RECOMMENDATION FOR SEASONAL INFLUENZA VACCINE COMPOSITION FOR NEW ZEALAND FOR 2018

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- The Therapeutic Goods Administration, DOHA for hosting the Australian Influenza Vaccine Committee.
- Participants in the National GP-based influenza-like illness surveillance programme and hospital-based SARI surveillance programme.

Disclaimer

RECOMMENDATIONS

The Australian Influenza Vaccine Committee (AIVC) met with a New Zealand representative (Appendix 1) in Canberra on 11 October 2017 to consult on the influenza vaccine composition for 2018 for New Zealand, Australia and South Africa. The recommended composition for trivalent vaccines was:

- A(H1N1) an A/Michigan/45/2015 (H1N1)pdm09-like virus
- A(H3N2) an A/Singapore/INFIMH-16-0019/2016 (H3N2)-like virus
- B a B/Phuket/3073/2013-like virus (belonging to B/Yamagata lineage)

Quadrivalent vaccines contain the above three viruses and plus one more vaccine component:

- B a B/Brisbane/60/2008-like virus (belonging to B/Victoria lineage)

CONTENTS

List of Tables 6
List of Figures 7
Influenza epidemiology 9
World-wide influenza activity, February to September 2017 9
Influenza activity in Australia, February to September 2017 10
Influenza activity in South Africa, February to September 2017 12
Influenza activity in New Zealand IN 2017 13
Community-based surveillance 13
Hospital-based surveillance 22
New Zealand strain characterisations 32
Circulating strains in 2017 32
Predominant strains during 1997–2017 34
Influenza A(H1N1)pdm09 36
Seasonal influenza A(H3N2) 36
Influenza B 38
Oseltamivir resistance 38
Influenza vaccine effectiveness 40
Recent strain characterisation for southern hemisphere viruses and likely vaccine candidates 42
Influenza A(H1N1)pdm09 42
Seasonal influenza A(H3N2) 43
Influenza B 44
Summary of vaccine composition recommendation 47
Explanation of “like” strains suitable for inclusion in vaccine 47
Appendix 1 - Composition of the Australian Influenza Vaccine Committee 2017 48
Appendix 2 – Isolates received for analysis at the Australian WHO Collaborating Centre 49
Appendix 3 – Influenza A(H1N1)pdm09 50
Appendix 4 - Influenza A (H3N2) 57
Appendix 5 - Influenza B 68
Appendix 6 - WHO Recommendation for Influenza Vaccines 79

]

LIST OF TABLES

Table 1. Influenza Vaccine Recommendations for New Zealand, 1991–2017 8

Table 2. National ILI and influenza activity thresholds 14

Table 3. Weekly consultation rate for influenza-like illness by District Health Board, ... 17

Table 4. Demographic characteristics of ILI and influenza cases, 4 January–27 August 2017 .. 18

Table 5. Influenza and non-influenza respiratory viruses among ILI cases, 1 May to 27 August 2017 19

Table 6. Demographic characteristics of SARI cases and related influenza cases, since 1 May 2017 25

Table 7. Influenza and non-influenza respiratory viruses among SARI cases, 1 May–27 August 2017 26

Table 8. Influenza viruses by type and subtype for weeks 1–34, 2017 32

Table 9. Antiviral susceptibility to oseltamivir for influenza viruses, 2014–2017 38

Table 10. Antiviral susceptibility to zanamivir for influenza viruses, 2014–2017 39

Table 11. Estimated influenza vaccine effectiveness, by participant age group and by influenza virus type and subtype: crude and propensity adjusted models, New Zealand, 2017 influenza season 41

LIST OF FIGURES

Figure 1. Weekly consultation rates for influenza-like illness in New Zealand in 2017 compared to 2013–2016.....15

Figure 2. Weekly ILI consultation rates in 2017 compared to 2013–2017.....15

Figure 3. Weekly ILI-associated influenza rates in 2017 compared to 2013–2016 16

Figure 4. Weekly Consultation Rates for Influenza-like Illness in New Zealand, 1992–2017 17

Figure 5. Temporal distribution of the number and proportion of influenza viruses from ILI specimens, 1 May to 27 August 2017, by type and week.....20

Figure 6. Temporal distribution of the number and proportion of non-influenza viruses from ILI specimens, 1 May to 27 August 2017, by type and week.....20

Figure 7. Weekly number of ILI-related calls to Healthline, 2010–2017.....21

Figure 8. Weekly resident SARI and SARI-associated influenza incidence, 2017 23

Figure 9. Weekly hospitalisation rates for SARI in 2017 compared to 2012–2016.....24

Figure 10. Weekly hospitalisation rates for SARI-associated influenza in 2017 compared to 2012–2016 24

Figure 11. Temporal distribution of the number and proportion of influenza viruses from SARI specimens, 1 May–27 August 2017, by type and week.....27

Figure 12. Temporal distribution of the number and proportion of non-influenza viruses from SARI specimens, 1 May–27 August 2017, by type and week.....27

Figure 13. Influenza hospital discharges, 2000–2017*.....28

Figure 14. Influenza hospital discharges by week, 2017*.....29

Figure 15. Influenza hospital discharge rates by age group, 2017* 30

Figure 16. Hospital discharge rates by prioritised ethnic group, 2017* 31

Figure 17. Total influenza viruses by type and week reported for weeks 1–34, 2017 33

Figure 18. Influenza viruses by type, 1997–2017 34

Figure 19. Influenza A viruses by subtypes 1997–2017 35

Figure 20. Influenza B viruses by lineages, 1990–2017 36

Figure 21. Phylogenetic relationships among influenza A(H3N2) haemagglutinin genes.....37

Table 1. Influenza Vaccine Recommendations for New Zealand, 1991–2017

Decision		Use year	A H3N2	A H1N1	B (Trivalent)	B (Quadrivalent)
NZ & WHO*	2017	2018	A/Singapore/INFIMH-16-0019/2016	A/Michigan/45/2015	B/Phuket/3073/2013	B/Brisbane/60/2008
NZ & WHO*	2016	2017	A/Hong Kong/4801 /2014	A/Michigan/45/2015	B/Brisbane/60/2008	B/Phuket/3073/2013
NZ & WHO*	2015	2016	A/Hong Kong/4801 /2014	A/California/7/2009	B/Brisbane/60/2008	B/Phuket/3073/2013
NZ & WHO*	2014	2015	A/Switzerland/9715293/2013	A/California/7/2009	B/Phuket/3073/2013	B/Brisbane/60/2008
NZ & WHO*	2013	2014	A/Texas/50/2012	A/California/7/2009	B/Massachusetts/2/2012	B/Brisbane/60/2008
NZ & WHO*	2012	2013	A/Victoria/361/2011	A/California/7/2009	B/Wisconsin/1/2010	
NZ & WHO*	2011	2012	A/Perth/16/2009	A/California/7/2009	B/Brisbane/60/2008	
NZ & WHO*	2010	2011	A/Perth/16/2009	A/California/7/2009	B/Brisbane/60/2008	
NZ & WHO*	2009	2010	A/Perth/16/2009	A/California/7/2009	B/Brisbane/60/2008	
NZ & WHO*	2008	2009	A/Brisbane/10/2007	A/Brisbane/59/2007	B/Florida/4/2006	
NZ & WHO*	2007	2008	A/Brisbane/10/2007	A/Solomon Islands/3/2006	B/Florida/4/2006	
NZ & WHO*	2006	2007	A/Wisconsin/67/2005	A/New Caledonia/20/99	B/Malaysia/2506/2004	
NZ & WHO*	2005	2006	A/California/7/2004	A/New Caledonia/20/99	B/Malaysia/2506/2004	
NZ & WHO*	2004	2005	A/Wellington/1/2004	A/New Caledonia/20/99	B/Shanghai/361/2002	
NZ & WHO*	2003	2004	A/Fujian/411/2002	A/New Caledonia/20/99	B/Hong Kong/330/2001	
NZ & WHO*	2002	2003	A/Moscow/10/99	A/New Caledonia/20/99	B/Hong Kong/330/2001	
NZ & WHO*	2001	2002	A/Moscow/10/99	A/New Caledonia/20/99	B/Sichuan/379/99	
NZ	2000	2001	A/Sydney/5/97	A/New Caledonia/20/99	B/Beijing/184/93	
WHO*	2000	2001	A/Moscow/10/99	A/New Caledonia/20/99	B/Beijing/184/93	
NZ & WHO*	1999	2000	A/Sydney/5/97	A/Beijing/262/95	B/Beijing/184/93	
NZ	1998	1999	A/Sydney/5/97	A/Bayern/7/95	B/Beijing/184/93	
WHO**	1997-98		A/Wuhan/359/95	A/Bayern/7/95	B/Beijing/184/93	
NZ	1997	1998	A/Wuhan/359/95	A/Texas/36/91	B/Beijing/184/93	
WHO**	1996-97		A/Wuhan/359/95	A/Singapore/6/86***	B/Beijing/184/93	
NZ	1996	1997	A/Johannesburg/33/94	A/Texas/36/91	B/Beijing/184/93	
WHO**	1995-96		A/Johannesburg/33/94	A/Singapore/6/86	B/Beijing/184/93	
NZ	1995	1996	A/Guangdong/25/93	A/Texas/36/91	B/Panama/45/90	
WHO**	1994-95		A/Shangdong/9/93	A/Singapore/6/86	B/Beijing/184/93	
NZ	1994	1995	A/Beijing/32/92	A/Texas/36/91	B/Panama/45/90	
WHO**	1993-94		A/Beijing/32/92	A/Singapore/6/86	B/Panama/45/90	
NZ	1993	1994	A/Shanghai/24/90	A/Texas/36/91	B/Panama/45/90	
WHO**	1992-93		A/Beijing/353/89	A/Singapore/6/86	B/Yamagata/16/88 or B/Panama/45/90	
NZ	1992	1993	A/Beijing/353/89	A/Victoria/36/88	B/Yamagata/16/88 or B/Panama/45/90	
WHO**	1991-92		A/Beijing/353/89	A/Singapore/6/86	B/Yamagata/16/88 or B/Panama/45/90	

