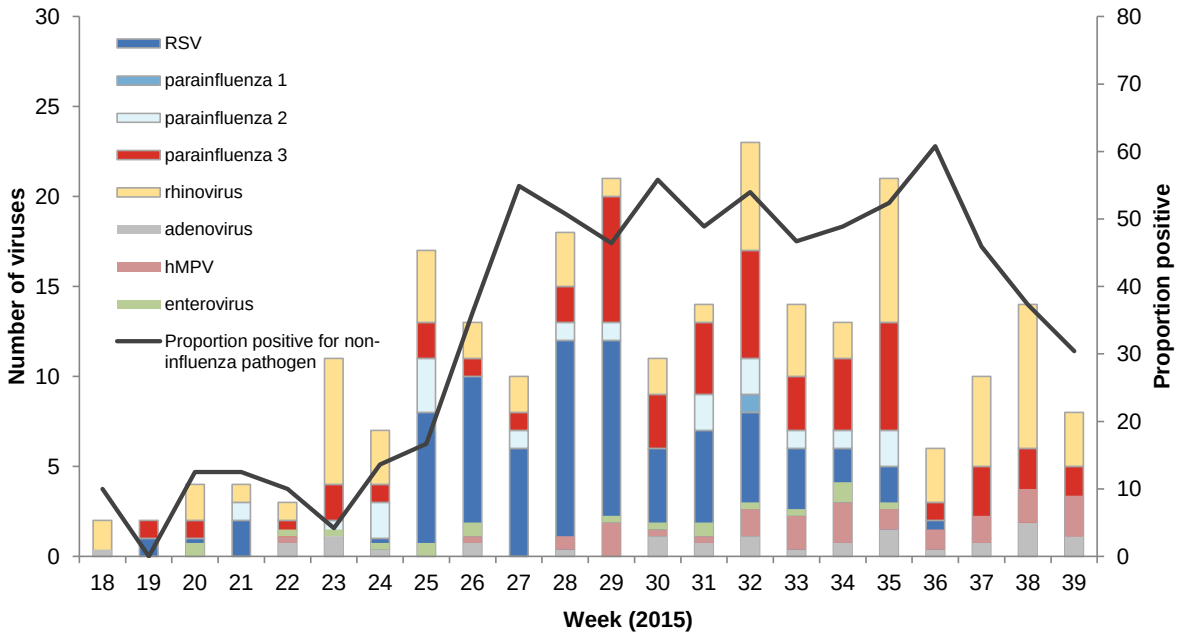
Table 5. Non-influenza respiratory viruses among ILI cases, 27 April to 27 September 2015

Non-influenza respiratory viruses	ILI Cases
No. of specimens tested	1374
No. of positive specimens (%)[1]	327 (23.8)
Respiratory syncytial virus (RSV)	97
Parainfluenza 1 (PIV1)	1
Parainfluenza 2 (PIV2)	18
Parainfluenza 3 (PIV3)	60
Rhinovirus (RV)	70
Adenovirus (AdV)	36
Human metapneumovirus (hMPV)	47
Enterovirus	19
Single virus detection (% of positives)	369 (84.4)
Multiple virus detection (% of positives)	68 (15.6)

[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 14. High RSV activity was recorded from week 25 (ending 21 June) to week 29 (ending 19 July). The proportion of rhinovirus among all non-influenza viruses remained at a constant level throughout the study period.

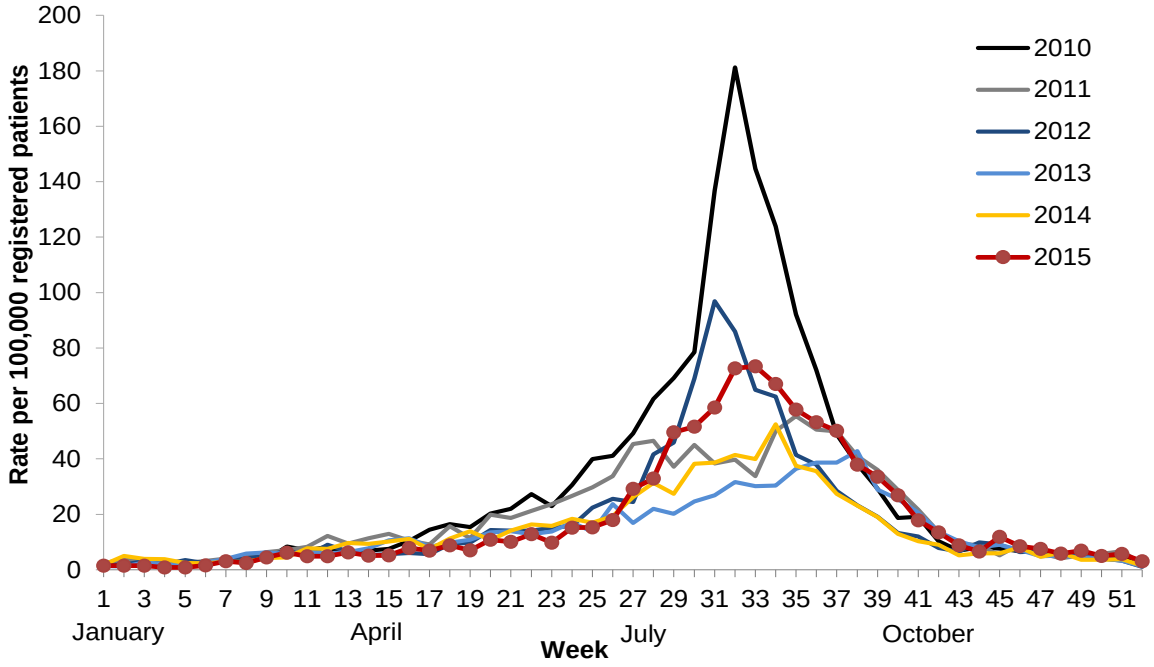
Figure 14. Temporal distribution of the number and proportion of non-influenza viruses from SHIVERS ILI specimens by type and week, 27 April to 27 September 2015



HEALTHSTAT GP-BASED SURVEILLANCE

Figure 15 shows the weekly rate of ILI consultations per 100,000 general practice patients collected by HealthStat sentinel GPs from 2010 to 2015. The ILI rate in 2015 was similar to the yearly level between 2010 and 2014.

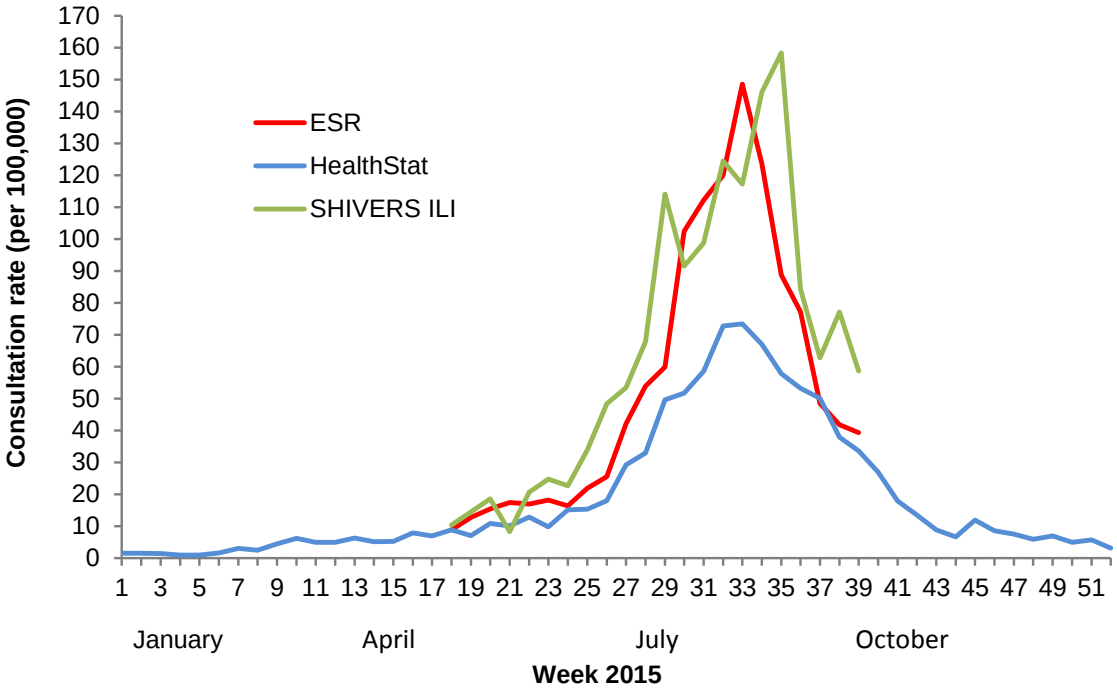
Figure 15. HealthStat ILI consultation rates by week from 2010–2015



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

Overall, the trend of the 2015 HealthStat data was lower than ESR's sentinel GP surveillance (Figure 16). SHIVERS ILI surveillance is similar to ESR's sentinel GP surveillance.

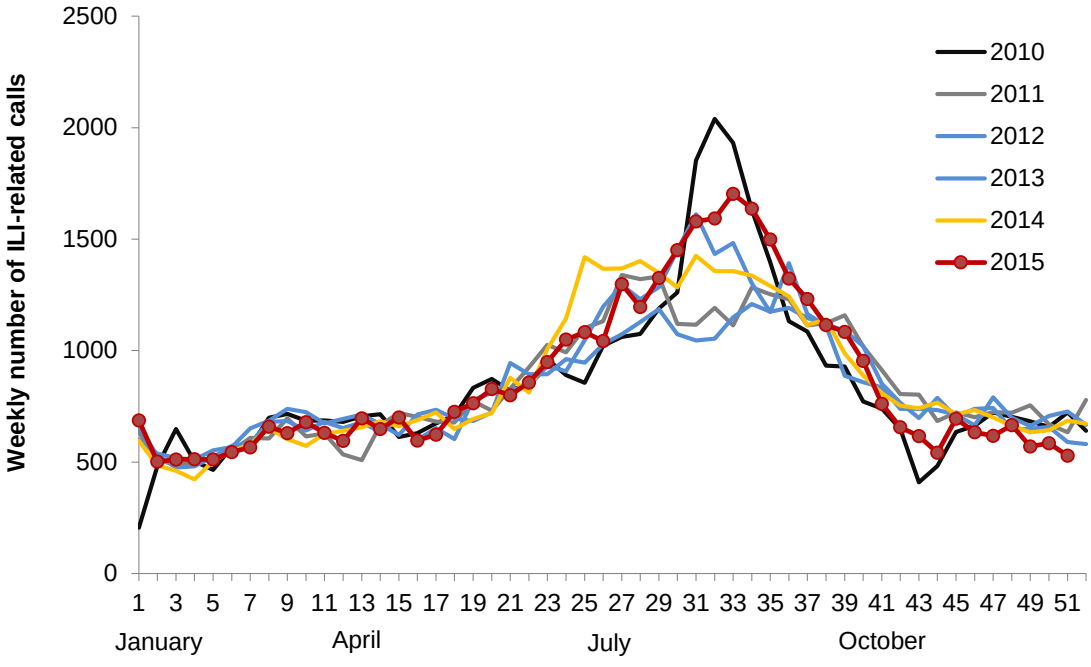
Figure 16. ESR, HealthStat and SHIVERS sentinel ILI consultation rates, 2015



HEALTHLINE

Figure 17 shows the weekly number of calls to Healthline for ILI from 2010 to 2015. The number of calls in 2015 was slightly higher than the number in 2014; similarly to the yearly average between 2010 and 2013. In 2015, Healthline calls peaked in week 33 (ending 16 August), with 1703 ILI-related calls.

Figure 17. Weekly numbers of ILI related calls to Healthline in 2010–2015



Data source: Healthline New Zealand.

HOSPITAL-BASED SURVEILLANCE

E/S/R

www.surv.esr.cri.nz

HOSPITAL-BASED SURVEILLANCE

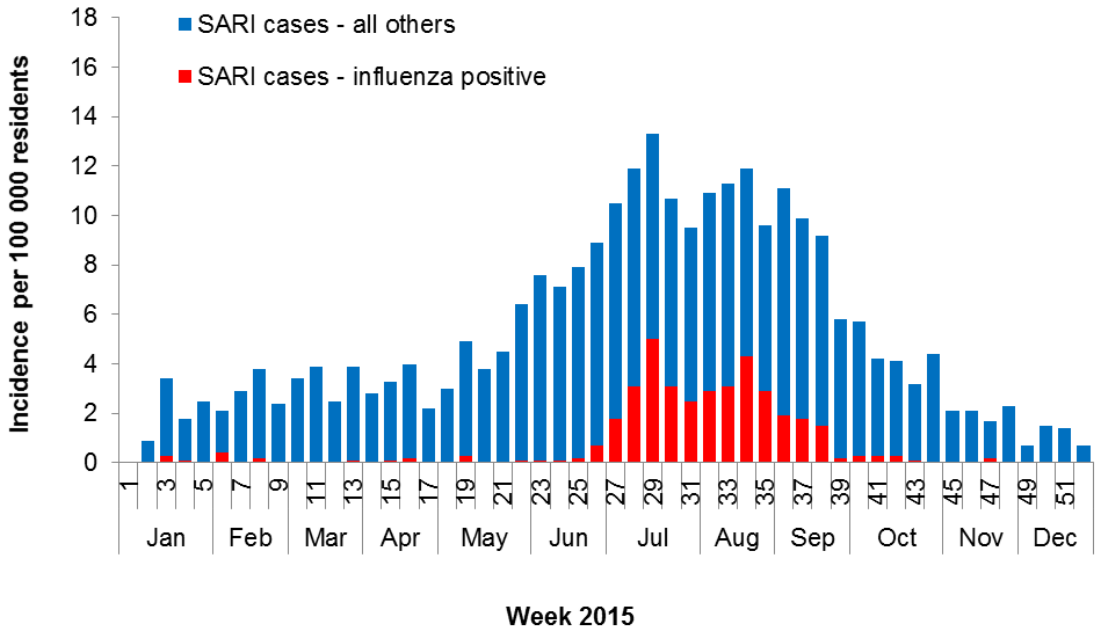
SHIVERS HOSPITAL-BASED SURVEILLANCE FOR SEVERE ACUTE RESPIRATORY INFECTIONS

From 29 December 2014 to 27 December 2015, there were 144,122 acute admissions to ADHB and CMDHB hospitals. A total of 7026 (4.9%) patients with suspected respiratory infections were assessed in these hospitals (Appendix Table 15). Of these, 2755 (39.2%) patients met the SARI case definition. Among these SARI patients, 2113 (76.7%) had laboratory PCR testing for influenza. Of these, 373 (17.7%) had an influenza virus detected.

Of the 7026 assessed patients, 4271 (60.8%) did not meet the SARI case definition. A total of 2129 (49.8%) of these non-SARI respiratory cases were also tested for influenza viruses. Among the tested non-SARI respiratory cases, 184 (8.6%) had influenza viruses detected.

In 2015, there were 19.1 SARI cases per 1000 acute hospitalisations, which is similar to the 20.4 per 1000 hospitalisations during the same period in 2014.The temporal distribution of SARI influenza cases (those meeting the SARI definition and positive for influenza) and non-influenza SARI cases in 2015 is shown in Figure 18.

Figure 18. Weekly SARI and influenza incidence, 2015



The overall SARI activity in 2015 is described as at a moderate level. This is based on SHIVERS SARI hospitalisation rates during 2012–2015 using the MEM to define the start and intensity level of the influenza season. Among SARI cases reported in 2015, 2442 (88.6%) were residents of ADHB and CMDHB, giving a cumulative SARI incidence of 269.6 per 100,000 population (95% CI: 238.8, 304.2) (Figure 21). This was higher than the 214.0 cases per 100,000 (95% CI: 186.3, 244.6) population during 2014. The weekly SARI rate peaked at 13.3 per 100,000 (week 29, ending 19 July) within the range of the moderate intensity level (12.1-15.0 per 100,000. Figure 19 shows the weekly SARI rate for 2015 in relation to the intensity levels during 2012–2015.

The overall SARI-associated influenza activity during 2015 was at a high seasonal level using the MEM to define the start of influenza season and intensity level of the SARI. Of the 373 SARI-associated influenza cases, 348 (93.3%) were residents of ADHB or CMDHB, which gives a cumulative influenza incidence of 38.4 (95% CI: 34.5, 42.7) per 100,000 population (Figure 20).

This SARI-associated influenza rate is similar to the 39.0 (95% CI: 35.0, 43.3) per 100,000 population recorded in 2014. The weekly SARI associated influenza rate peaked at 4.97 per 100,000 (week 29, ending 19 July), within the low end of the high intensity level (4.8-5.9 per 100,000). Figure 19 and Figure 20 demonstrate that the 2015 season had moderate SARI and very high influenza-associated SARI intensity.

Figure 19. Weekly hospitalisation rates for SARI in 2015 compared to 2012–2015

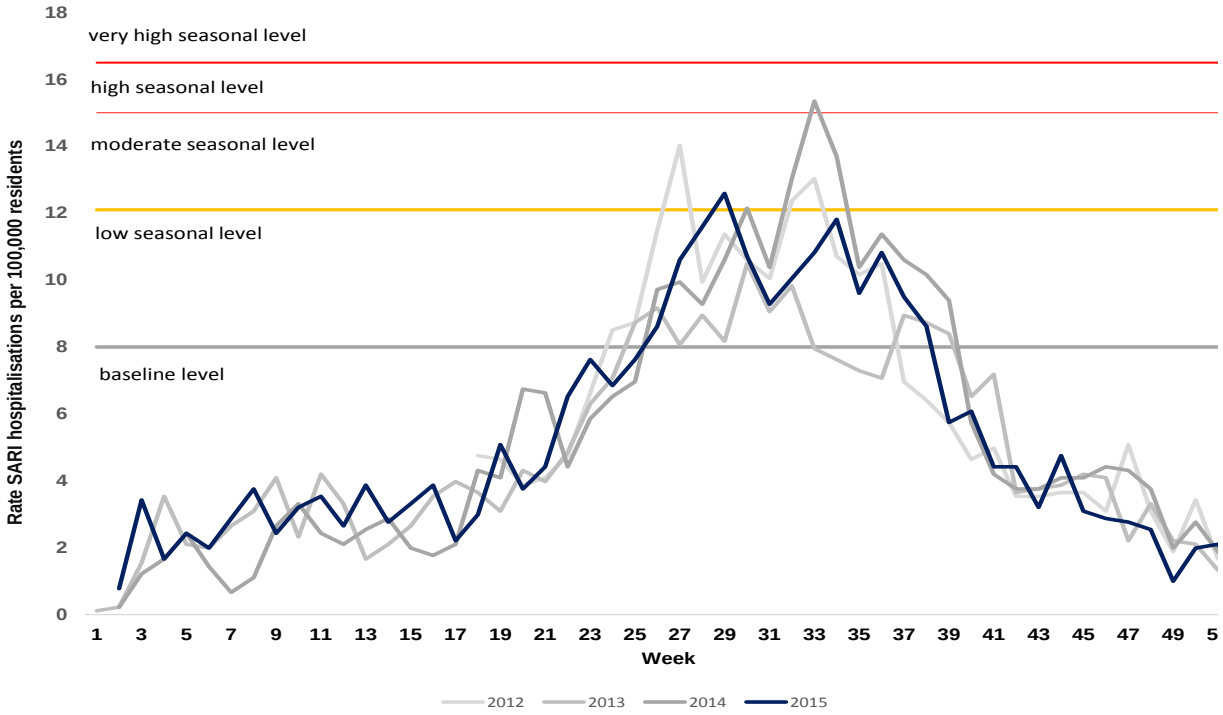
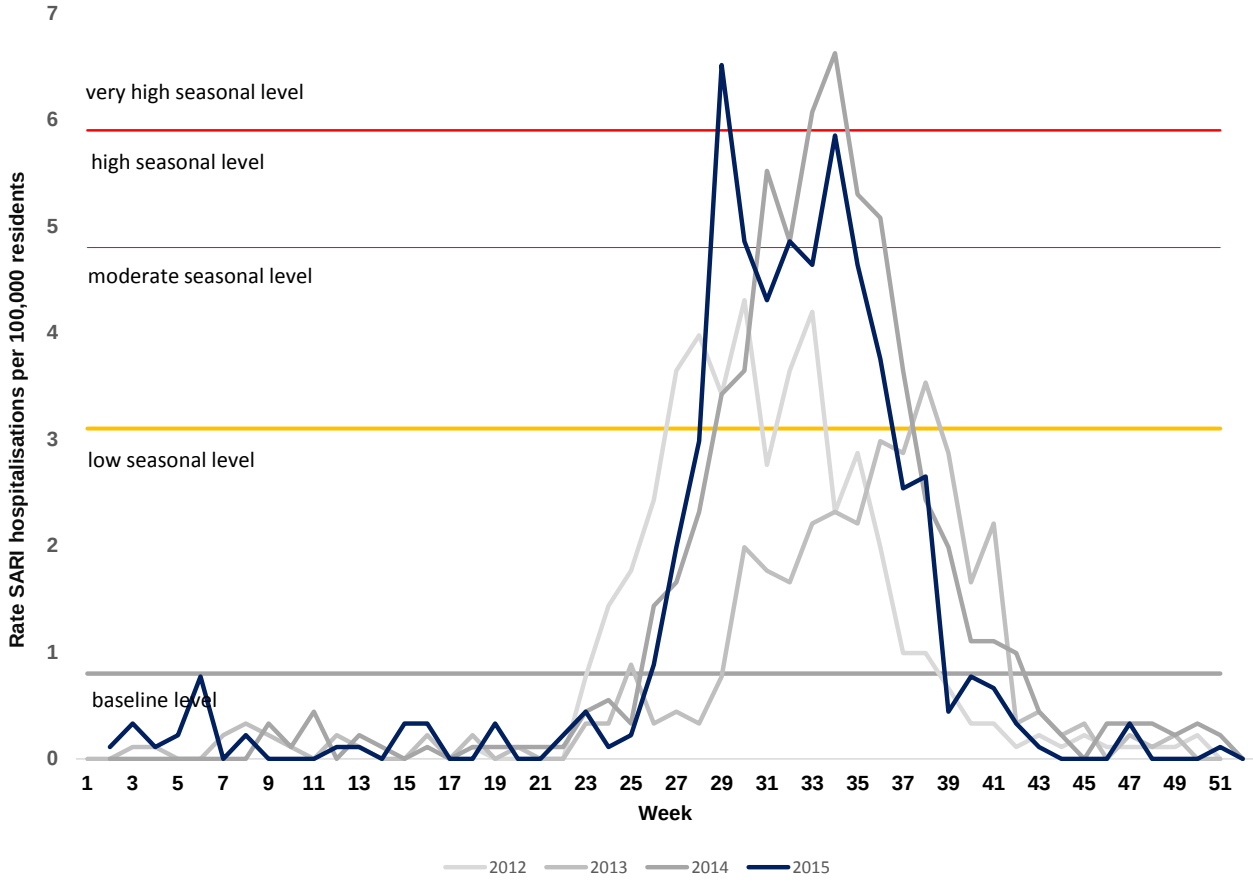


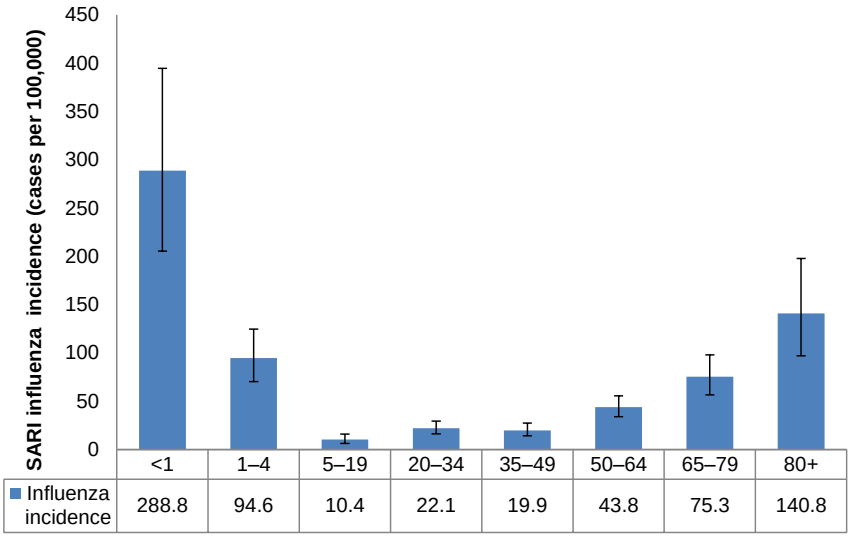
Figure 20. Weekly hospitalisation rates for SARI-associated influenza in 2015 compared to 2012–2015



Extrapolating SARI and related influenza hospitalisations obtained in 2015 from the ADHB and CMDHB population to the New Zealand, it is estimated that in 2015 there were 12,054 New Zealanders hospitalised with SARI of which 1,717 would have been influenza positive.

The cumulative SARI-associated influenza incidence by age group for 2015 is shown in Figure 21. The highest rate of SARI-associated influenza hospitalisation was recorded in infants aged <1 year (288.8 per 100,000) followed by those ages 80 years and over (140.8 per 100,000). Infants and elderly have the lowest rate of ILI consultations overall (Figure 3) or influenza associated ILI consultations (Figure 10).

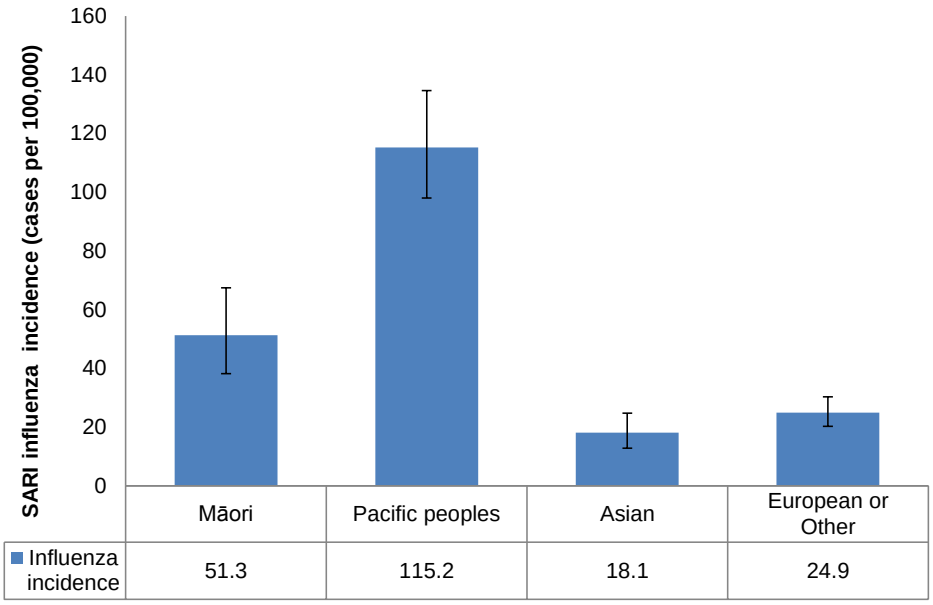
Figure 21. Cumulative SARI-associated influenza hospitalisation incidence and 95% CIs by age group, 2015



	<1	1–4	5–19	20–34	35–49	50–64	65–79	80+
Influenza incidence	288.8	94.6	10.4	22.1	19.9	43.8	75.3	140.8

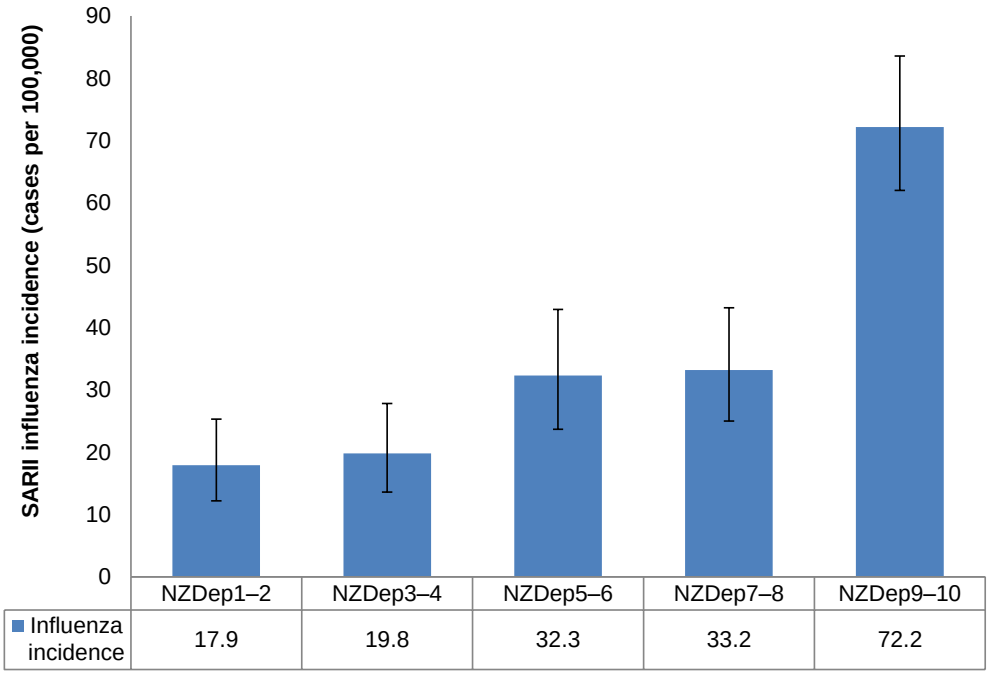
The cumulative SARI-associated influenza incidence by ethnic group for 2015 is shown in Figure 22. Pacific peoples had the highest hospitalisation rate. This was followed by Māori, European or Other and Asian ethnic groups. Overall, Pacific peoples and Māori ethnic groups had significantly higher SARI-associated influenza incidence rates compared to Asian and European or Other ethnic groups. This rate for Pacific people was over twice as high as that of Māori people.

Figure 22. SARI-associated influenza hospitalisation incidence and 95% CIs by ethnic group, 2015



Rates of influenza incidence among SARI cases by deprivation index (NZDep) are shown in Figure 23. Cases in the most deprived quintile (NZDep9–10) had a significantly higher rate compared to all other quintiles, which is similar to the 2013 and 2014 results.

Figure 23. SARI-associated influenza hospitalisation incidence and 95% CIs by NZDep, 2015



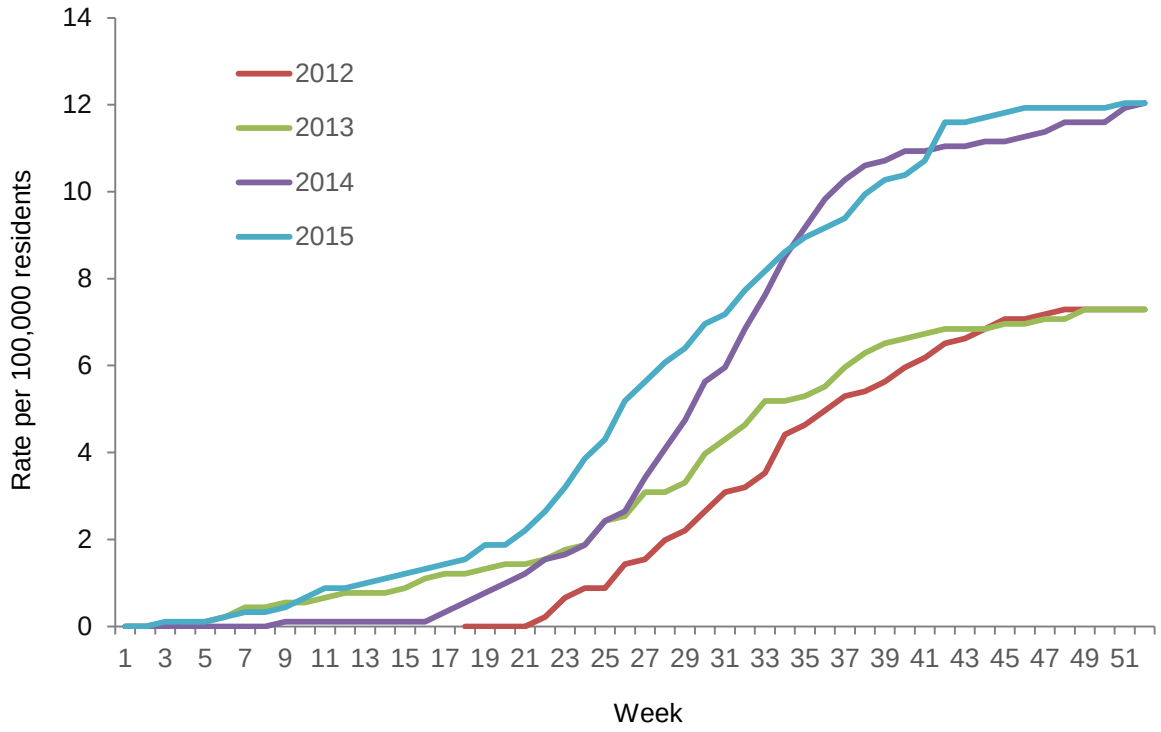
SHIVERS INTENSIVE CARE UNIT (ICU) ADMISSIONS AND DEATHS (SEVERE HOSPITAL OUTCOMES)

A measure of the severity of an acute hospitalisation is an admission to an ICU, or death recorded while in hospital. In 2015, 387 (33% of the 1163 ICU admissions had acute respiratory illness (ARI), including those respiratory patients not meeting the SARI case definition, in the SHIVERS participating hospitals. The cumulative incidence rate of the ICU patients with ARI was 25.8 per 100,000 (Appendix Table 16). A total of 26 (8.0%, 26/324 of tested) of the ICU patients with ARI were positive for influenza viruses. The influenza incidence rate of the ICU patients with ARI was 2.2 per 100,000 (95% CI: 1.3, 3.4).

Of the 387 assessed ICU patients with ARI, 183 (47%, 183/387) met the SARI case definition (Appendix Table 16). The proportion of the ICU patients with SARI among total ICU admissions was 15.7%, higher than the 11.7% in 2014. The proportion of the ICU patients with SARI among total SARI cases was 6.6% (183/2755), higher than the 5.1% in 2014. The cumulative incidence rate of the ICU patients with SARI was 12.0 per 100,000, higher than the 10.0 per 100,000 in 2014. A total of 20 (12.6%, 20/159 of tested) of the ICU patients with SARI were positive for influenza viruses. The influenza incidence of the ICU patients with SARI was 1.7 per 100,000 (95% CI: 0.9, 2.7), similar to the 2.0 per 100,000 in 2014.

The cumulative incidence rates of the ICU patients with SARI during 2015 was compared to the previous years 2012–2014 (Figure 24). The 2015 and 2014 cumulative incidence rates were higher than 2012–2013. However, the steepness of the slope in 2015 was not as high as that of 2014.