* WHO recommendations are for the Southern Hemisphere winter

* * WHO recommendations are for the Northern Hemisphere winter

INFLUENZA EPIDEMIOLOGY

WORLD-WIDE INFLUENZA ACTIVITY, FEBRUARY TO SEPTEMBER 2017

Between February and September 2017, influenza activity was reported in all regions, with a predominance of influenza A(H3N2) and influenza B viruses.

NORTHERN HEMISPHERE TEMPERATE REGION

In the northern hemisphere, influenza activity was high from February to March and declined thereafter with the exception of a few countries in the Americas and Asia. Influenza A(H3N2) and B viruses co-circulated in most temperate countries of Africa, the Americas, Asia and Europe. Mexico was the only country that reported an influenza season dominated by influenza A(H1N1)pdm09 viruses.

SOUTHERN HEMISPHERE TEMPERATE REGION

In the southern hemisphere, activity remained low until May when regional to widespread activity was reported from a number of countries with detections of mainly influenza A(H3N2) and B viruses. Regional and wide- spread activity was reported from June to August in South Africa, with influenza A(H3N2) co-circulating with influenza B viruses. High levels of activity associated with influenza A(H3N2) and to a lesser extent B viruses were reported in most countries in the southern cone of the Americas from April onwards. In Oceania, high levels of influenza A(H3N2) activity followed by B viruses in the later part of the season (July–September) was reported.

TROPICAL AND SUBTROPICAL REGIONS

In the tropical and subtropical regions of Africa, activity was generally low with regional outbreaks reported from Uganda and widespread influenza A(H1N1)pdm09 and B virus activity reported from Mauritius. In the tropical Americas influenza activity was variable with a few countries reporting regional to widespread activity of A(H3N2) virus from February to June. In tropical and subtropical Asia high influenza A(H1N1)pdm09 virus activity was reported from several countries (Bangladesh, Cambodia, India, Maldives, Myanmar, Nepal, Philippines, Sri Lanka), while A(H3N2) viruses predominated in Hong Kong Special Administrative Region of China (Hong Kong SAR). In Singapore and Thailand, influenza A(H1N1)pdm09, A(H3N2) and B viruses co-circulated.

(Abridged from the Weekly Epidemiological Record, 2017 92(42):625-648).

INFLUENZA LABORATORY SURVEILLANCE FROM WHO COLLABORATING CENTRE AT MELBOURNE

The WHO Collaborating Centre for Reference and Research on Influenza in Melbourne, Australia (Melbourne WHOCC) analysed influenza isolates received from 1 February to 21 September 2017. Influenza A(H3N2) virus was the predominant strain which accounted for 57% (1552/2709) of isolates, while 16% (426/2709) were A(H1N1)pdm09, 22% (604/2709) were B/Yamagata lineage and 2% (57/2709) were B/Victoria lineage (Table 2.1 in Appendix 2).

INFLUENZA ACTIVITY IN AUSTRALIA, FEBRUARY TO SEPTEMBER 2017

Influenza activity in Australia in 2017 in general was at a high level with some regional variations. There are 7 influenza surveillance systems in Australia, which can be divided into three categories.

INFLUENZA-LIKE-ILLNESS SURVEILLANCE

- **Australian Sentinel Practice Research Network (ASPREN).** This system has general practitioners (GPs) who report influenza-like illness (ILI) presentation rates in New South Wales, South Australia, Victoria, Queensland, Tasmania, Western Australia and the Northern Territory. As jurisdictions joined ASPREN at different times and the number of GPs reporting has changed over time, the representativeness of ASPREN data in 2017 may be different from that of previous years. The national case definition for ILI is presentation with fever, cough and fatigue. Overall, the rate of ILI consultations peaked during the week 34 ending 27 August. The peak ILI rate was higher than 2015 and 2016.
- **FluTracking.** FluTracking is an online health surveillance system to detect influenza epidemics. It involves participants from around Australia completing a simple online weekly survey, which collects data on the rate of ILI symptoms in communities. Overall, the rates of fever and cough among participants in 2017 peaked in week 33 (ending 20 August), higher than the peak rate observed in 2015 and 2016.

LABORATORY SURVEILLANCE

- **National Notifiable Disease Surveillance System (NNDSS).** In Australia, laboratory-confirmed cases of influenza became notifiable to state and territory health departments from 1 January 2001. From 1 January to 13 October 2017, there have been 215,280 laboratory-confirmed notifications of influenza diagnosed and reported to NNDSS. Of these, 63% were influenza A (57% A(unsubtyped), 5% A(H3N2) and 1% A(H1N1)pdm09), 36% of cases were reported as influenza B and less than 1% were influenza A & B co-detections or untyped. In addition, so far in 2017, notification rates have tended to increase with increasing age and have been highest in adults aged 85 years or older, with a secondary peak in children aged 5-9 years. While influenza A(H3N2) is detected across all age groups, it accounts for a greater proportion of influenza A where subtyping is available in adults aged 85 years or older, than in any other age group. Overall, the 2017 notification data have been higher than 2016.
- **WHOCC Laboratory Surveillance.** This is conducted by the Melbourne WHOCC. A total of 2130 influenza viruses from Australia were received for analysis at the Melbourne WHOCC from 1 February to 21 September 2017. Of them, 61% were influenza A(H3N2), 14% A(H1N1)pdm09 and 21% influenza B/Yamagata and 2% B/Victoria. Of the 1676 influenza viruses tested for neuraminidase inhibitor resistance, one influenza A(H1N1)pdm09 virus has shown reduced inhibition to the antiviral drug Zanamivir by enzyme inhibition assay.