Figure 24. Cumulative incidence rates of ICU cases with SARI among ADHB and CMDHB residents, 2015



The incidence rate for the ICU patients with SARI was about five times higher among Pacific peoples compared to other ethnic groups, and concentrated among young cases. The same trend was observed in 2014.

During 2015, a total of 950 hospital deaths were recorded from all causes. Of them, 95 (10%, 95/950) deaths had acute respiratory illness. Of these 95 deaths with ARI, 38 were at ADHB and 57 at CMDHB. A total of 7 (14.6%, 7/48 of tested) of the deaths with ARI were positive for influenza viruses. The influenza incidence rate of the deaths with ARI was 0.8 per 100,000 (95% CI: 0.3, 1.6).

Of the 95 assessed deaths with ARI, 41 (43%, 41/95) met the SARI case definition. The proportion of the deaths with SARI among total hospital deaths was 4.3% (41/950), which is higher than 2014 (1.5%). The proportion of deaths among SARI cases was 1.5% (41/2755), which is higher than 2014 (0.6%). Of the 22 SARI deaths with viral testing, 4 (18.2%) were positive for influenza viruses. The influenza incidence rate of the deaths with SARI was 0.3 per 100,000 (95% CI: 0.07, 1.0), which is not significantly different than the rate (0.4 per 100,000) in 2014.

UNDERLYING CONDITIONS

During 2015, among all consented children aged <15 years admitted to hospital with SARI, 62.0% (577/930) did not have a reported underlying condition or a prior respiratory hospitalisation. Of all SARI children with influenza, 36.0% (36/100) had at least one reported underlying condition or prior hospitalisation; whereas, 38.2% (317/830) of the children without influenza had at least one underlying condition or prior hospitalisation. Prior respiratory hospitalisation was the most commonly reported condition in both groups (Table 6). This was followed by premature birth, which was reported in 15.0% (15/100) of SARI children with influenza and in 15.3% (127/830) of children without influenza. Vaccination with the current seasonal influenza vaccine was below 30% in children regardless of their underlying condition or prior hospitalisation status.

Table 6. Underlying conditions among the SARI children (<15 years) with or without influenza, 2015

Underlying conditions (Children aged <15 years)	Influenza positive SARI hospitalisations		Influenza negative SARI hospitalisations	
	N	(%)	N	(%)
Total	100	(100.0)	830	(100.0)
Asthma	5	(5.0)	50	(6.0)
Chronic respiratory disease	2	(2.0)	18	(2.2)
Cardiovascular conditions	2	(2.0)	22	(2.7)
Neurological conditions	1	(1.0)	15	(1.8)
Diabetes	0	(0.0)	0	(0.0)
Obesity (BMI>30 or clinical judgement)	0	(0.0)	1	(0.1)
Cerebrovascular conditions	0	(0.0)	0	(0.0)
Renal conditions	1	(1.0)	7	(0.8)
Liver conditions	1	(1.0)	5	(0.6)
Cancer	1	(1.0)	1	(0.1)
Immune-compromised	0	(0.0)	1	(0.1)
Born premature	15	(15.0)	127	(15.3)
Prior respiratory hospitalisation	21	(21.0)	191	(23.0)
None of the above conditions	64	(64.0)	513	(61.8)

During 2015, among all consented SARI adults aged ≥ 15 years admitted to hospital, 69.4% (522/752) reported at least one underlying condition or had a prior respiratory hospitalisation. Of all SARI adults with influenza, 60.4% (104/172) had at least one underlying condition or prior respiratory hospitalisation, while of all adults without influenza, 72.0% (418/580) reported having at least one underlying condition or prior respiratory hospitalisation (Table 7).

Cardiovascular conditions were the most commonly reported underlying conditions in both adults with influenza (25.0%, 43/172) and those without (27.1%, 157/580). Current season influenza vaccine coverage was 52% for adult SARI patients with underlying conditions or prior respiratory hospitalisation regardless of their influenza positivity. Among adult patients without underlying conditions or prior hospitalisation, those with confirmed influenza infections had lower influenza vaccine coverage than those without influenza (24% vs. 36%).

Table 7. Underlying conditions among the SARI adults with or without influenza, 2015

Underlying conditions (adults aged ≥15 years)	Influenza positive SARI hospitalisations		Influenza negative SARI hospitalisations	
	N	(%)	N	(%)
Total	172	(100.0)	580	(100.0)
Cardiovascular conditions	43	(25.0)	157	(27.1)
Obesity (BMI>30 or clinical judgement)	27	(15.7)	104	(17.9)
Asthma	32	(18.6)	130	(22.4)
Chronic respiratory disease	6	(3.5)	30	(5.2)
Diabetes	28	(16.3)	106	(18.3)
Renal conditions	12	(7.0)	41	(7.1)
Cerebrovascular conditions	3	(1.7)	20	(3.4)
Liver conditions	4	(2.3)	9	(1.6)
Neurological conditions	2	(1.2)	12	(2.1)
Cancer	6	(3.5)	21	(3.6)
Immune-compromised	6	(3.5)	17	(2.9)
Prior respiratory hospitalisation	24	(14.0)	137	(23.6)
None of the above conditions	68	(39.5)	162	(27.9)

We calculated the incidence of influenza associated SARI hospitalisations among pregnant women using standard methods for estimating the number of pregnant women in the catchment area [11]. The rate of influenza associated SARI hospitalization for non-pregnant women aged 15–45 years old was 15.2 per 100,000. In comparison to non-pregnant women of reproductive age, the rate of influenza associated SARI hospitalization was 5 fold higher (95%CI: 2.0-11.0) for pregnant women (rate 75.7 per 100,000).

INFLUENZA VIRUSES ISOLATED IN SHIVERS SARI PATIENTS

In 2015, 2464 specimens from SARI patients were tested and 508 (20.6%) were positive for influenza viruses, including 294 for influenza A and 214 for influenza B viruses (Table 8).

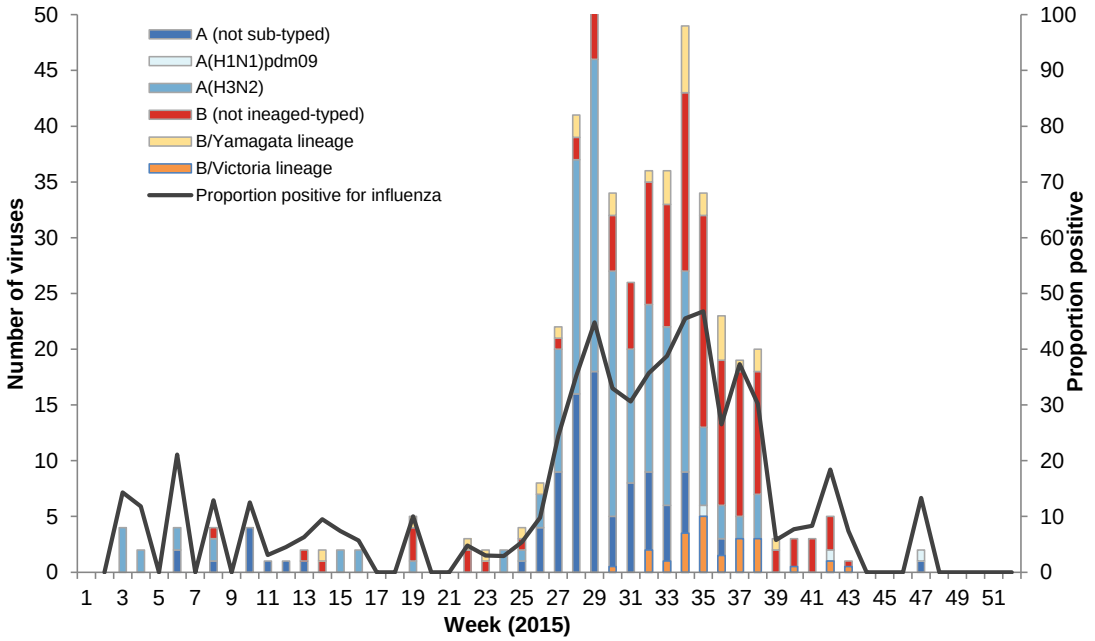
Table 8. Influenza viruses among SARI cases, 2015

Influenza viruses	SARI		
	Cases	ICU	Deaths
No. of specimens tested	2464	213	32
No. of positive specimens (%)[1]	508 (20.6)	38 (17.8)	5 (15.6)
Influenza A	294	14	3
A (not subtyped)	108	7	1
A (H1N1)pdm09	3	1	0
A(H1N1)pdm09 by PCR	2	1	0
* A/California/7/2009 (H1N1) - like	1	0	0
A(H3N2)	183	6	2
A(H3N2) by PCR	173	6	2
‡A/Switzerland/9715293/2013 (H3N2) - like	10	0	0
Influenza B	214	24	2
B (lineage not determined)	136	13	1
B/Yamagata lineage	35	1	0
B/Yamagata lineage by PCR	14	0	0
¥B/Phuket/3073/2013 - like	21	1	0
B/Victoria lineage	43	10	1
B/Victoria lineage by PCR	21	6	0
B/Brisbane/60/2008 - like	22	4	1
Influenza and non-influenza co-detection (% +ve)	34 (6.7)	8 (21.1)	1 (20.0)

[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 A(H3N2) vaccine component for NZ in 2015.
¥ This virus was the B vaccine component for NZ in 2015.
*This virus was the A(H1N1) vaccine component for NZ in 2015

The temporal distribution of the number and proportion of the influenza viruses from SARI patients is shown in Figure 25. Influenza A(H3N2) was the predominant strain from week 23 (ending 7 June) to week 34 (ending 23 August). From week 35 (ending 30 August) influenza B became the predominant strain. SARI-associated influenza viruses peaked in week 29 (ending 19 July), with a secondary peak in week 34.

Figure 25. Temporal distribution of the number and proportion of influenza viruses from SARI specimens by type and week, 2015



NON-INFLUENZA RESPIRATORY VIRUSES

In addition to testing for influenza viruses, specimens from the SARI surveillance were also tested for the presence of eight non-influenza viruses. In 2015, 3184 SARI specimens were tested for non-influenza respiratory viruses. Of these, 1416 (44.5%) were positive. Details are given in Table 9.

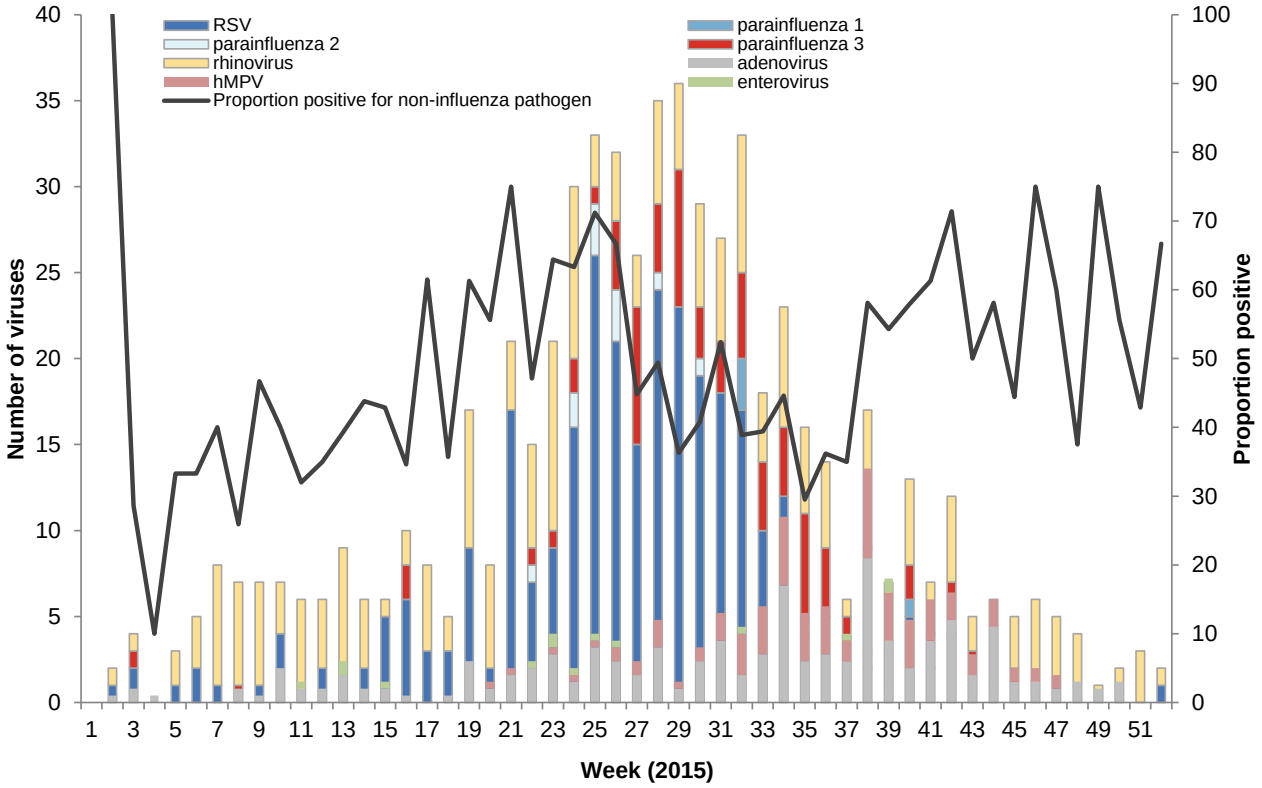
Table 9. Non-influenza respiratory viruses among SARI cases, 2015

Non-influenza respiratory viruses	SARI		
	Cases	ICU	Deaths
No. of specimens tested	3184	322	36
No. of positive specimens (%)[1]	1416 (44.5)	185 (57.5)	15 (41.7)
Respiratory syncytial virus (RSV)	478	47	1
Parainfluenza 1 (PIV1)	5	0	0
Parainfluenza 2 (PIV2)	19	7	0
Parainfluenza 3 (PIV3)	148	29	4
Rhinovirus (RV)	490	72	2
Adenovirus (AdV)	363	61	11
Human metapneumovirus (hMPV)	150	19	5
Enterovirus	37	2	0
Single virus detection (% of positives)	1172 (82.8)	141 (76.2)	9 (60.0)
Multiple virus detection (% of positives)	244 (17.2)	44 (23.8)	6 (40.0)

[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 26. High RSV activity occurred between weeks 15 (ending 12 April) and 33 (16 August). RSV activity peaked in week 29 (ending 19 July), simultaneous with the influenza peak. The proportion of rhinovirus remained approximately constant from May to September.

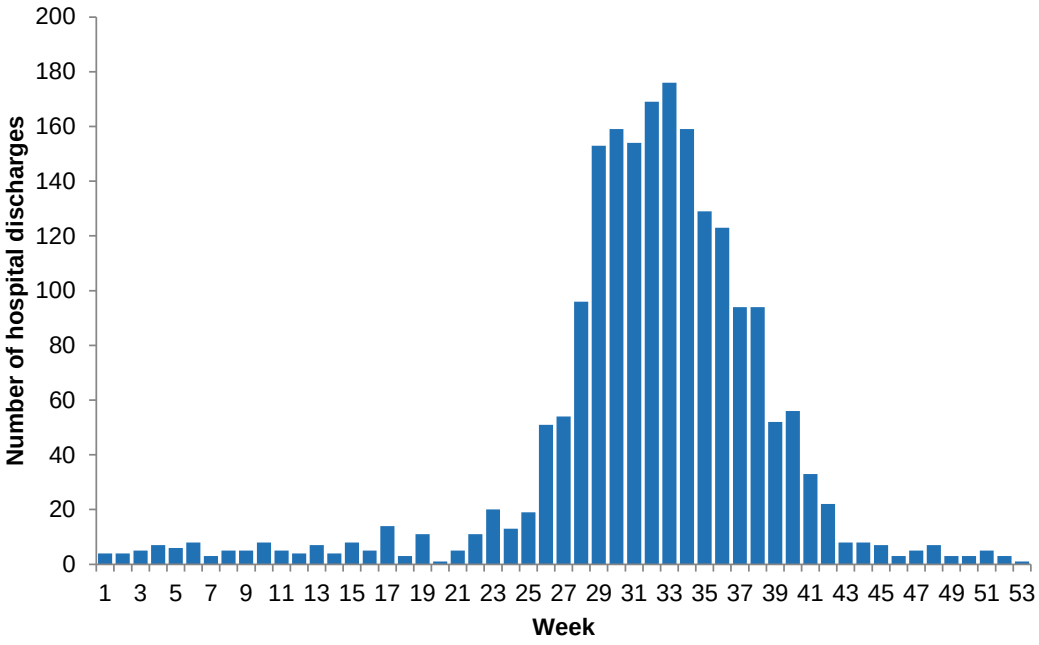
Figure 26. Temporal distribution of the number and proportion of non-influenza viruses from SARI specimens by type and week, 2015



MINISTRY OF HEALTH DATA ON PUBLICLY FUNDED HOSPITAL DISCHARGES

Influenza hospitalisations by week discharged are shown in Figure 27 and indicate that 85.4% (1719) of these hospitalisations occurred from weeks 26–40. The highest number of hospitalisations (787) occurred in August (weeks 31–35). Hospitalisations peaked in week 33—the same as national sentinel virus numbers and national sentinel ILI consultations. Non-sentinel viruses peaked in week 32.

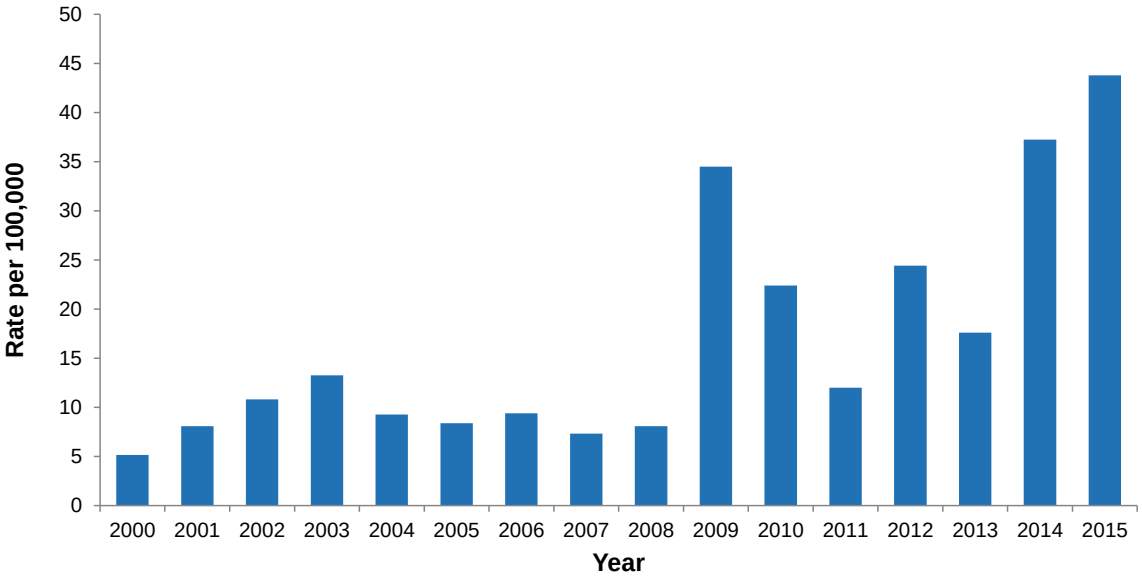
Figure 27. Influenza hospital discharges by week, 2015



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

The number of influenza hospitalisations in 2015 ranked the highest during the period from 2000 to 2015 (Figure 28). In 2015, there were 2012 (43.8 per 100,000) hospitalisations for influenza compared with 1680 (37.3 per 100,000) hospitalisations in 2014 and 782 (17.5 per 100,000) in 2013.

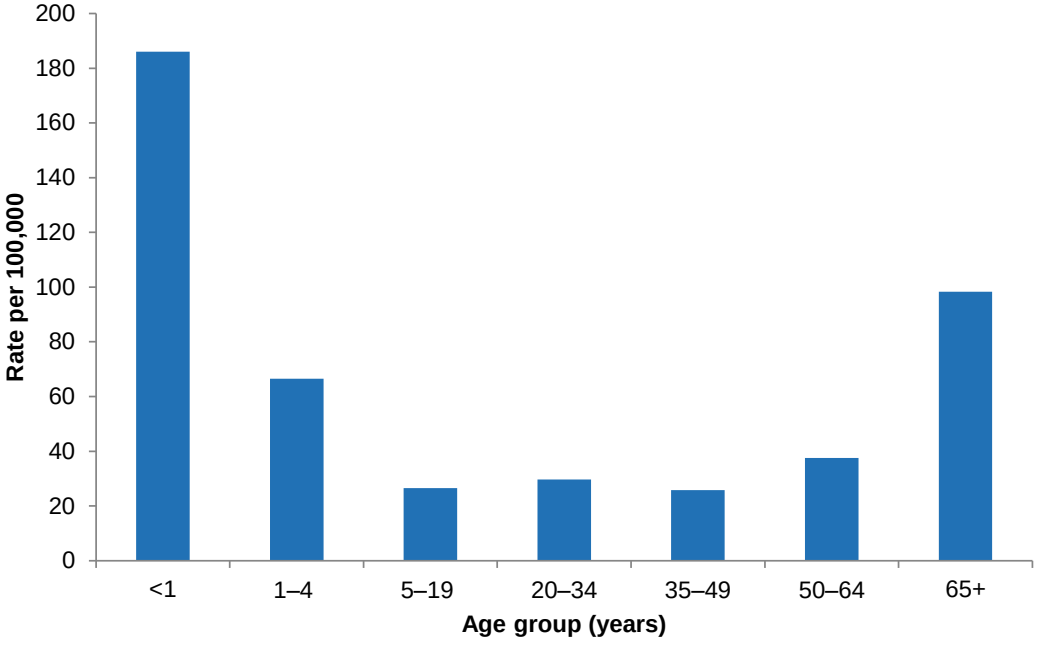
Figure 28. Influenza hospital discharge rates, 2000–2015



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

Figure 29 stratifies influenza hospitalisation rates in 2015 by age group. In 2015, by far the highest hospitalisation rates occurred in children aged less than one year (186.1 per 100,000 patient population). This was almost two times the next highest rate of 98.3 per 100,000 for adults aged 65 years and over.

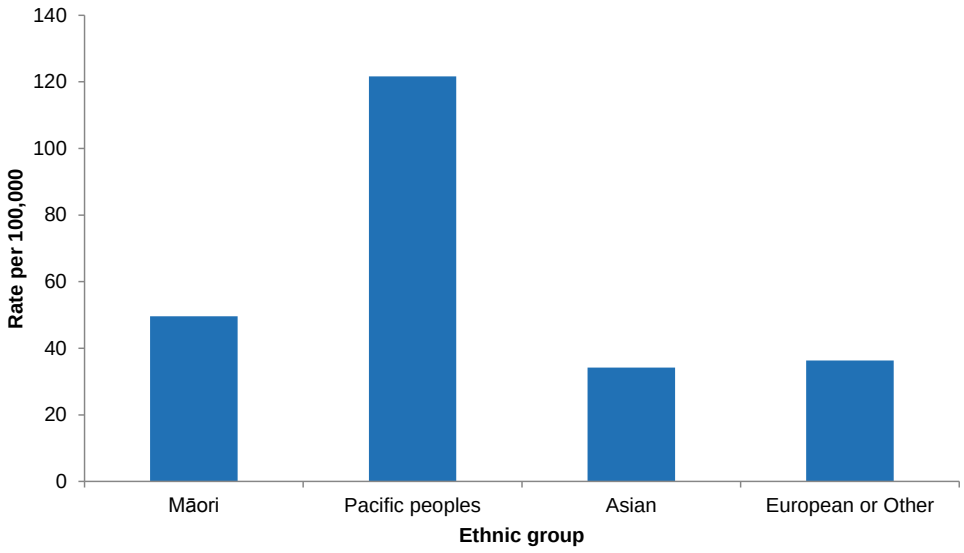
Figure 29. Influenza hospital discharge rates by age group, 2015



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

The ethnic distribution of influenza hospitalisations in 2015 is shown in Figure 30. Pacific peoples had the highest hospitalisation rate (121.7 per 100,000), followed by Māori (49.6 per 100,000). Asian ethnic group had the lowest rate of hospitalisations (34.2 per 100,000).

Figure 30. Hospital discharge rates by ethnic group in 2015



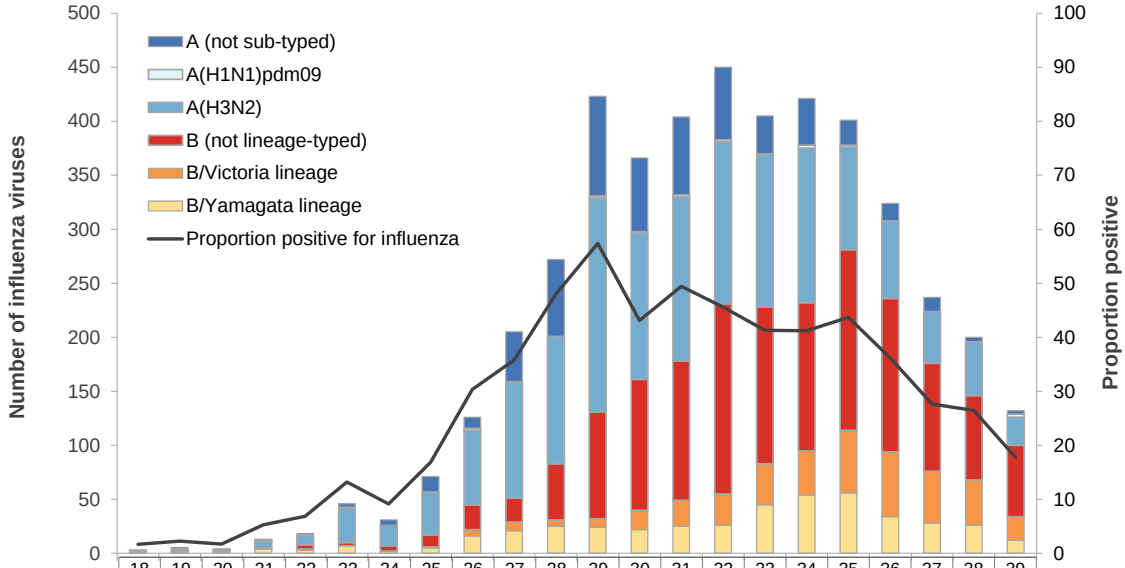
Data source: Ministry of Health, NMDS (Hospital Events).

LABORATORY-BASED NON-SENTINEL SURVEILLANCE—FOR OUTPATIENTS AND HOSPITAL INPATIENTS

For laboratory-based non-sentinel surveillance (which includes SHIVERS isolates (SARI and ILI)) from January to December 2015, a total of 19,699 specimens were tested. Of these, 4938 (25.1%) specimens tested positive for influenza viruses. This is higher in numbers but not in proportions in comparison to the 3871 (29.5%) and 2130 (26.8%) viruses identified through non-sentinel surveillance in 2014 and 2013 respectively.

Figure 31 shows the temporal distribution of influenza viruses reported by type and sub-type from non-sentinel surveillance for weeks 18–39. Influenza viruses peaked in week 32 (3–9 August 2015). A(H3N2) peaked in week 29 (198 viruses) and influenza B peaked in week 35 (281 viruses).

Figure 31. Influenza viruses from non-sentinel surveillance by type and week reported, 2015

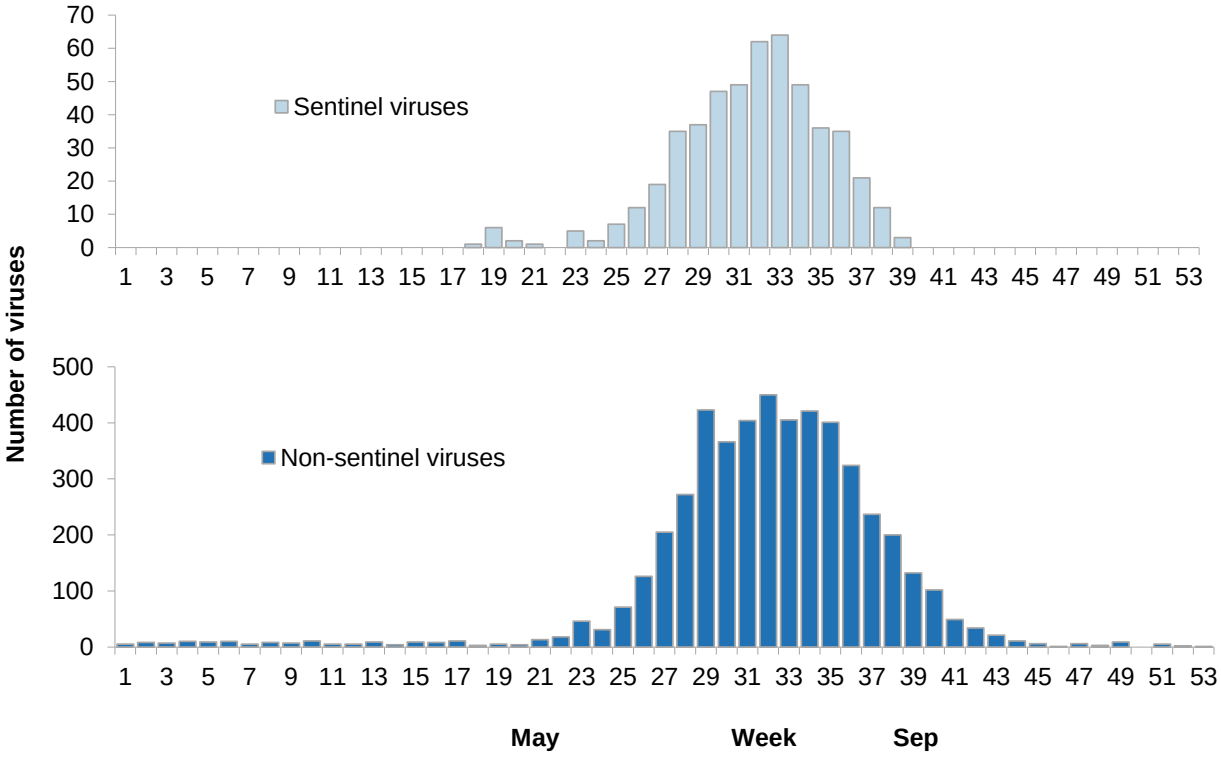


	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
A (not sub-typed)	0	1	0	1	1	3	5	14	10	46	71	92	68	72	67	35	43	23	16	13	4	3
A(H1N1)pdm09	0	0	0	1	0	1	0	0	2	1	0	2	1	2	2	1	3	2	0	0	0	3
A(H3N2)	2	2	2	6	9	32	19	40	69	107	118	198	136	152	150	141	143	95	72	48	50	26
B (not lineage-typed)	1	1	1	1	4	3	5	11	23	22	52	99	121	129	176	145	137	167	142	100	78	66
B/Victoria lineage	0	0	0	0	1	0	0	1	6	8	6	8	18	24	29	38	41	58	60	48	42	22
B/Yamagata lineage	0	1	1	4	3	7	2	5	16	21	25	24	22	25	26	45	54	56	34	28	26	12

*Data shown from weeks 18–39 only.

Compared to the timing of influenza virus detection by non-sentinel surveillance (which includes SHIVERS isolates), peak detection was in week 32 (450 viruses) from non-sentinel surveillance and week 33 (64 viruses) for sentinel surveillance (Figure 32).

Figure 32. Number of influenza viruses detected by surveillance type and week specimen taken, 2015



IMMUNISATION COVERAGE

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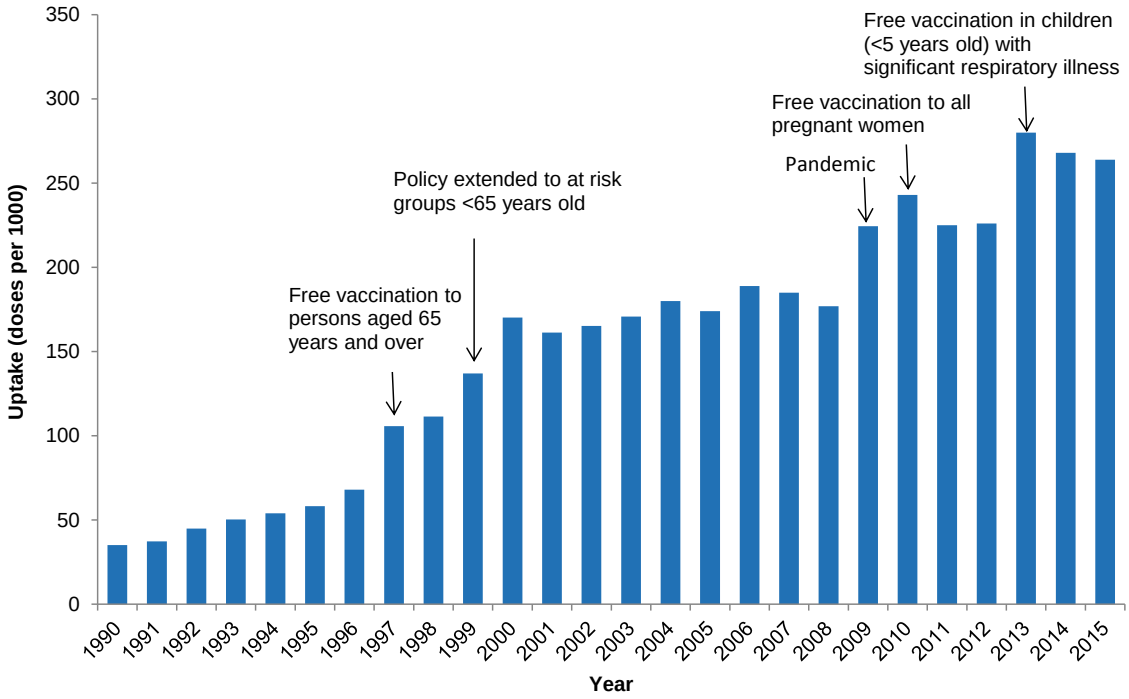
IMMUNISATION COVERAGE

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 2015 (Figure 33). At least 1,211,151 doses of the seasonal trivalent influenza vaccine were distributed in New Zealand in the 2015 season. The coverage rate of influenza vaccine (both publicly and privately funded) as estimated by vaccine distribution figures during the 2015 seasonal influenza immunisation programme was 264 doses per 1000 population, similar to the 268 doses per 1000 population administered in 2014.

Figure 33. Influenza vaccine coverage[1], 1990–2015



[1] Estimated by vaccine distribution figures.