SEVERITY SURVEILLANCE

- **Influenza hospitalisations.** The Influenza Complications Network (FluCAN) collects detailed clinical information on all hospitalised cases of influenza and pneumonia from a sample of

four sentinel hospitals across Australia. Since 3 April 2017, a total of 3812 people have been admitted with confirmed influenza, of which 559 (15%) were children aged less than 15 years and 1967 (52%) were adults 65 years of age or older. About 9% of influenza patients (n=334) have been admitted to ICU, and influenza B (13%) had higher ICU admission than influenza A (9%). The majority of hospital admissions have been due to influenza A (69%).

- **Australian Paediatric Surveillance.** This surveillance system reports on hospital admissions of children aged 15 years and under to intensive care units (ICUs) around Australia following complications due to influenza infection, and was initiated at the start of June 2009 through the Australian Paediatric Surveillance Unit (APSU). Details of admissions are reported weekly. Between 1 June and 30 September 2017, there have been 50 hospitalisations associated with severe complications of influenza reported including one death. 37 cases were associated with influenza A infection and 13 with influenza B infection.

- **Death associated with influenza and pneumonia.** Nationally reported influenza deaths are notified by jurisdictions to the NNDSS. So far in 2017, 504 influenza associated deaths have been notified to the NNDSS, with a median age of 85 years (range 0 to 107 years). The majority of deaths were due to influenza A (80%, n=402). The number of influenza associated deaths reported to the NNDSS is reliant on the follow up of cases to determine the outcome of their infection and most likely does not represent the true mortality impact associated with this disease.

(Abridged from the Australian Influenza Surveillance Report 2017, No.11, Department of Health and Ageing, Australia and a report by Dr Ian Barr, WHO Collaborating Centre for Influenza, Melbourne).

INFLUENZA ACTIVITY IN SOUTH AFRICA, FEBRUARY TO SEPTEMBER 2017

Influenza surveillance in South Africa in 2017 consisted of 4 main surveillance programmes:

- **Viral watch programme**. This program was established in 1984. It focuses on patients with ILI consultations seen mainly by general practitioners (90%) as well as a few paediatricians and primary health care clinics across the country. This program includes doctors and primary health care nurses from 8 of 9 South African provinces.
- **ILI surveillance in public health clinics**. This programme was established in 2012. It systematically enrols patients meeting a clinical case definition of ILI. Patients are enrolled at 2 government funded primary health care clinics in two provinces of South Africa. Detailed epidemiologic data are collected on all patients.
- **National syndromic surveillance for pneumonia**. The SARI (pneumonia) surveillance programme was established in 2009 and it monitors SARI cases in hospitalised patients. Detailed epidemiologic data are collected on all patients. This programme currently includes 6 hospitals as 5 sentinel sites covering 5 provinces.
- **Private hospital consultation surveillance**. This programme was established in 2002. It is based on hospital discharge data (ICD-codes J10-J18) for those private hospitals. No specimens for pathogens testing were collected for surveillance purpose.

In 2017, a total of 5618 suspected influenza specimens were processed up to week 34. Of which, 874 influenza viruses were detected. This gave an overall detection rate of 15%. Among all detected influenza viruses, influenza A(H3N2) was the predominant strain accounting for 80% (704/874) influenza viruses with influenza B detected in 11% (101/874) and influenza A(H1N1)pdm09 in 7% (59/874). Ten influenza A positive specimens were not subtyped. Of the influenza B cases, 94% (95/101) were influenza B/Yamagata lineage viruses.

A total of 71 seasonal influenza A(H3N2) viruses were sequenced and they were clustered genetically in group 3C.2a subgroup including 60 in the 3C.2a1 subgroup.

A total of 6 influenza A(H1N1)pdm09 viruses were sequenced and most of them were clustered genetically in subgroup 6B.1.

A total of 16 influenza B/Yamagata lineage viruses were sequenced and most of them were clustered genetically in clade Y3.

(Abridged from a report by Dr Florette Treurnicht, National Institute for Communicable Diseases, South Africa).

INFLUENZA ACTIVITY IN NEW ZEALAND IN 2017

The national influenza surveillance system in New Zealand is an essential public health tool for assessing and implementing strategies to control influenza. The surveillance system includes community-based surveillance (National sentinel general practice surveillance, Healthline - telephone health advice service) and hospital-based surveillance (SARI surveillance, Ministry of Health data on publicly funded hospital discharges, laboratory-based surveillance for outpatients and hospital in-patients).

COMMUNITY-BASED SURVEILLANCE

NATIONAL SENTINEL GENERAL PRACTICE SURVEILLANCE

New Zealand's longitudinal sentinel GP-based surveillance system was established in 1989 as part of the World Health Organization's (WHO) Global Influenza Surveillance and Response System. It is operated nationally by the ESR and locally by influenza surveillance co-ordinators in the public health services (PHS). Previously (1989–2015), every week during the influenza season from May to September (weeks 18–39), GPs were required to record the number of consultations for influenza-like illness (ILI) each week and the age group of the patient (<1, 1–4, 5–19, 20–34, 35–49, 50–64, 65+), for each case patient who meets the case definition for ILI, on a standardised form.

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"[3].

While the sentinel GP-based surveillance system has been operating successfully for a number of years, the manual method of data collection is outdated and time-consuming. The process adds extra time to the sentinel practices during the busy winter season and only provides the surveillance system with very limited consultation data.

In 2016, a modernised electronic data collection was introduced, enhanced influenza-like illness surveillance (e-ILI). It uses an interactive advance form designed by HealthLink to record a consultation-seeking patient with ILI. Symptoms and onset dates including demography (age, sex, and ethnicity), clinical information, medication, vaccination status, and specimen collection were collected electronically and data was sent directly to ESR.

The ILI case definition was also modified to "an acute respiratory illness with a history of fever or measured fever of ≥38°C, AND cough, AND onset within the past 10 days".

The syndromic eILI surveillance is all-year-round. The virological specimen collection and testing for those ILI patients is only during the influenza season, May-September inclusive.

Each participating practice from the Auckland and Wellington regions collected respiratory samples (ie, a nasopharyngeal or throat swab) from all ILI patients seen. For the remaining areas, three

respiratory samples, one each from the first ILI patient examined on Monday, Tuesday and Wednesday were collected weekly.

All practices forwarded these samples to the WHO National Influenza Centre at ESR apart for those in the Canterbury, South Canterbury and West Coast DHBs who forwarded their samples to Canterbury Health Laboratories for virus characterisation. Laboratory identification included molecular detection using the polymerase chain reaction (PCR), isolation of the virus or direct detection of viral antigens. Influenza viruses were typed as A or B. Influenza A viruses were further sub-typed as A(H3N2) or A(H1N1)pdm09. Influenza B viruses were further lineage-typed as B/Yamagata or B/Victoria lineage. Eight non-influenza respiratory viruses were also tested: respiratory syncytial virus, parainfluenza virus types 1, 2 and 3, rhinovirus, adenovirus, human metapneumovirus and enterovirus.

Canterbury Health Laboratory reported to ESR weekly on the total number of swabs received from each DHB and the influenza viruses identified, and updated details on influenza types and sub-types from previous weeks. ESR reports national information on epidemiological and virological surveillance of influenza weekly and yearly to relevant national and international organisations, including the WHO, with reports 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 in 2016.

The values for the different intensity levels for 2017 are listed in the table below. This is based on New Zealand's consultation rates from 2000–2015 (excluding the pandemic year, 2009) and WHO's interim guidance severity assessment.

Table 2. National ILI and influenza activity thresholds

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

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

In 2017, 75 sentinel practices were recruited from all 20 DHBs under ESR's sentinel GP-based surveillance with a total patient roll of 411,138. From week 1 (ending 8 January 2017) through week 34 (ending 27 August 2017), a total of 2365 consultations for ILI were reported from the 20 DHBs. The cumulative incidence of ILI consultation during this period was 262.0 per 100,000 population. The average weekly ILI consultation rate between weeks 18 and 34 was 33.2 per 100,000 population.

National ILI and ILI-associated influenza consultation rates in 2017 were at a low level (Figure 1–4). From week 18 (ending 7 May) through week 24 (ending 18 June), consultation activity remained below the seasonal threshold. The ILI and ILI-associated influenza consultation rate peaked during week 27 (ending 9 July) with the ILI consultation rate of 51.8 per 100,000 and then declined but remained above the seasonal threshold level.

Figure 1. Weekly consultation rates for influenza-like illness in New Zealand in 2017 compared to 2013–2016

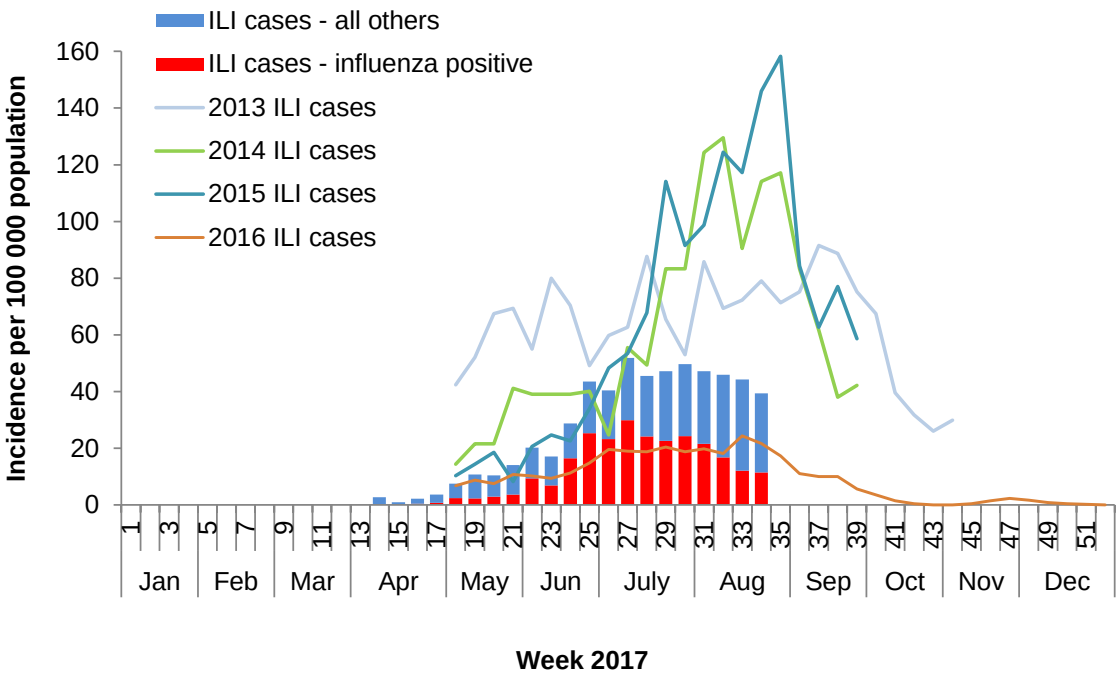


Figure 2. Weekly ILI consultation rates in 2017 compared to 2013–2017

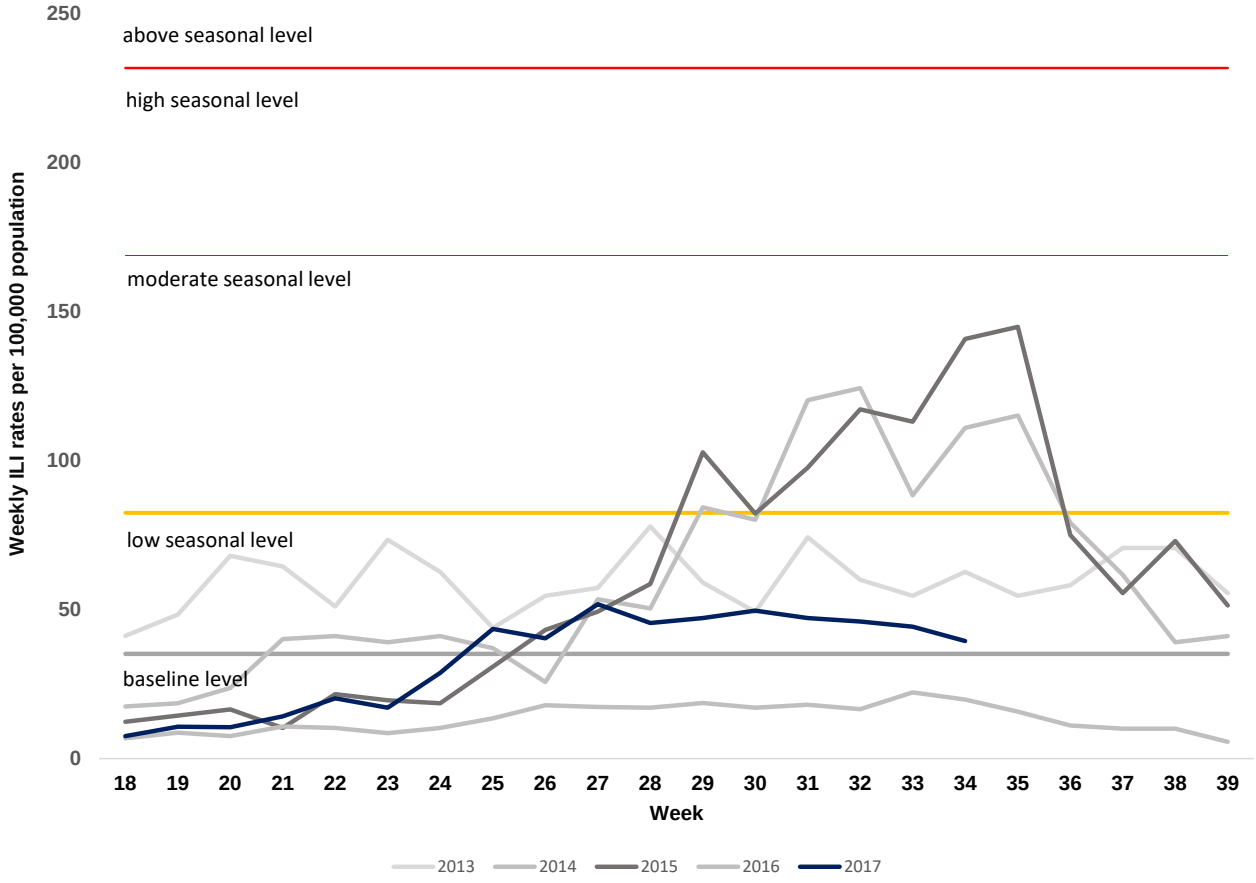
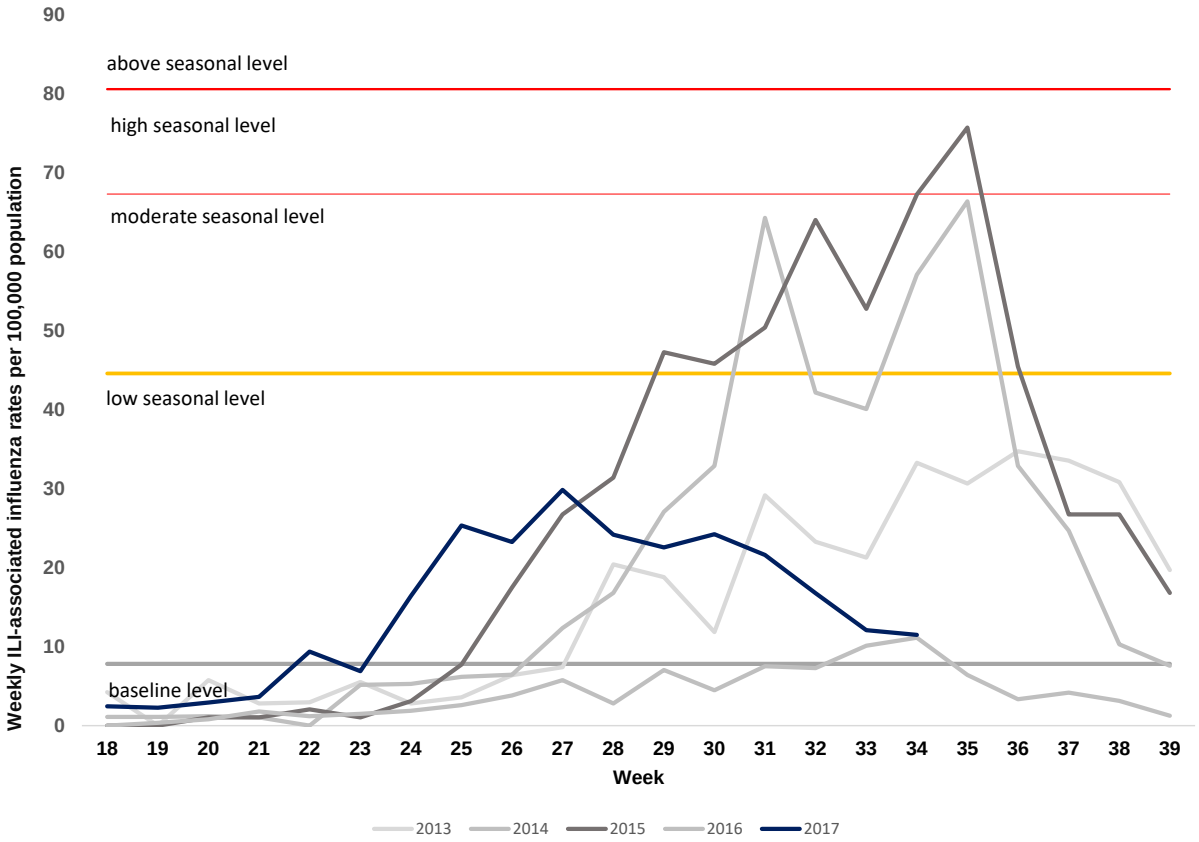
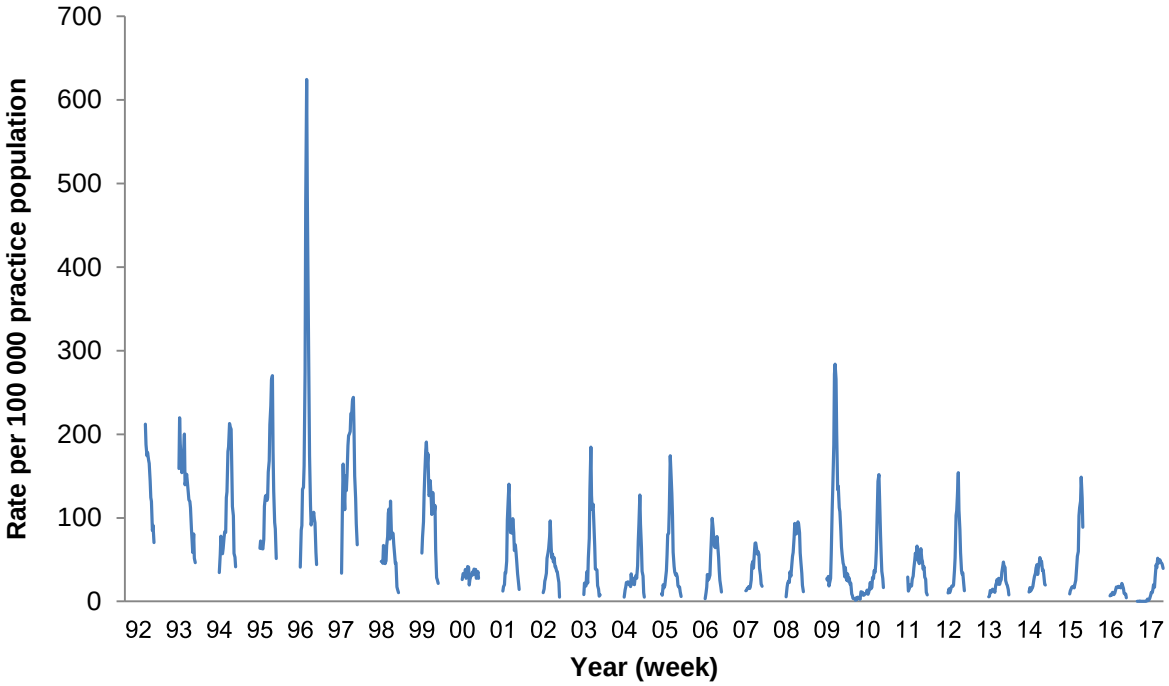