The coverage for people 65 years and older was 67.3%; similar to the coverage of 67.5% achieved in 2014 (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, 2015

Age group (years)	Total vaccines received
<1	280
1–4	5,596
5–19	22,686
20–34	29,137
35–49	49,942
50–64	116,034
65+	444,600
Total	**668,275**

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

VIRUS STRAIN CHARACTERISATION

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VIRUS STRAIN CHARACTERISATION

CIRCULATING VIRAL STRAINS IN 2015

A total of 5443 influenza viruses were detected and reported through any surveillance system in 2015, with influenza B representing 53.1% (2892) and influenza A 46.9% (2551) of all influenza viruses (Table 11). Among A sub-typed, 97.6% (1875/1921) were A(H3N2) virus and 2.4% (46/1921) were A(H1N1) virus. Among B lineage-typed, 51.1% (551/1078) were of Victoria and 48.9% (527/1078) Yamagata.

Table 11. Influenza virus identifications by type and sub-type and lineage-typed, 2015

Viruses	All viruses (%)	Sub-typed and lineage-typed (%)
Influenza A	**2551 (46.9)**	**1921**
Influenza A (not sub-typed)	**630 (11.6)**	
Influenza A(H1N1)pdm09	**46 (0.8)**	**46**
A(H1N1)pdm09 by PCR	35 (0.6)	35 (76.1)
A/California/7/2009 (H1N1)-like	11 (0.2)	11 (23.9)
Influenza A(H3N2)	**1875 (34.4)**	**1875**
A(H3N2) by PCR	1775 (32.6)	1775 (94.7)
A/Switzerland/9715293/2013 (H3N2)-like	93 (1.7)	93 (5.0)
A/Texas/50/2012 (H3N2)-like	7 (0.1)	7 (0.4)
Influenza B	**2892 (53.1)**	**1078**
Influenza B (not lineage-typed)	**1814 (33.3)**	
B/Yamagata lineage	**527 (9.7)**	**527**
B/Yamagata lineage by PCR	185 (3.4)	185 (35.1)
B/Phuket/3073/2013-like	340 (6.2)	340 (64.5)
B/Massachusetts/2/2012	2 (0.0)	2 (0.4)
B/Victoria lineage	**551 (10.1)**	**551**
B/Brisbane/60/2008-like	337 (6.2)	337 (61.2)
B/Victoria lineage by PCR	214 (3.9)	214 (38.8)
Total	**5443 (100.0)**	**2999**

Figure 34 shows the influenza virus identifications by type and sub-type for each week throughout 2015. A(H3N2) was the predominant type until week 29 (ending 19 July) after which influenza B became the predominant type in week 30 (ending 26 July).

Figure 34. Total influenza viruses by type and week specimen taken, 2015

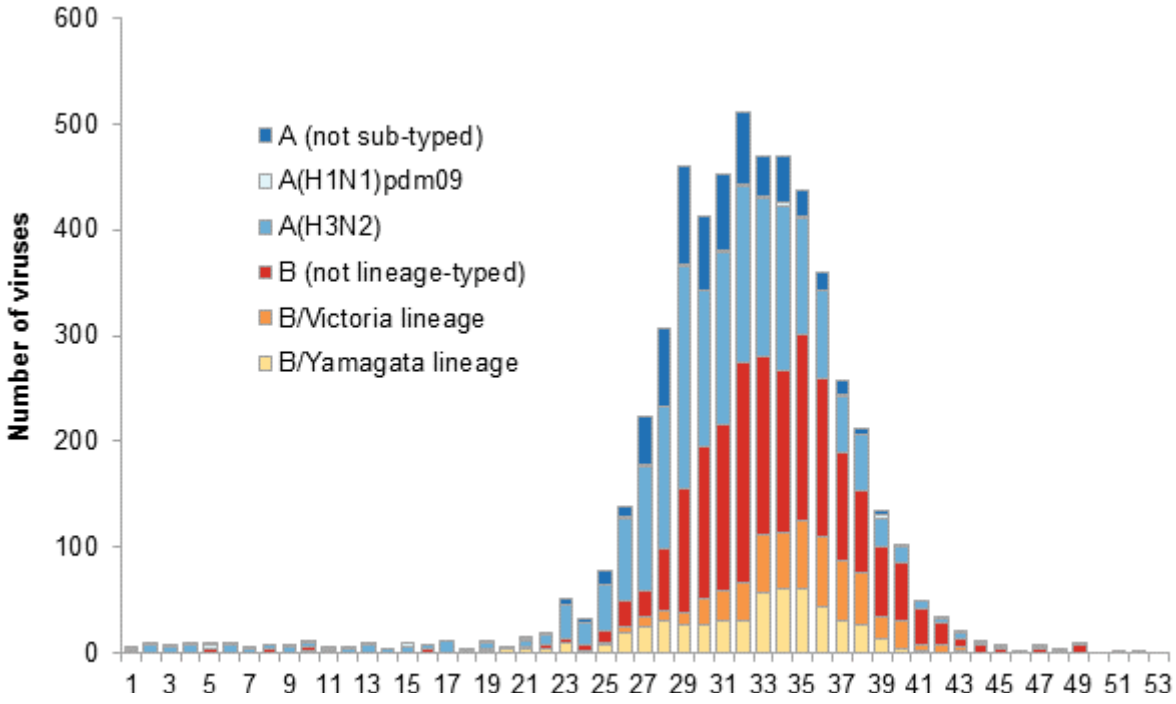


Figure 35 shows the general pattern of influenza virus identifications. Influenza A and B viruses co-circulated throughout the season.

Figure 35. Total influenza A and B viruses by week specimen taken, 2015

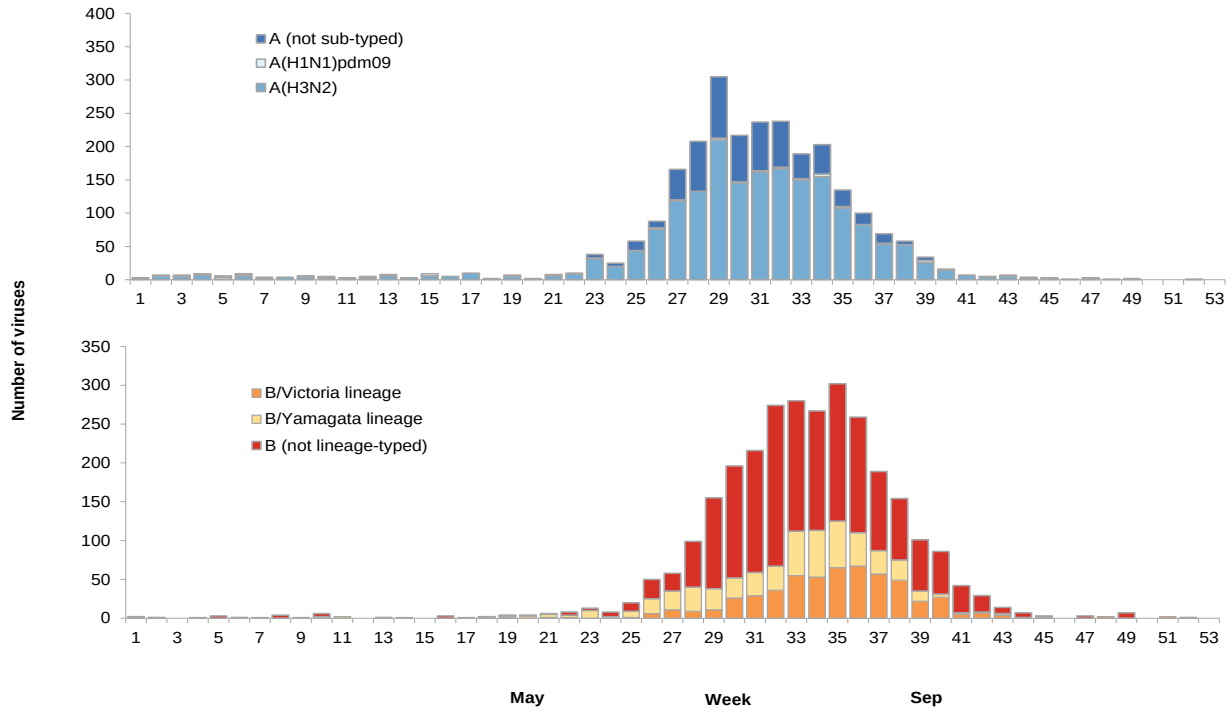
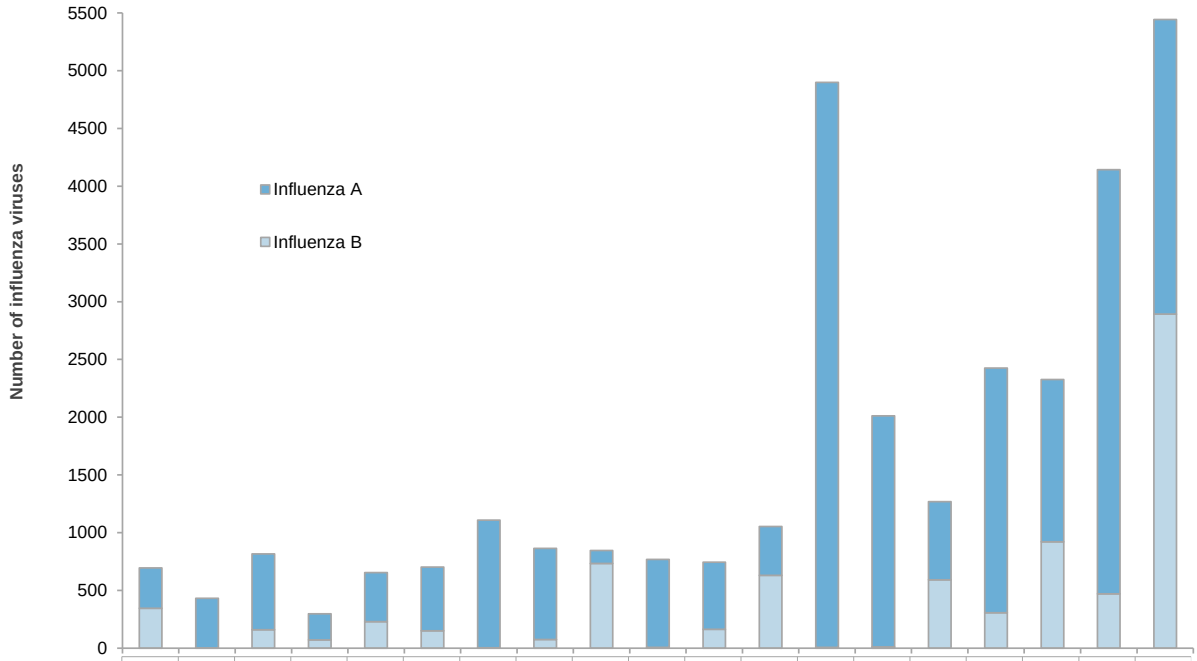


Figure 36 shows the number and percentage of typed influenza viruses from 1997 to 2015. Influenza A is the most frequent predominant influenza type. Of 19 influenza seasons during 1997–2015, influenza A predominated in 15 seasons whereas influenza B only predominated in three seasons (2005, 2008 and 2015). There was one season (1997) with equal proportion of influenza A and B circulation.

Figure 36. Influenza viruses by type, 1997–2015

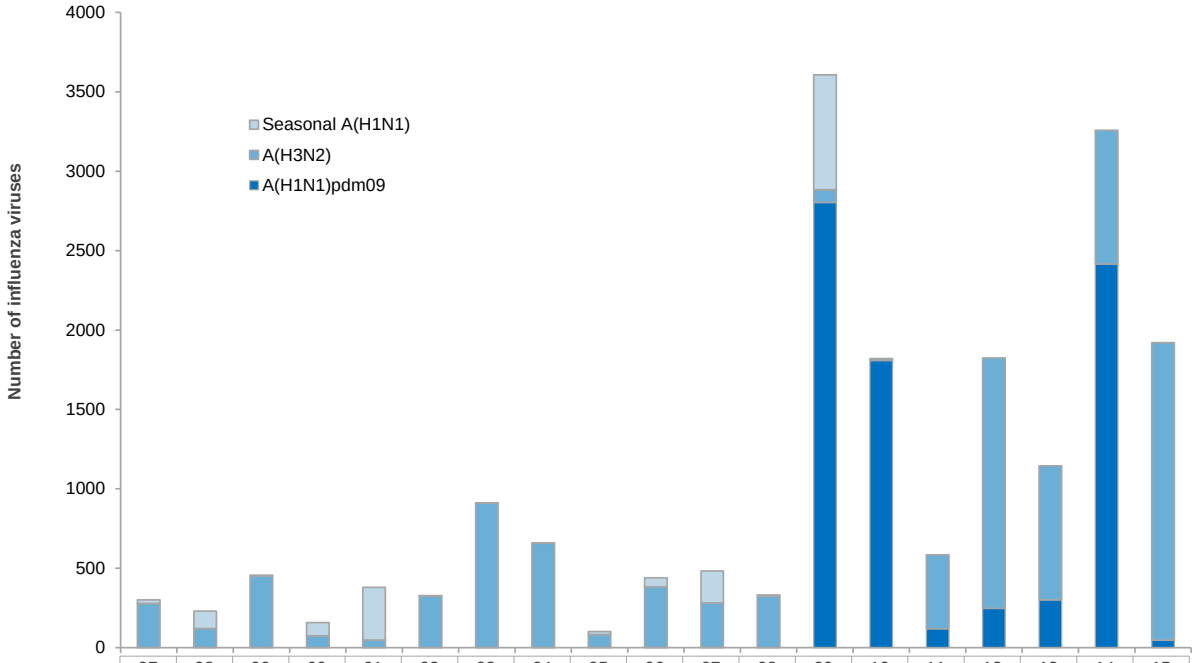


	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Influenza A (%)	50	100	80	76	65	78	100	91	13	99	78	40	100	100	53	87	60	89	47
Influenza B (%)	50	0	20	24	35	22	0	9	87	1	22	60	0	0	47	13	40	11	53

Figure 37 shows the number and percentage of all sub-typed influenza A viruses from 1997 to 2015 (excluding influenza A not sub-typed). Overall, the patterns of the predominant influenza A subtypes among all sub-typed A viruses during 1997–2015 are described below:

- Influenza A(H3N2) strain predominated for 14 seasons (1997, 1998, 1999, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2011, 2012, 2013 and 2015). 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 37. Influenza A viruses by subtypes 1997–2015

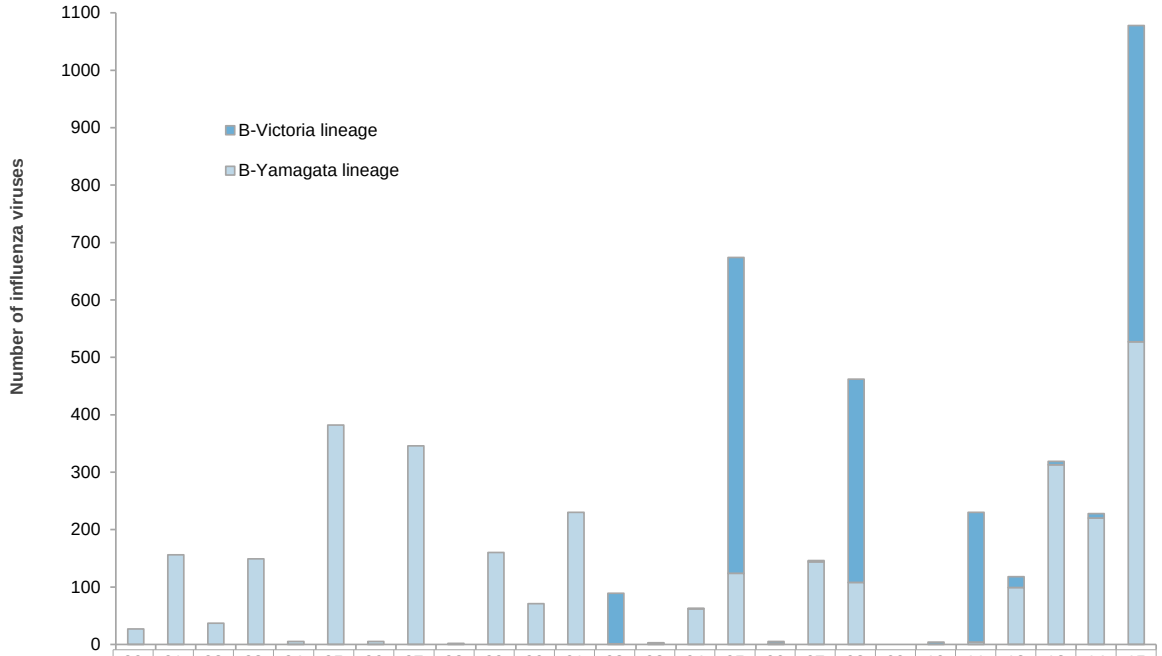


	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Seasonal A(H1N1)	8	48	0	52	87	1	0	0	18	13	42	2	20	0	0	0	0	0	0
A(H3N2)	92	52	100	48	13	99	100	100	82	87	58	98	2	1	80	86	74	26	98
A(H1N1)pdm09	0	0	0	0	0	0	0	0	0	0	0	0	78	99	20	14	26	74	2

Figure 38 shows the number and percentage of all B viruses from 1990 to 2015 (excluding influenza B not lineage-typed). Overall, the patterns of the predominant influenza B among all lineage-typed B viruses during 1990–2015 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 three years in New Zealand (2002, 2005, 2008 and 2011). 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.
- In 2015, there were almost equal proportions of B/Yamagata and B/Victoria lineage viruses.

Figure 38. Influenza B viruses by lineages, 1990–2015



	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
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
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

IMPACT OF VIRUS TYPE AND SUBTYPE ON AGE GROUPS

SHIVERS ILI and SARI surveillance provided reliable numerators and denominators, the data is 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 2015 are shown in Figure 39 and Figure 40. SARI-related A(H3N2) incidence rates were high in the youngest (0–4 year olds) and the oldest (≥ 65 years). Influenza B also affected these groups more – particularly influenza B/Victoria 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 40). Although less disparate, ILI-related A(H3N2) incidence rates were higher in most age groups than those for B/Yamagata or B/Victoria, though B/Yamagata was higher in those 35–49 years.