Figure 3. Weekly ILI-associated influenza rates in 2017 compared to 2013–2016



Weekly national ILI consultation rates for the study period were compared with the weekly consultation rates for ILI in 1992–2017 (Figure 4). The peak ILI rate in 2017 was the fourth lowest during 2000–2017.

Figure 4. Weekly Consultation Rates for Influenza-like Illness in New Zealand, 1992–2017



As in previous years, 2017 consultation rates for ILI varied greatly among DHBs (From week 18 (ending 7 May 2017) through week 34 (ending 27 August), Waitemata DHB had the highest average consultation rate (221.9 per 100,000), followed by Whanganui (127.6 per 100,000), and Auckland (87.7 per 100,000) (Table 3).

Table 3. Weekly consultation rate for influenza-like illness by District Health Board, 2017

DHB	Rate per 100 000																	Average rate
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
Auckland	26.4	24.7	26.4	31.7	52.8	44.0	79.2	125.0	102.1	146.2	137.4	109.2	144.4	121.5	102.1	105.7	112.7	87.7
Bay of Plenty	0.0	0.0	0.0	0.0	13.5	6.7	6.7	40.4	47.1	74.1	26.9	26.9	33.7	40.4	47.1	47.1	74.1	28.5
Canterbury	2.8	7.1	14.2	4.3	4.3	1.4	15.6	22.8	12.8	17.1	12.8	28.4	25.6	21.3	31.3	25.6	28.4	16.2
Capital and Coast	7.8	7.8	11.7	15.6	42.8	35.0	50.6	23.4	31.2	97.3	70.1	85.7	50.6	27.3	62.3	89.6	27.3	43.3
Counties Manukau	3.0	6.0	0.0	6.0	3.0	0.0	9.0	3.0	18.0	9.0	18.0	3.0	6.0	9.0	0.0	3.0	0.0	5.6
Hawke's Bay	0.0	0.0	5.2	15.7	5.2	5.2	15.7	0.0	20.9	20.9	41.7	10.4	15.7	41.7	36.5	15.7	5.2	15.0
Hutt Valley	15.2	0.0	0.0	0.0	0.0	3.8	3.8	3.8	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	1.8
Lakes*	0.0	0.0	0.0	22.3	0.0	0.0	0.0	0.0	0.0	0.0	66.8	0.0	0.0	0.0	0.0	0.0	0.0	5.2
MidCentral*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5	35.5	35.5	0.0	0.0	35.5	35.5	35.5	0.0	35.5	14.6
Nelson Marlborough	0.0	29.2	19.5	0.0	9.7	0.0	39.0	29.2	19.5	19.5	39.0	87.7	29.2	39.0	68.2	29.2	19.5	28.1
Northland	15.7	7.9	31.5	15.7	0.0	0.0	7.9	62.9	31.5	31.5	15.7	15.7	0.0	0.0	7.9	0.0	0.0	14.3
South Canterbury	9.3	27.8	9.3	18.6	0.0	0.0	18.6	9.3	9.3	9.3	0.0	46.4	92.8	74.2	74.2	148.5	213.4	44.8
Southern	2.2	4.4	0.0	10.9	8.7	10.9	2.2	4.4	8.7	8.7	15.3	24.0	8.7	21.8	24.0	8.7	13.1	10.4
Tairawhiti	0.0	0.0	14.4	28.9	57.7	28.9	28.9	101.0	43.3	28.9	28.9	57.7	28.9	28.9	28.9	28.9	14.4	32.3
Taranaki	4.4	0.0	0.0	4.4	0.0	0.0	4.4	13.1	4.4	8.7	4.4	4.4	0.0	0.0	8.7	4.4	0.0	3.6
Waikato*	0.0	32.5	19.5	19.5	26.0	39.0	26.0	52.1	26.0	84.6	58.6	39.0	32.5	19.5	45.5	26.0	6.5	32.5
Wairarapa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0	80.0	40.0	40.0	0.0	0.0	0.0	0.0	0.0	21.2
Waitemata*	7.9	47.5	15.8	63.3	174.0	126.6	189.8	348.0	324.3	292.7	237.3	348.0	395.5	411.3	292.7	308.5	189.8	221.9
West Coast	6.3	6.3	0.0	0.0	0.0	12.7	0.0	6.3	19.0	12.7	0.0	0.0	0.0	6.3	12.7	0.0	0.0	4.8
Whanganui*	0.0	0.0	60.2	241.0	0.0	60.2	120.5	0.0	301.2	301.2	301.2	0.0	361.4	241.0	60.2	60.2	60.2	127.6
New Zealand	**7.5**	**10.7**	**10.5**	**14.1**	**20.2**	**17.0**	**28.7**	**43.5**	**40.4**	**51.8**	**45.5**	**47.2**	**49.6**	**47.2**	**46.0**	**44.3**	**39.4**	**33.2**

From 4 January to 27 August 2017, a total of 2365 ILI cases were identified. This gives a cumulative ILI incidence of 575.2 per 100,000 patient population (Table 4). Among the 1886 tested ILI cases, 859 (45.5%) were positive for influenza viruses. This gives an ILI related influenza incidence of 262.0 per 100,000 patient population.

Table 4. Demographic characteristics of ILI and influenza cases, 4 January–27 August 2017

Characteristics	ILI & influenza cases among sentinel practices				
	ILI cases	Influenza cases	Prop Influenza positive[1] (%)	ILI incidence (per 100 000)	Influenza incidence[2] (per 100 000)
Overall	**2365**	**859**	**45.5 (100.0)**	**575.2**	**262.0**
Age group (years)					
<1	27	3	13.6 (0.3)	408.5	55.7
1–4	166	34	26.4 (4.0)	677.3	178.5
5–19	616	281	57.8 (32.7)	728.1	421.0
20–34	388	128	39.9 (14.9)	451.6	180.1
35–49	551	205	47.1 (23.9)	672.2	316.8
50–64	405	136	41.5 (15.8)	552.3	229.0
65–79	179	56	41.2 (6.5)	438.3	180.5
>80	33	16	55.2 (1.9)	247.1	136.3
Unknown	0	0	0.0		
Ethnicity					
Māori	234	80	43.2 (9.3)	411.2	177.8
Pacific peoples	107	39	47.0 (4.5)	357.9	168.2
Asian	233	115	54.8 (13.4)	777.7	425.9
European and Other	1789	625	44.4 (72.8)	609.2	270.6
Unknown	2	0	0.0	0.0	
Sex					
Female	1339	472	44.6 (54.9)	627.4	279.6
Male	1022	387	46.8 (45.1)	516.9	241.9
Unknown	4	0	0.0		

[1]Proportion of cases tested which were positive for influenza viruses

[2]Adjusted to positivity of tested cases

Between 2 January to 27 August 2017, a total of 1871 ILI specimens were tested for influenza viruses and 858 (45.9%) were positive, with more influenza A (503) than influenza B (355) viruses. Additionally, a total of 1810 ILI specimens were tested for non-influenza viruses and 365 (20.2%) were positive with non-influenza viruses (Table 5 and Figure 5).

Table 5. Influenza and non-influenza respiratory viruses among ILI cases, 1 May to 27 August 2017

Influenza viruses	ILI
	Cases (%)
No. of specimens tested	1871
No. of positive specimens (%)[1]	858 (45.9)
Influenza A	503
A (not subtyped)	14
A(H1N1)pdm09	58
A(H1N1)pdm09 by PCR	41
A/Michigan/45/2015 (H1N1)pdm09 - like	13
A/California/7/2009 (H1N1)pdm09 - like	4
A(H3N2)	431
A(H3N2) by PCR	383
A/Hong Kong/4801/2014 (H3N2) - like	48
Influenza B	355
B (lineage not determined)	39
B/Yamagata lineage	301
B/Yamagata lineage by PCR	147
B/Phuket/3073/2013 - like	154
B/Victoria lineage	15
B/Victoria lineage by PCR	7
B/Brisbane/60/2008 - like	8
Influenza and non-influenza co-detection (% +ve)	46 (5.4)

Non-influenza respiratory viruses	ILI
	Cases (%)
No. of specimens tested	1810
No. of positive specimens (%)[1]	365 (20.2)
Respiratory syncytial virus (RSV)	102
Parainfluenza 1 (PIV1)	3
Parainfluenza 2 (PIV2)	23
Parainfluenza 3 (PIV3)	47
Rhinovirus (RV)	122
Adenovirus (AdV)	42
Human metapneumovirus (hMPV)	24
Enterovirus	24
Single virus detection (% of positives)	346 (94.8)
Multiple virus detection (% of positives)	19 (5.2)

[1]Number of specimens positive for at least one of the listed viruses; note a specimen may be positive for more than one virus.

Figure 5. Temporal distribution of the number and proportion of influenza viruses from ILI specimens, 1 May to 27 August 2017, by type and week