Figure 39. SARI related A(H3N2), B/Victoria and B/Yamagata by age groups, 2015

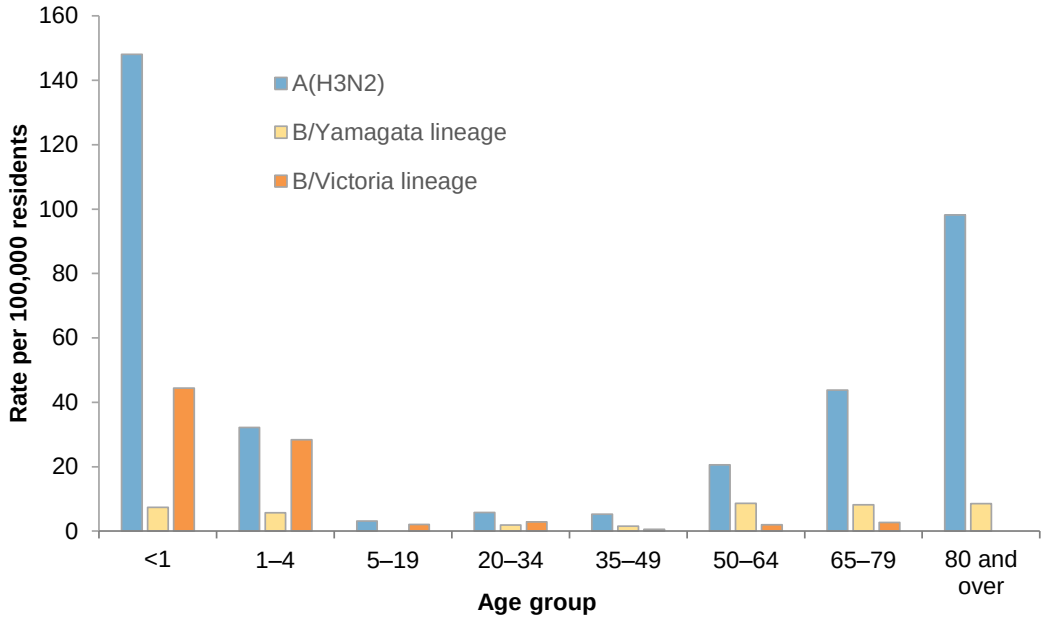
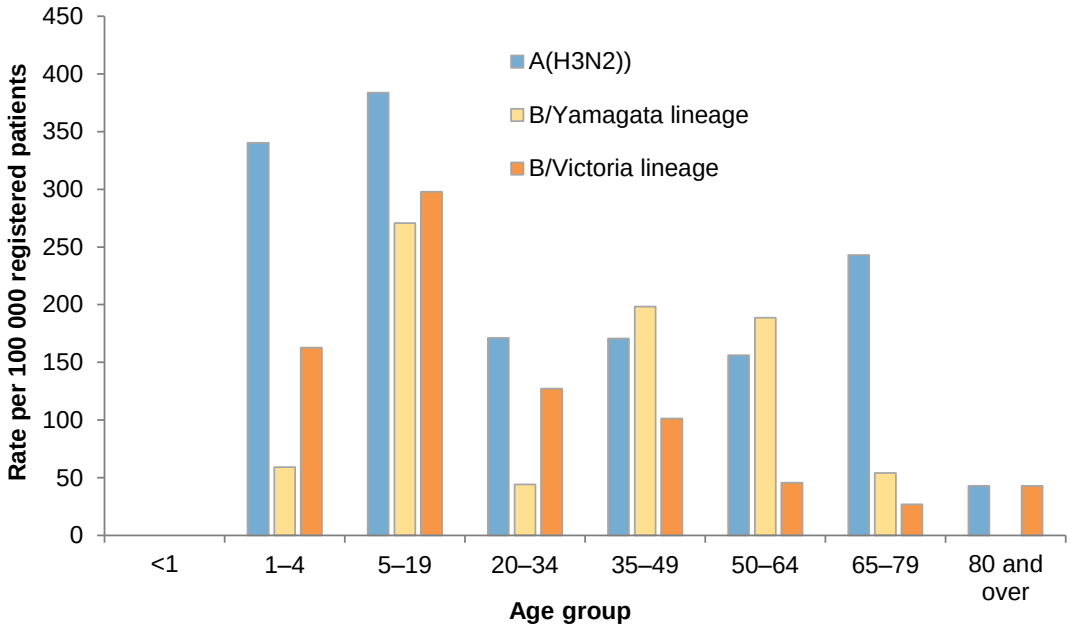


Figure 40. ILI related A(H3N2), B/Victoria and B/Yamagata by age groups, 2015



INFLUENZA A(H1N1)PDM09

In 2015, eight representative influenza A(H1N1)pdm09 isolates were antigenically typed. The results from the NIC and WHOCC-Melbourne indicated that most of the currently circulating influenza A(H1N1)pdm09 viruses were antigenically close to the vaccine strain A/California/7/2009 (H1N1). Genetically, most of the A(H1N1)pdm09 viruses fell into groups 6B and 6C (CDC designation, Appendix A).

INFLUENZA A(H3N2)

In 2015, 80 representative seasonal influenza A(H3N2) isolates were antigenically typed. 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/Switzerland/9715293/2013-like viruses. However, most of A(H3N2) viruses fell into genetic sub-clade 3C.2a (the most representative strain being A/HongKong/4801/2014-like) whereas A/Switzerland/9715293/2013-like strain belonged to group 3C.3a (CDC designations, Appendix B). In addition, most of A(H3N2) viruses reacted better with ferret antisera raised to egg-propagated A/HongKong/4801/2014-like strain than those ferret antisera raised to egg-propagated A/Switzerland/9715293/2013-like strain.

INFLUENZA B

In 2015, 162 representative seasonal influenza B/Yamagata lineage isolates (B/Phuket/3073/2013-like, the current vaccine strain) and 102 B/Victoria lineage isolates (B/Brisbane/60/2008-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/Phuket/3073/2013-like viruses and also B/Brisbane/60/2008-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 3 and 1A respectively (CDC designations, Appendices C and D). It appears that these genetic changes have not resulted in significant antigenic changes.

OSELTAMIVIR RESISTANCE MONITORING

In 2015, 846 influenza viruses were tested for resistance to oseltamivir and 874 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, 2013–2015

Influenza	NA inhibition to Oseltamivir*	Fold change in IC50 of test viruses (No. of viruses)**		
		2013	2014	2015
A(H1N1)pdm09	Normal	0-4 (75)	0-9 (665)	0-2 (12)
	Reduced	-	35 (1)	-
	Highly reduced	-	356 (1)	-
A(H3N2)	Normal	0-3 (321)	0-8 (164)	0-5 (110)
	Reduced	-	-	-
	Highly reduced	-	-	-
Influenza B	Normal	0-4 (316)	0-4 (167)	0-5 (730)
	Reduced	-	-	-
	Highly reduced	-	-	-

*Neuraminidase inhibition was defined as:
Normal inhibition = IC50 values which are within or close to the median IC50 of the type/subtype matched viruses as detailed in the table above.
Reduced inhibition = IC50 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 = IC50 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, 2013–2015

Influenza	NA inhibition to Zanamivir*	Fold change in IC50 of test viruses (No. of viruses)**		
		2013	2014	2015
A(H1N1)pdm09	Normal	0-6 (72)	0-6 (671)	0-2 (12)
	Reduced	-	-	-
	Highly reduced	-	-	-
A(H3N2)	Normal	0-5 (324)	0-7 (157)	0-4 (110)
	Reduced	-	-	-
	Highly reduced	-	-	-
Influenza B	Normal	0-5 (313)	0-5 (168)	0-4 (735)
	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 hospitalization [1, 12]. Preliminary results for influenza vaccine effectiveness (VE) against acute respiratory illness with circulating laboratory-confirmed influenza viruses in New Zealand from 27 April to 26 September 2015, using a case test negative design were 36% (95% confidence interval (CI): 11–54) for general practice encounters and 50% (95% CI: 20–68) for hospitalisations. VE against hospitalised influenza A(H3N2) illnesses was moderate at 53% (95% CI: 6–76) but improved compared with previous season.

SOUTHERN HEMISPHERE VACCINE STRAIN RECOMMENDATIONS

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SOUTHERN HEMISPHERE VACCINE STRAIN RECOMMENDATIONS

In October 2015, the Australian Influenza Vaccine Committee (AIVC), which includes a New Zealand representative, met to decide on the composition of the influenza vaccine for the 2015 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 2015 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). Current vaccines containing A/California/7/2009 antigen elicited antibodies in humans that reacted well to the recent influenza A(H1N1)pdm09 isolates.

Based on southern hemisphere and global data, the WHO Consultative Group and the AIVC recommended that the 2015 vaccines contain an influenza A/California/7/2009 (H1N1)-like strain as the A(H1N1) vaccine component.

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 were antigenically similar to A/Switzerland/9715293/2013-like strain, however, genetically, recent circulating A(H3N2) viruses were closely related to A/HongKong/4801/2014-like strain (sub-clade 3C.2a), different from the vaccine strain A/Switzerland/9715293/2013-like strain (sub-clade 3C.3a). In addition, most of A(H3N2) viruses reacted better with ferret antisera raised to egg-propagated A/HongKong/4801/2014-like strain than those ferret antisera raised to egg-propagated A/Switzerland/9715293/2013-like strain. Therefore, an A/Hong Kong/4801/2014-like virus was selected to replace the A/Switzerland/9715293/2013-like virus as the A(H3N2) vaccine component. AIVC accepted this recommendation.

INFLUENZA B

Two distinct lines of influenza B have co-circulated in many countries during recent years. During 1980s, 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 2015. 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 lineage isolates were antigenically closely related to B/Phuket/3073/2013-like strain. In Australia and New Zealand, a rapid increase in the proportion of B/Victoria lineage viruses was observed from June and they became the predominant lineage by August 2015. The WHO Consultative Group recommended vaccines containing B/Brisbane/60/2008-like strain as the B component of

the 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 2016 is:

A(H1N1)	**an A/California/7/2009 (H1N1)pdm-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

DISCUSSION

The need for reliable and timely influenza surveillance was reiterated during the 2009 influenza A(H1N1)pdm09 pandemic when insufficient surveillance worldwide [13] hampered international response efforts [14]. 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-wide leader in influenza surveillance, which provides complete 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 2015, ILI activity in New Zealand was at a moderate level compared to previous years. The year 2015 had the 13th highest cumulative consultation rate (1203.4/100,000) and peak weekly consultation rate (148.5/100,000) in the past 24 years (1992–2015). Based on these rates, an estimated 55,304 individuals or 1.2% of the population visited a GP with ILI. ILI cumulative consultation rates varied greatly across the country with the highest rates reported in South Canterbury (154.7), Tairawhiti (96.4) and West Coast (84.4). Variability in DHB-level rates could result from small numbers of participating practices, small registered patient population counts, or variations in individual diagnostic practices. Over half (50.8%) of the specimens collected through national ILI surveillance were positive for influenza, which is higher than in previous years (37.2% in 2014 and 32.6% in 2013). ILI surveillance in Auckland (SHIVERS) in 2015 demonstrated the highest influenza-positive ILI consultation rates among school aged children (5–19 years old).

NZ ILI surveillance provides a platform for real-time monitoring of the impact and transmission of community based influenza and other respiratory viruses, as well as, a rapid assessment of the effectiveness of the seasonal influenza vaccine. To assure comprehensive monitoring in 2015, NZ ILI surveillance included year-round HealthStat tracking (ILI-coded visits without virologic testing in 100 randomly sampled general practices nationwide) and two ILI season active surveillance components (64 general practices nationwide with a subset of patient testing and 16 SHIVERS practices with complete ILI patient testing). Overall, these systems detect similar trends and peaks regarding ILI activity; however, they vary in the specificity of the information provided (laboratory confirmed disease vs. syndromic ILI coded), the timeliness (real-time vs. lagged), and robustness of information provided, such as vaccination status or underlying conditions. It would be efficient and effective to develop a sustainable national sentinel general practice-based ILI surveillance system by combining the strengths from the three systems into one system.

Severe acute respiratory illness and influenza in hospitalised patients

In 2015, the overall severe acute respiratory illness activity was at a moderate level as measured by the cumulative SARI hospitalization rate (269.6/100,000) and SARI-associated influenza rate (39.0/100,000) as well as weekly peak rates when compared to previous years (2012–2014). Based on these rates, an estimated 12,000 New Zealanders were hospitalized with SARI and 1,700 of these SARI hospitalisations were associated with influenza infections. Because the SARI case definition is restricted to those patients with acute onset of cough and fever, it under-estimates influenza associated hospitalisations. The timing of sample collection also affects the likelihood of detecting influenza.

NZ hospital-based surveillance provides real-time monitoring capacity for severe clinical presentations with a number of respiratory viruses in addition to seasonal influenza (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, also provides a timely understanding of seriousness of influenza disease and its impact (two critical indicators of severity assessment). Severity assessment provides scientific evidence to determine the timing, scale, emphasis, intensity and urgency of pandemic response actions. The SARI surveillance system 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 with 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 (non-sentinel laboratory-based surveillance).

Influenza-associated ICU admissions

In 2015, roughly 5% (20/373) of all patients hospitalized with influenza-positive SARI were admitted to the ICU. The ICU admission rate for influenza-positive SARI was similar to 2014, and higher than 2013. ICU surveillance was expanded in 2014 to include all ICU admissions for 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 2015, influenza-positive ICU admission rates were similar regardless of SARI status. Influenza-associated ICU admission is a good outcome measure of severity caused by influenza. Such surveillance 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 (high body mass index, asthma) or women, who are pregnant, 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, treatment, and management of co-morbidities. The 2015 NZ SARI surveillance confirmed these risks with over half of the adults hospitalised with influenza having an underlying condition and five-fold higher rates of hospitalisation with influenza for pregnant women compared to non-pregnant women of child-bearing age. Cardiovascular conditions, obesity and asthma were the most commonly reported underlying conditions. Influenza vaccine coverage was low (<30%) among 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) and older people (≥ 65 years). Influenza-associated GP consultation rates, however, show the opposite pattern, with a higher rate in pre-schoolers, 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 and Pacific peoples experienced the highest rates of influenza-associated hospitalisations but the lowest rates of general practice consultations, while the Asian ethnic group showed the opposite trend. When NZDep was evaluated, the most deprived populations (NZDep 9–10) were found to have the highest rates of influenza-associated hospitalisations but the 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 2015 was influenza A (H3N2), which is typically associated with more severe disease in the age groups with high influenza associated hospitalisations. In 2015, two influenza B lineage viruses (Yamagata and Victoria) were co-circulated with higher attack rates in the community compared to influenza A viruses. The high rate of influenza-associated GP visits among school aged children (5–19 years) are likely related to these influenza B viruses. These patterns may be the result of multi-factorial influences such as influenza strain-specific pathogenesis, host immune response, socio-demographic factors and health seeking behaviour among these at-risk age groups. The highly age-specific impact of viral strains and unpredictability of predominant seasonal strains and future pandemic viruses 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 had significant respiratory illness [36, 37, 38]. Vaccine coverage estimates in each of these groups are not available. Among people aged 65 years and older, influenza vaccination coverage was 67%, which is still below the target of 75% for this age group.

An annual, interim assessment of the seasonal influenza vaccine effectiveness (VE) is conducted with Auckland SARI and ILI surveillance to provide an estimate of the current vaccine performance for NZ and international VE monitoring.[34, 35]. The 2015 influenza VE (visits as of 26 September 2016) was 36% (95% CI: 11-54) for GP encounters and 50% (95% CI: 20-68) for hospitalisations. VE against hospitalised influenza A(H3N2) illnesses was moderate at 53% (95% CI: 6-76) and comparable to previous seasons [1]. Influenza vaccine strain selection requires annual consultations and frequent updates to match the antigenic drift of the circulating viral strains and ample evidence indicates that influenza vaccine effectiveness (VE) varies not only by virus type (subtype) but also from year to year [26, 27].