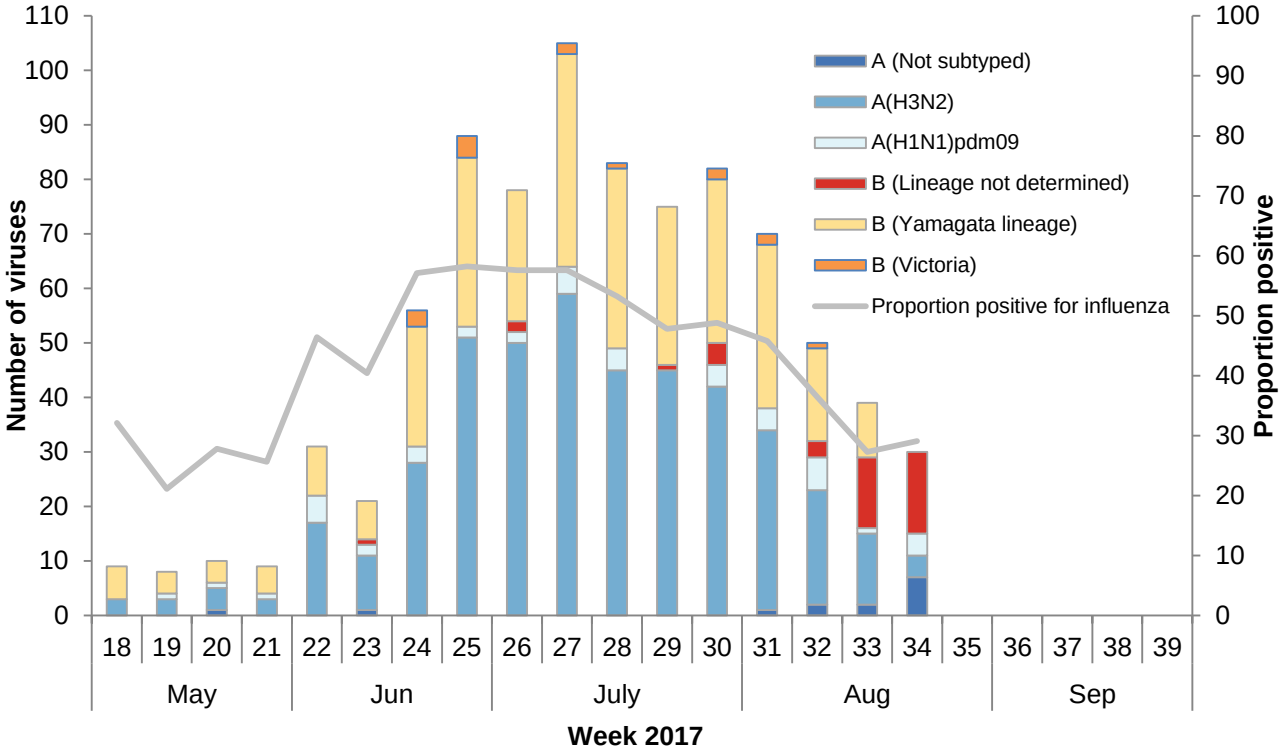
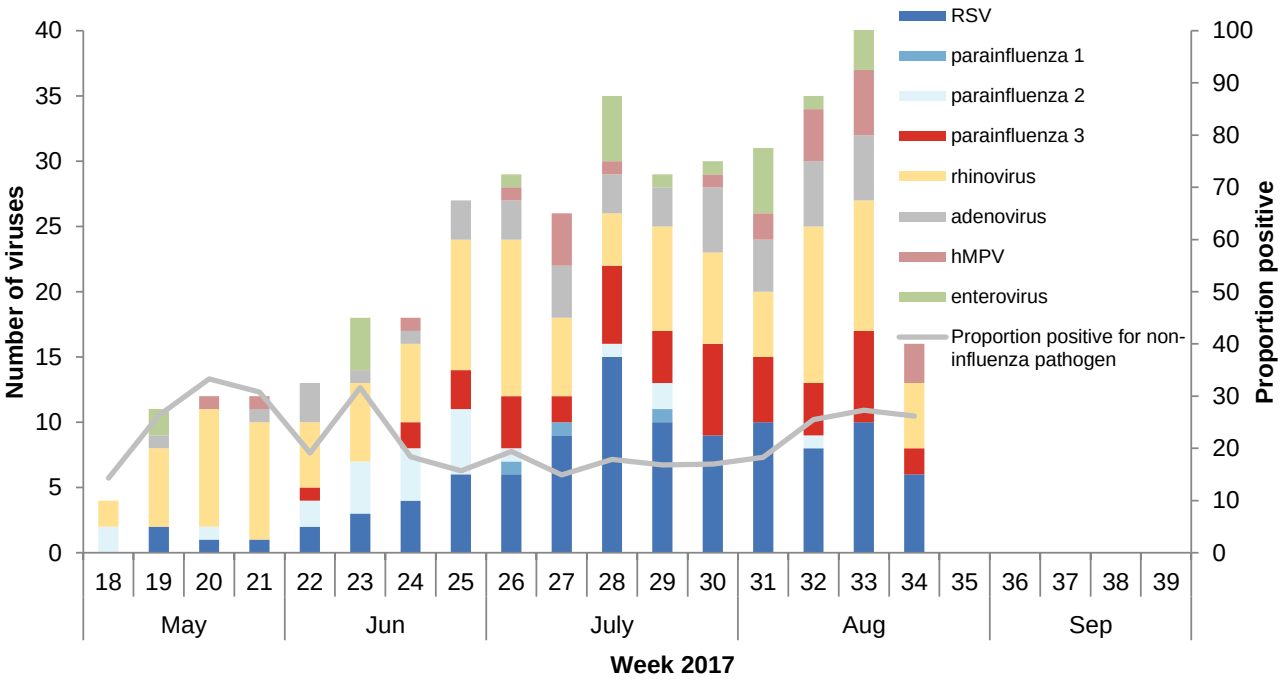


Figure 6. Temporal distribution of the number and proportion of non-influenza viruses from ILI specimens, 1 May to 27 August 2017, by type and week



HEALTHLINE

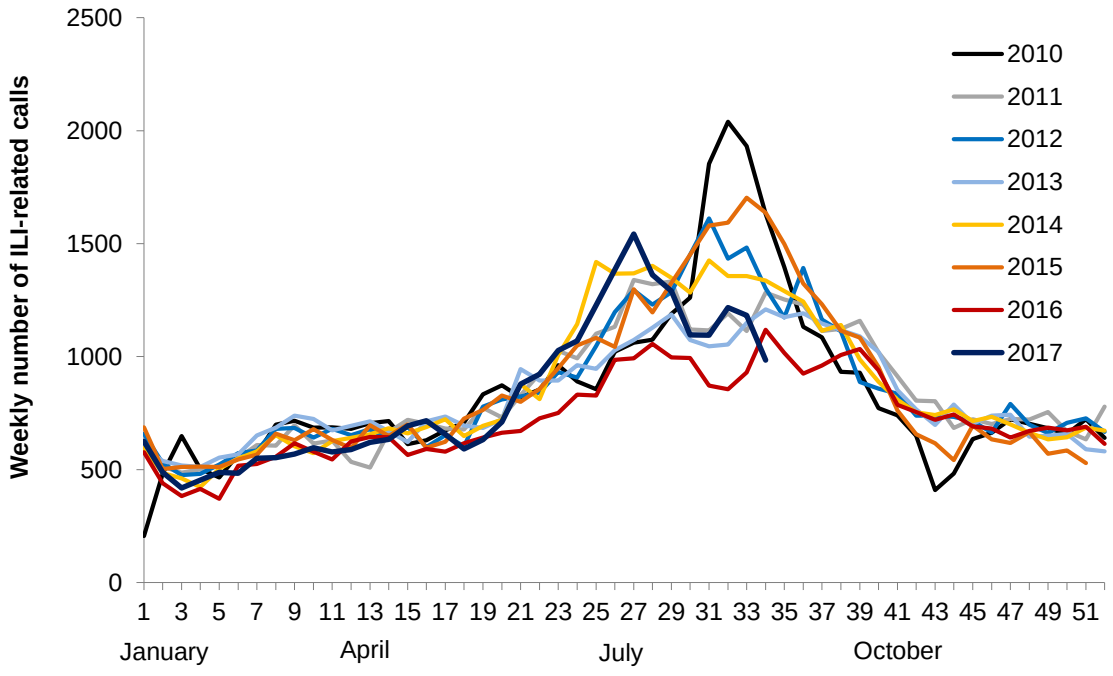
Healthline is the free national 0800 24 hour telephone health advice service funded by the Ministry of Health. Calls made to Healthline are triaged using electronic clinical decision support software. Data collected are daily counts of all symptomatic calls made to Healthline and those triaged for Influenza-Like-Illness (ILI). Note that about 70% of all calls to Healthline are symptomatic (other calls not part of this analysis include queries for information etc).

Analysis is frequency based with alarms raised by identifying statistical deviations (aberations) from previous calls. Data are reported for all ages and in five age bands (0–4, 5–14, 15–44, 45–64, 65+ years). The analysis of the call frequency is based on the cumulative summation (CUSUM) algorithm implemented in Early Aberration Reporting System (EARS) application developed by the Centres for Disease Control and Prevention (CDC), Atlanta, United States. EARS has three sensitivity thresholds (high, medium and low). If the daily call count exceeds a threshold a flag is signalled.

Cases of ILI are defined as those that are recorded in the Healthline database as having one of the following 18 guidelines: adult fever; 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; upper respiratory tract infections/colds – pregnant.

Figure 7 shows the weekly number of calls to Healthline for ILI during 2010–2017. Healthline calls in 2017 were in the middle range, similar to the level in 2012.

Figure 7. Weekly number of ILI-related calls to Healthline, 2010–2017



Data source: Healthline NZ

HOSPITAL-BASED SURVEILLANCE

HOSPITAL-BASED SEVERE ACUTE RESPIRATORY ILLNESS (SARI) SURVEILLANCE

In this active surveillance system, in-patients with suspected respiratory infections admitted overnight to any of the four hospitals (Auckland City Hospital and the associated Starship Children's Hospital, Middlemore Hospital and the associated Kidz First Children's Hospital) in the two DHBs, were screened by research nurses each day. Overnight admission was defined as: "*A patient who is admitted under a medical team, and to a hospital ward or assessment unit*". Case ascertainment followed a surveillance algorithm. The presence of the components of the case definition was determined through a combination of reviewing the clinician's admission diagnoses and by interviewing patients about their presenting symptoms. Records of all patients admitted overnight to medical wards were reviewed daily to identify anyone with a suspected respiratory infection. These patients were categorised into one of ten admission diagnostic syndrome groups. Research nurses then interviewed the patients and documented the components of the case definition that were present and differentiated patients into SARI and non-SARI cases.