No resistance to influenza antivirals was detected in 2015. 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 ILI and influenza cases, sentinel practices in ADHB and CMDHB, sentinel practices in ADHB and CMDHB, 27 April to 27 September 2015

Characteristics	All ILI & influenza cases visiting sentinel practices in ADHB & CMDHB			ILI & influenza cases among ADHB & CMDHB residents		
	ILI cases	ILI cases per 1000 consultations	Influenza positive (%*)	ILI incidence (per 100 000)	Influenza positive (col %)	Influenza incidence (per 100 000) (95% CI)
Overall	**1416**	**11.7**	**614 (44.8)**	**1347.5**	**571 (100.0)**	**586.9 (539.9, 636.9)**
Age group (years)						. (., .)
<1	13	3.3	0 (0.0)	781.3	0 (0.0)	0.0 (0.0, 319.7)
1–4	160	11.0	44 (29.1)	2204.5	42 (7.4)	621.4 (448.2, 839.0)
5–19	474	22.9	247 (54.2)	2035.8	233 (40.8)	1051.8 (921.6, 1195.0)
20–34	211	11.8	93 (44.5)	944.4	84 (14.7)	411.0 (328.0, 508.6)
35–49	280	12.4	129 (47.1)	1180.1	118 (20.7)	544.0 (450.4, 651.1)
50–64	197	9.4	74 (38.7)	1139.0	68 (11.9)	442.6 (343.8, 560.8)
65–79	65	4.6	25 (38.5)	837.0	24 (4.2)	324.0 (207.7, 481.7)
>80	13	2.2	2 (16.7)	558.9	2 (0.4)	86.0 (10.4, 310.3)
Unknown	3					
Ethnicity						
Māori	76	7.2	33 (44.0)	934.9	27 (4.7)	394.4 (260.1, 573.3)
Pacific peoples	131	4.0	69 (53.9)	535.4	64 (11.2)	278.6 (214.6, 355.6)
Asian	252	14.8	120 (50.0)	1499.9	113 (19.8)	736.9 (607.7, 885.3)
European and others	951	15.9	389 (42.2)	1703.9	364 (63.7)	698.4 (628.7, 773.7)
Unknown	6	60.0			3 (0.5)	
DHB						
Auckland	1383	19.0	593 (44.3)	2080.8	550 (96.3)	895.5 (822.5, 973.2)
Counties Manukau	33	0.7	21 (65.6)	92.0	21 (3.7)	58.5 (36.2, 89.5)
Sex						
Female	597	8.8	289 (50.4)	1086.4	272 (47.6)	528.6 (467.8, 595.1)
Male	815	15.4	324 (40.7)	1631.9	298 (52.2)	650.1 (578.6, 728.0)
Unknown	4	142.9	1 (100.0)		1 (0.2)	
NZ Dep						
NZDep1–2	407	16.4	168 (42.9)	2019.0	162 (28.4)	845.2 (720.5, 985.1)
NZDep3–4	290	14.5	116 (40.6)	1495.4	107 (18.7)	597.0 (489.5, 721.0)
NZDep5–6	262	14.4	111 (43.9)	1541.1	104 (18.2)	665.0 (543.7, 805.2)
NZDep7–8	274	13.5	128 (48.1)	1360.2	111 (19.4)	623.9 (513.5, 750.8)
NZDep9–10	178	5.1	91 (52.9)	631.3	87 (15.2)	325.0 (260.4, 400.7)

*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 15. Demographic characteristics of SARI patients, 2015

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 positive (col %)	Influenza incidence rate per 100 000 (95%CI)
Overall	144122	**2755**	**19.1**	**373 (17.7)**	**269.6**	**348 (100.0)**	**38.4 (34.5, 42.7)**
Age group (years)							
<1	5267	592	112.4	43 (8.7)	3968.6	39 (11.2)	288.8 (205.4, 394.5)
1–4	10265	603	58.7	53 (12.0)	966.4	50 (14.4)	94.6 (70.2, 124.6)
5–19	16598	182	11.0	22 (18.0)	71.1	20 (5.7)	10.4 (6.3, 16.0)
20–34	27203	176	6.5	47 (33.3)	80.6	46 (13.2)	22.1 (16.2, 29.4)
35–49	21987	186	8.5	41 (25.5)	90.1	38 (10.9)	19.9 (14.1, 27.3)
50–64	24960	291	11.7	69 (27.2)	178.0	66 (19.0)	43.8 (33.9, 55.8)
65–79	23211	385	16.6	63 (22.0)	484.4	55 (15.8)	75.3 (56.7, 97.9)
>80	14631	242	16.5	34 (22.7)	1003.0	33 (9.5)	140.8 (97.0, 197.7)
Unknown	0	98		1 (1.5)		1 (0.3)	
Ethnicity							
Māori	19002	543	28.6	55 (12.9)	473.5	51 (14.7)	51.3 (38.2, 67.4)
Pacific peoples	29975	1062	35.4	163 (18.9)	730.5	159 (45.7)	115.2 (98.0, 134.6)
Asians	22646	344	15.2	40 (15.7)	146.4	38 (10.9)	18.1 (12.8, 24.8)
European and others	71465	769	10.8	115 (20.4)	161.6	100 (28.7)	24.9 (20.3, 30.3)
Unknown	994	37	37.2	0 (0.0)	10.7		0.0 (0.0, 6.6)
Hospitals							
ADHB	81480	1175	14.4	181 (22.9)	218.4	163 (46.8)	37.4 (31.8, 43.6)
CMDHB	62642	1579	25.2	192 (14.5)	317.1	185 (53.2)	39.4 (33.9, 45.5)
Sex							
Female	75744	1414	18.7	182 (16.7)	270.4	167 (48.0)	35.9 (30.7, 41.8)
Male	68374	1311	19.2	191 (18.7)	268.8	181 (52.0)	41.1 (35.3, 47.5)
Unknown	4						
NZ Dep							
NZDep1–2		242		34 (19.4)	121.1	32 (9.2)	17.9 (12.3, 25.3)
NZDep3–4		238		35 (21.2)	116.3	33 (9.5)	19.8 (13.6, 27.8)
NZDep5–6		371		52 (19.0)	215.7	47 (13.5)	32.3 (23.7, 42.9)
NZDep7–8		393		58 (19.9)	205.3	55 (15.8)	33.2 (25.0, 43.2)
NZDep9–10		1392		184 (16.4)	527.7	180 (51.7)	72.2 (62.1, 83.6)

*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 16. Demographic characteristics of SARI patients admitted to ICU, 2015

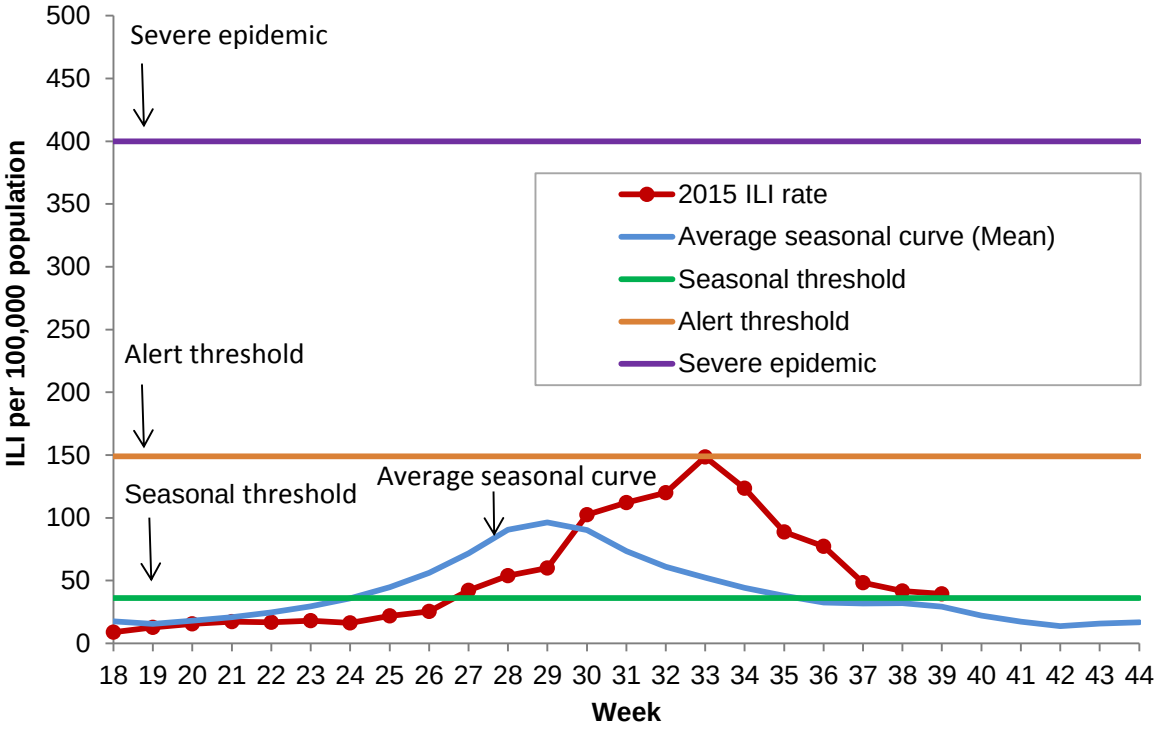
Characteristics	Total ICU admissions	All SARI cases	SARI & influenza ICU cases among all hospital patients				SARI & influenza ICU cases among ADHB & CMDHB residents				ARI & influenza ICU cases among ADHB & CMDHB residents		
			SARI ICU cases	SARI ICU per ICU admissions (per 1000)	% SARI ICU among all SARI	Influenza positive[1] (%)	SARI ICU cases	SARI ICU incidence (per 100 000)	Influenza positive (col %)	Influenza incidence (per 100 000) (CI)	ARI ICU incidence (per 100 000)	Influenza positive (col %)	Influenza incidence (per 100 000) (CI)
Overall	**1163**	**2755**	**183**	**157.4**	**6.6**	**20 (12.6)**	**109**	**12.0**	**15 (100.0)**	**1.7 (0.9, 2.7)**	**25.8**	**20 (100.0)**	**2.2 (1.3, 3.4)**
Age group (years)													
<1	214	592	64	299.1	10.8	4 (6.8)	39	288.8	2 (13.3)	14.8 (1.8, 53.5)	770.0	3 (15.0)	22.2 (4.6, 64.9)
1 to 4	150	603	56	373.3	9.3	7 (14.9)	28	53.0	5 (33.3)	9.5 (3.1, 22.1)	107.8	6 (30.0)	11.3 (4.2, 24.7)
5 to 19	119	182	27	226.9	14.8	1 (5.3)	12	6.2	1 (6.7)	0.5 (0.0, 2.9)	11.4	1 (5.0)	0.5 (0.0, 2.9)
20 to 34	123	176	5	40.7	2.8	2 (40.0)	5	2.4	2 (13.3)	1.0 (0.1, 3.5)	3.8	2 (10.0)	1.0 (0.1, 3.5)
35 to 49	161	186	7	43.5	3.8	1 (14.3)	5	2.6	1 (6.7)	0.5 (0.0, 2.9)	5.2	2 (10.0)	1.0 (0.1, 3.8)
50 to 64	201	291	13	64.7	4.5	5 (41.7)	10	6.6	4 (26.7)	2.7 (0.7, 6.8)	8.0	4 (20.0)	2.7 (0.7, 6.8)
65 to 79	167	385	6	35.9	1.6	0 (0.0)	6	8.2	0 (0.0)	0.0 (0.0, 5.0)	13.7	1 (5.0)	1.4 (0.0, 7.6)
80 and over	28	242	2	71.4	0.8	0 (0.0)	2	8.5	0 (0.0)	0.0 (0.0, 15.7)	25.6	1 (5.0)	4.3 (0.1, 23.8)
Unknown	0	98	3		3.1	0 (0.0)	2						
Ethnicity													
Māori	282	543	46	163.1	8.5	3 (7.3)	23	23.1	1 (6.7)	1.0 (0.0, 5.6)	47.2	2 (10.0)	2.0 (0.2, 7.3)
Pacific peoples	330	1062	63	190.9	5.9	7 (12.5)	53	38.4	7 (46.7)	5.1 (2.0, 10.5)	75.4	9 (45.0)	6.5 (3.0, 12.4)
Asians	103	344	18	174.8	5.2	4 (22.2)	13	6.2	4 (26.7)	1.9 (0.5, 4.9)	10.9	4 (20.0)	1.9 (0.5, 4.9)
European and others	435	769	56	128.7	7.3	6 (13.6)	20	5.0	3 (20.0)	0.7 (0.2, 2.2)	14.9	5 (25.0)	1.2 (0.4, 2.9)
Unknown	12	37	0	0.0	0.0	0 (-)	0	0.0		0.0 (0.0, 6.6)	0.0		0.0 (0.0, 6.6)
Hospitals													
ADHB	470	1175	124	263.8	10.6	12 (11.8)	55	12.6	7 (46.7)	1.6 (0.6, 3.3)	30.0	9 (45.0)	2.1 (0.9, 3.9)
CMDHB	693	1579	59	85.1	3.7	8 (14.0)	54	11.5	8 (53.3)	1.7 (0.7, 3.4)	21.9	11 (55.0)	2.3 (1.2, 4.2)
Sex													
Female	462	1414	100	216.5	7.1	12 (13.2)	61	13.1	9 (60.0)	1.9 (0.9, 3.7)	29.9	11 (55.0)	2.4 (1.2, 4.2)
Male	701	1311	83	118.4	6.3	8 (11.8)	48	10.9	6 (40.0)	1.4 (0.5, 3.0)	21.6	9 (45.0)	2.0 (0.9, 3.9)
Unknown	0	30	0		0.0	0 (-)	0						
NZDep													
NZDep1–2		242	12		5.0	1 (8.3)	9	5.0	1 (6.7)	0.6 (0.0, 3.1)	9.0	2 (10.0)	1.1 (0.1, 4.0)
NZDep3–4		238	29		12.2	4 (14.8)	12	7.2	4 (26.7)	2.4 (0.7, 6.1)	16.8	6 (30.0)	3.6 (1.3, 7.8)
NZDep5–6		371	20		5.4	3 (23.1)	11	7.6	2 (13.3)	1.4 (0.2, 5.0)	16.5	2 (10.0)	1.4 (0.2, 5.0)
NZDep7–8		393	35		8.9	4 (14.8)	14	8.5	3 (20.0)	1.8 (0.4, 5.3)	19.3	3 (15.0)	1.8 (0.4, 5.3)
NZDep9–10		1392	79		5.7	7 (9.7)	61	24.5	5 (33.3)	2.0 (0.7, 4.7)	51.8	7 (35.0)	2.8 (1.1, 5.8)

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

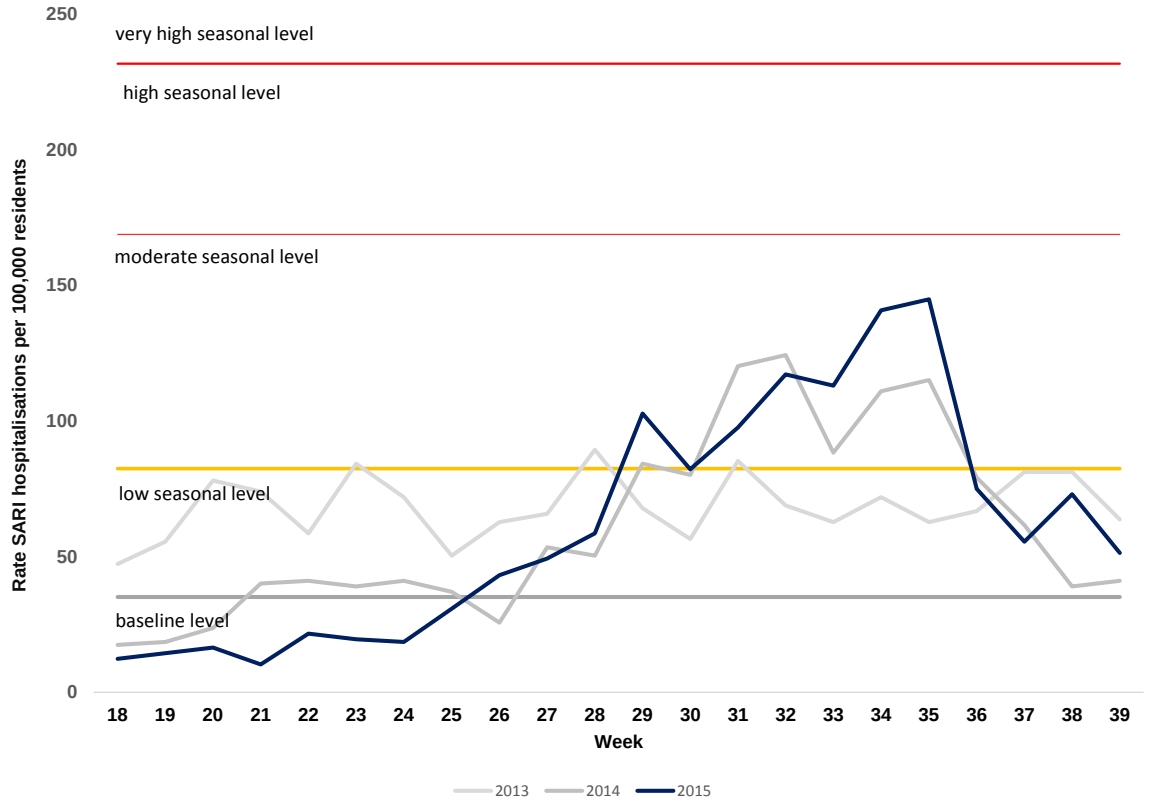
Appendix Table 17. Influenza-like illness peak rates (1992–2015) and annual consultation rates (1997–2015)

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

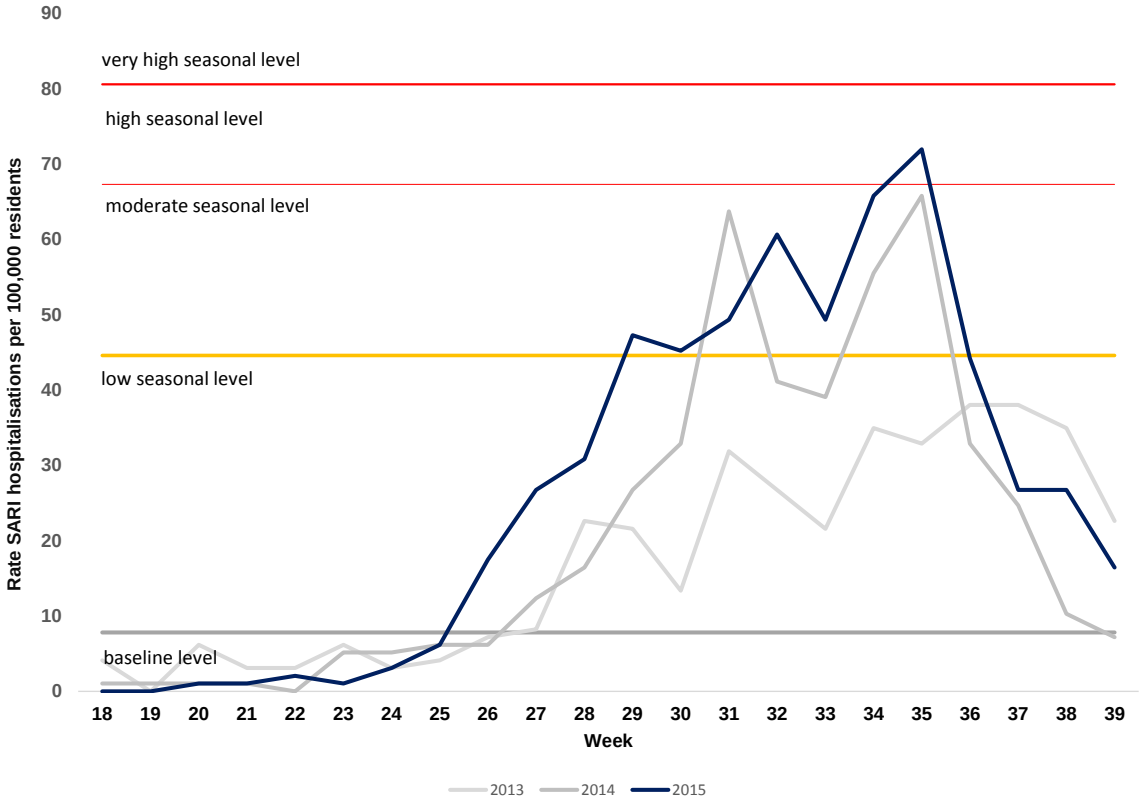
Appendix Figure 41. Weekly consultation rates for Influenza-like Illness (ILI) in New Zealand, 2009–2015



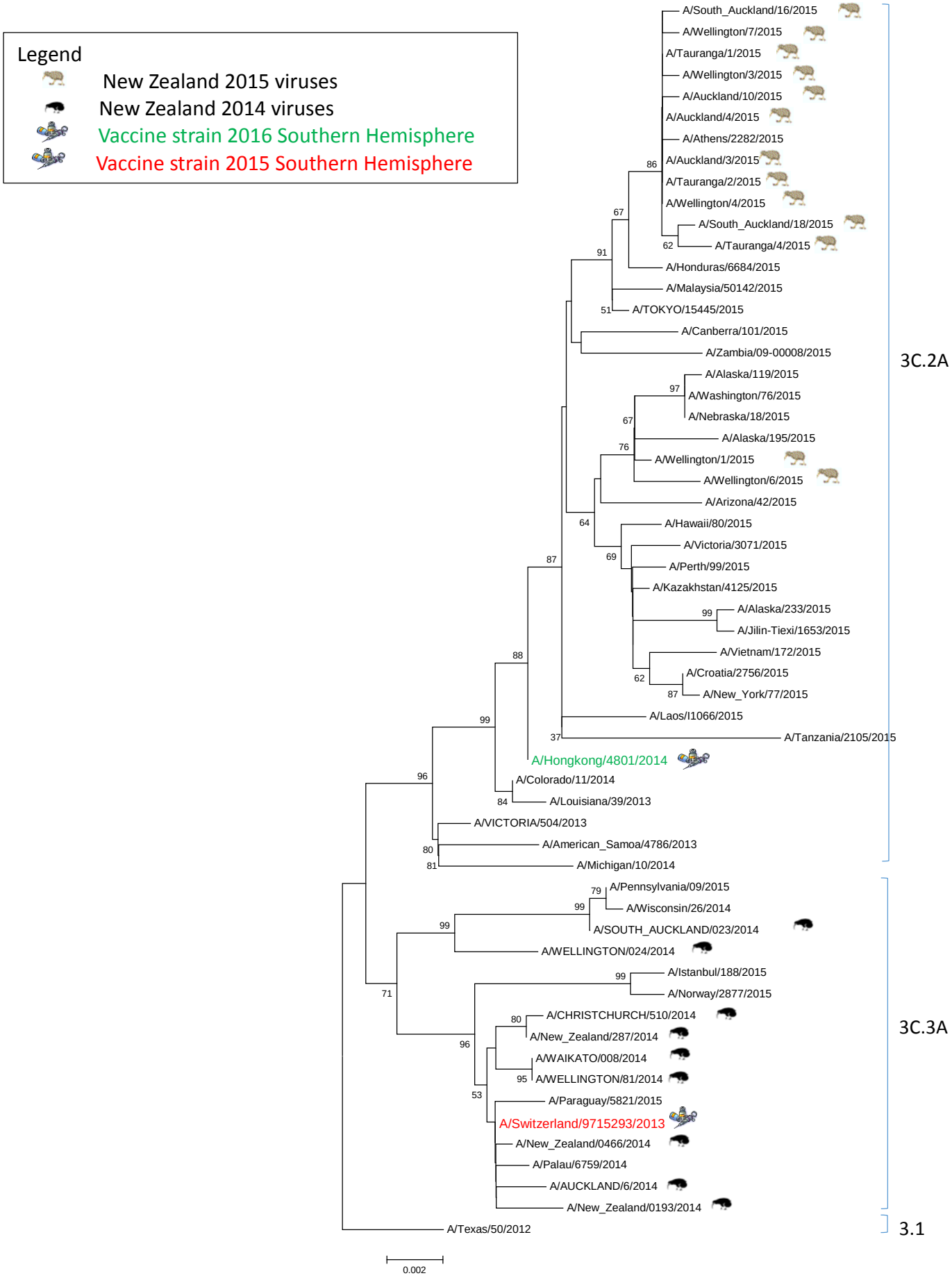
Appendix Figure 42. Weekly ILI consultation rates in 2015 compared to 2013–2014 rates (SHIVERS)



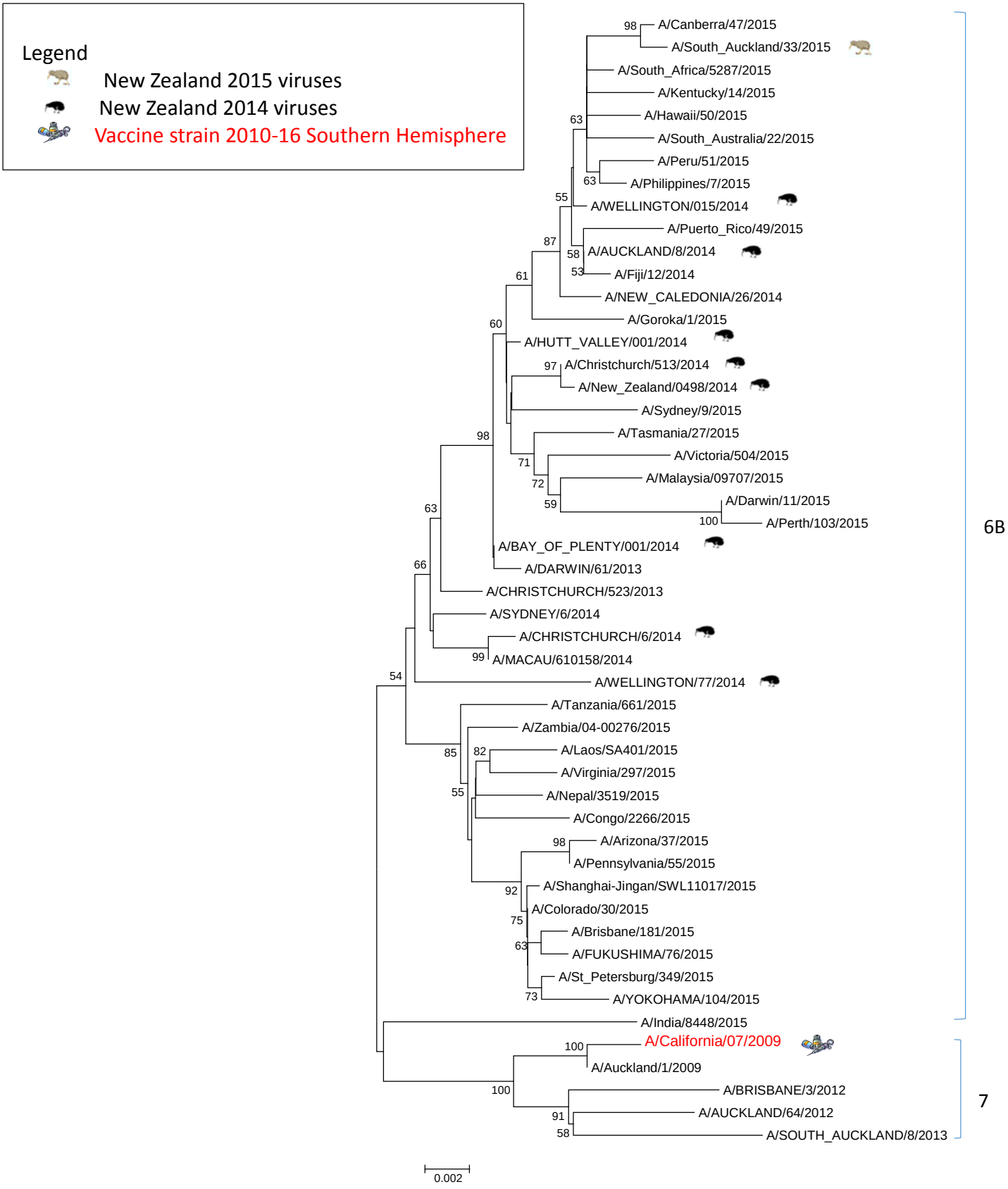
Appendix Figure 43. Weekly ILI influenza positive rates in 2015 compared to 2013–2014 rates (SHIVERS)



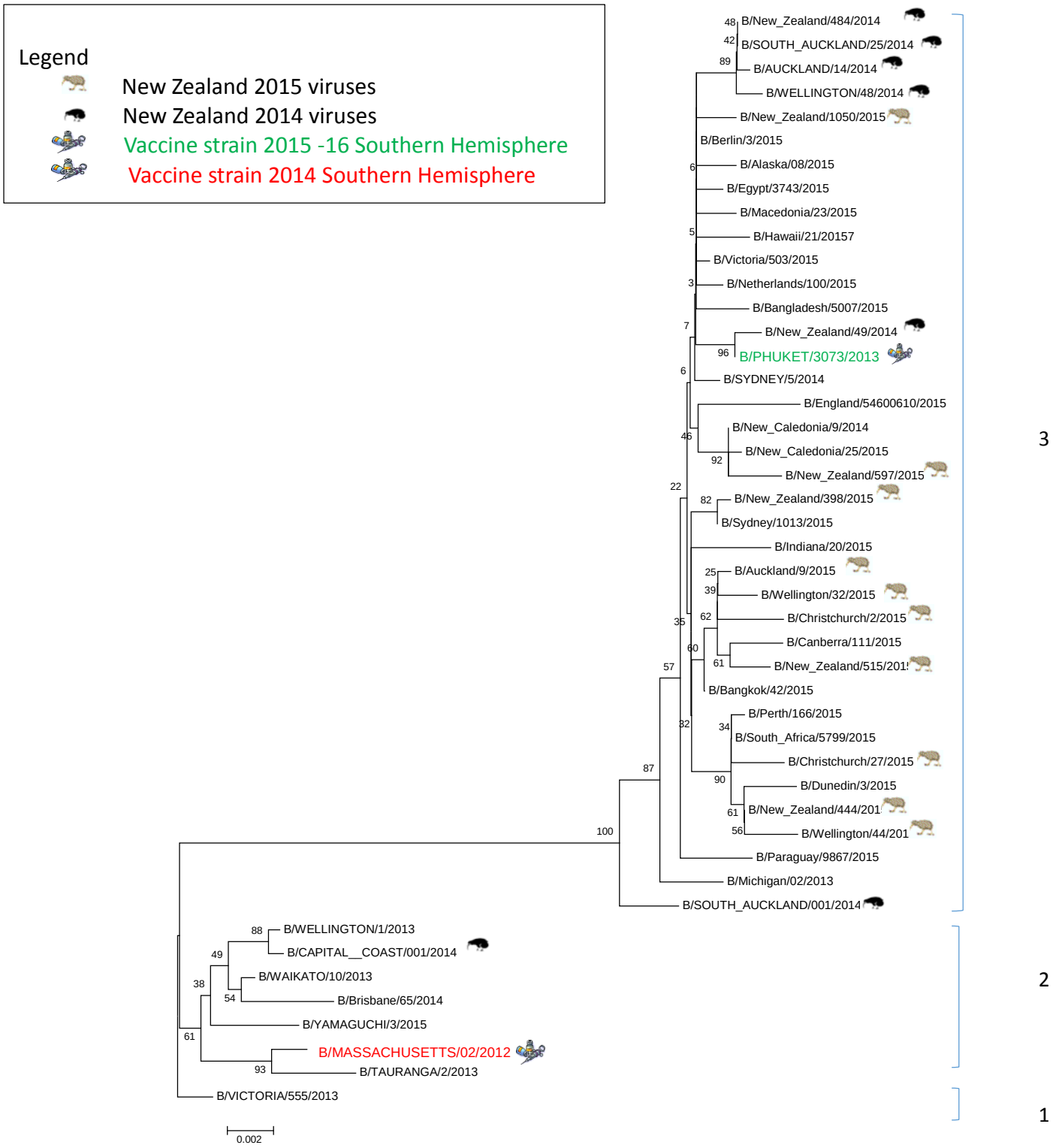
Phylogenetic relationships among influenza A(H3N2) haemagglutinin genes



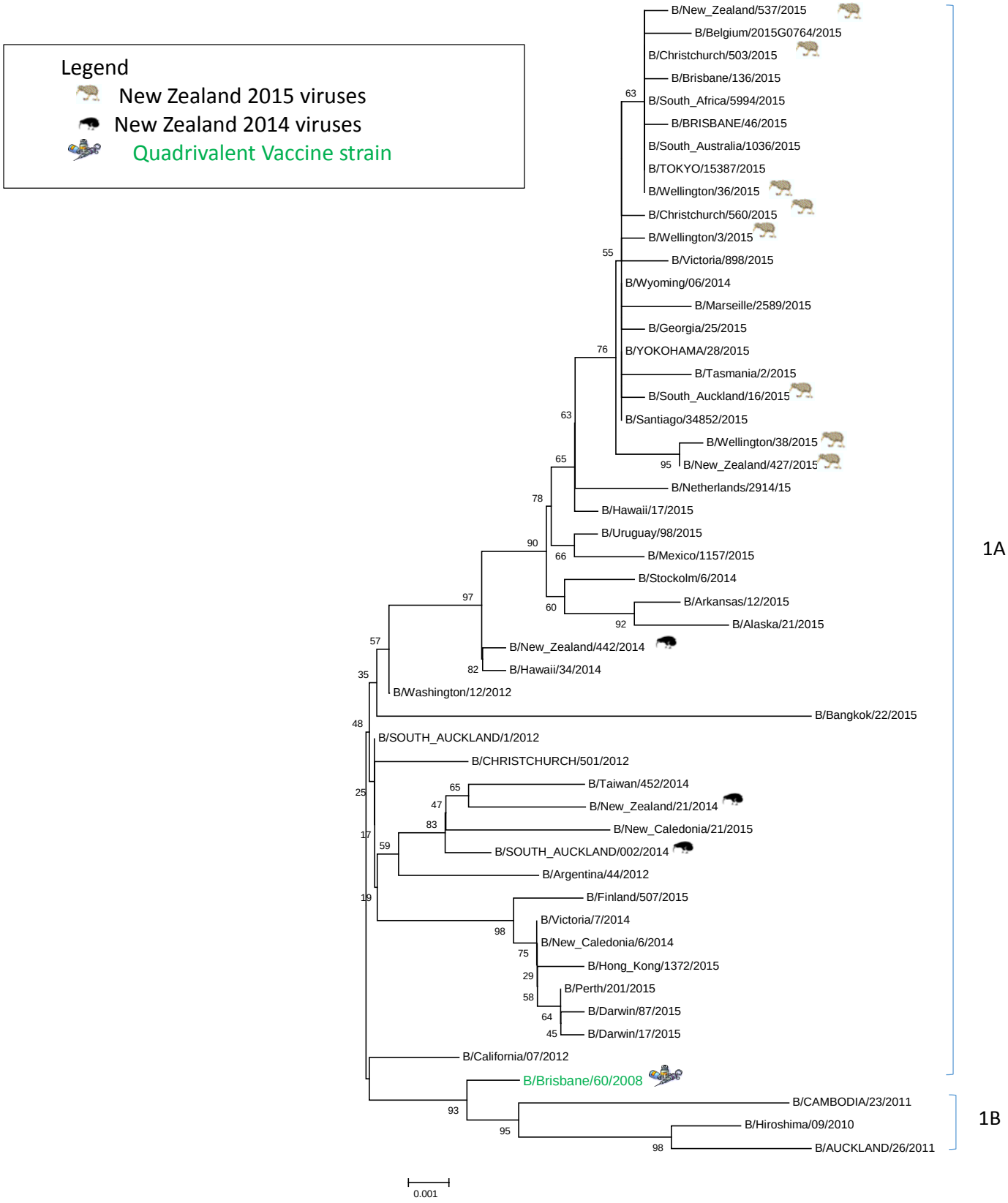
Phylogenetic relationships among influenza A(H1N1) haemagglutinin genes



Phylogenetic relationships among influenza B(Yamagata) haemagglutinin genes



Phylogenetic relationships among influenza B(Victoria) haemagglutinin genes



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