The case definition being used is the World Health Organisation (WHO) SARI case definition: "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 inpatient hospitalisation". If a patient with suspected respiratory infection met the SARI case definition, a respiratory sample was collected to test for influenza and other respiratory pathogens. In addition, patient information was captured via a case report form which included patient demographics, presenting symptoms and illness, pre-hospital healthcare, medication usage, influenza vaccination history, co-morbidities, disease course and outcome, including major treatments, ICU admission and mortality, epidemiologic risk factors and laboratory results.

The total numbers of all new hospital inpatient acute admissions and newly assessed and tested patients, including ICU admissions and deaths were collected. This allowed calculation of population-based incidence for SARI and associated influenza cases overall and stratified by age, sex, ethnicity and socio-economic status among the ADHB and CMDHB resident population (from 2013 census data). Incidence rates were calculated along with 95% confidence intervals (95%CI). In addition, this allowed the calculation of the proportion of SARI and associated influenza cases, including ICU admissions and deaths, by overall and stratified patients, among all acute admissions regardless of residence status. An acute admission is defined as an unplanned admission on the day of presentation at the admitting health care facility. Admission may have been from the emergency or outpatient departments of the health care facility, a transfer from another facility or a referral from primary care.

A case may have 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.

From 1 May to 27 August 2017, there were 48 243 acute admissions to ADHB and CMDHB hospitals. A total of 2544 patients with suspected respiratory infections were assessed in these

hospitals. Of these, 1364 (53.6%) patients met the SARI case definition. Among these, 1055 were residents of ADHB and CMDHB, giving the SARI incidence rate of 116.5 per 100 000 population.

Of the 1055 SARI cases identified from 1 May to 27 August 2017, 960 were residents of ADHB and CMDHB, giving the SARI incidence rate of 38.5 per 100 000 population (Figure 8, Figure 9 and Table 6). Among the 960 tested SARI cases who were ADHB and CMDHB residents, 317 (33.0%) had positive influenza virus results. This gives a SARI related influenza incidence of 38.5 per 100 000 population (Figure 10 and Table 6).

Figure 8. Weekly resident SARI and SARI-associated influenza incidence, 2017

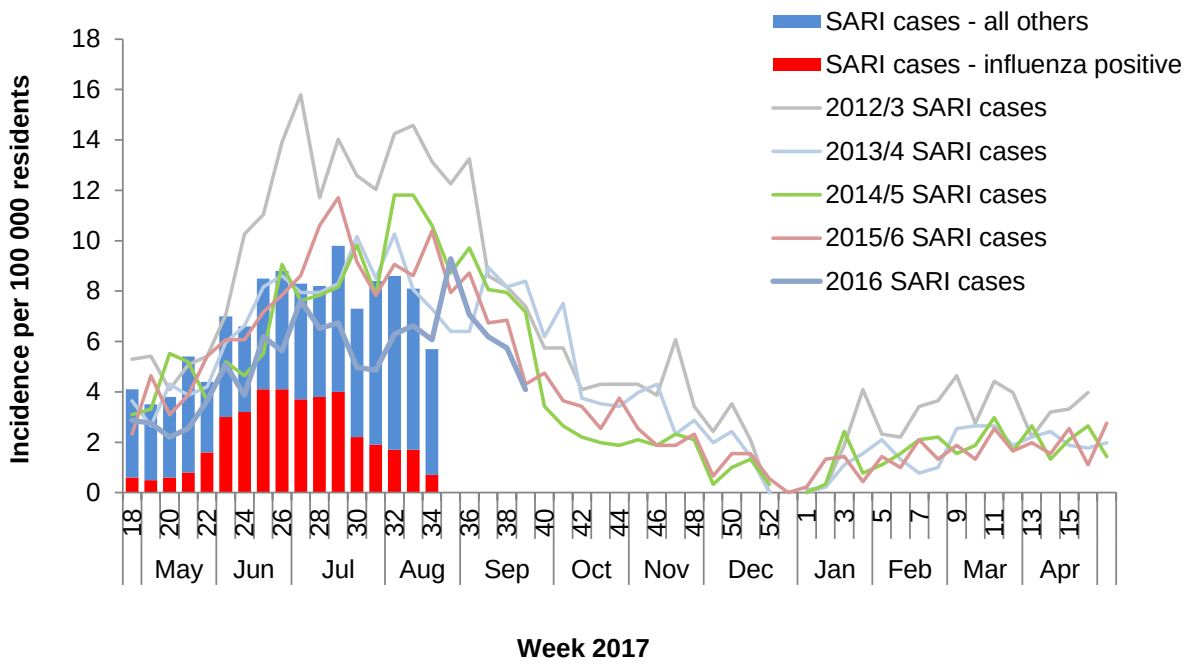


Figure 9. Weekly hospitalisation rates for SARI in 2017 compared to 2012–2016

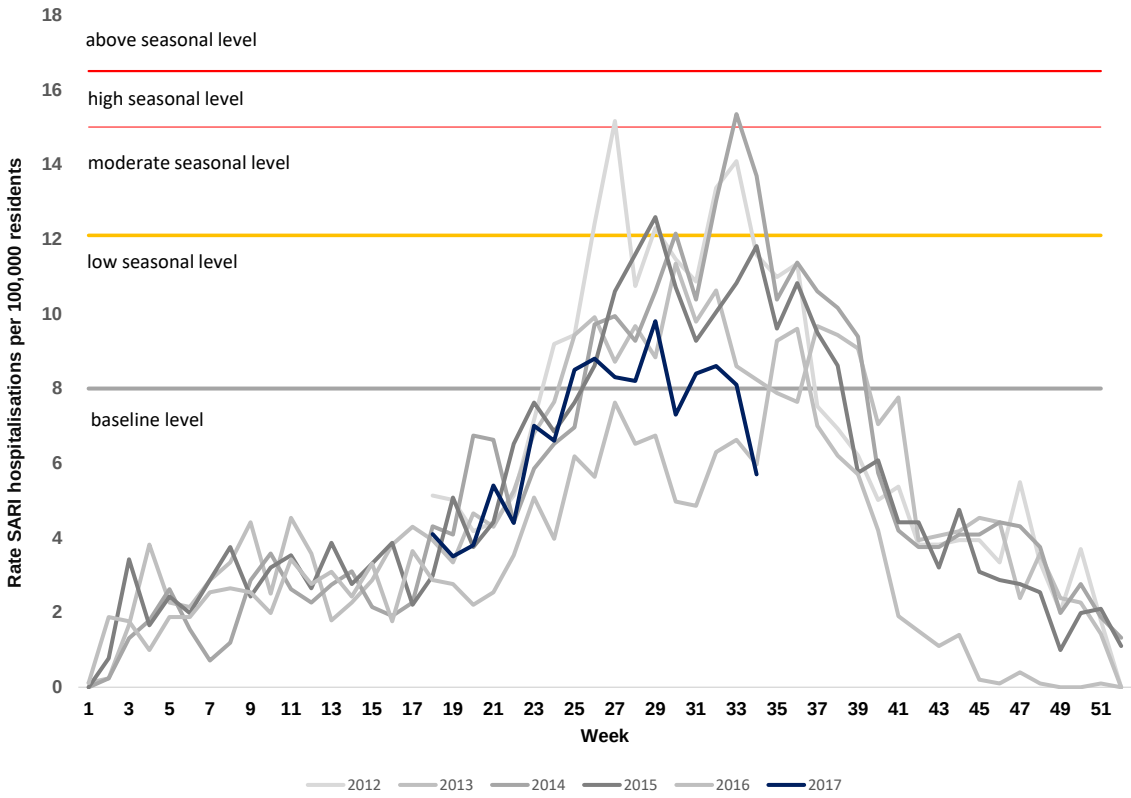
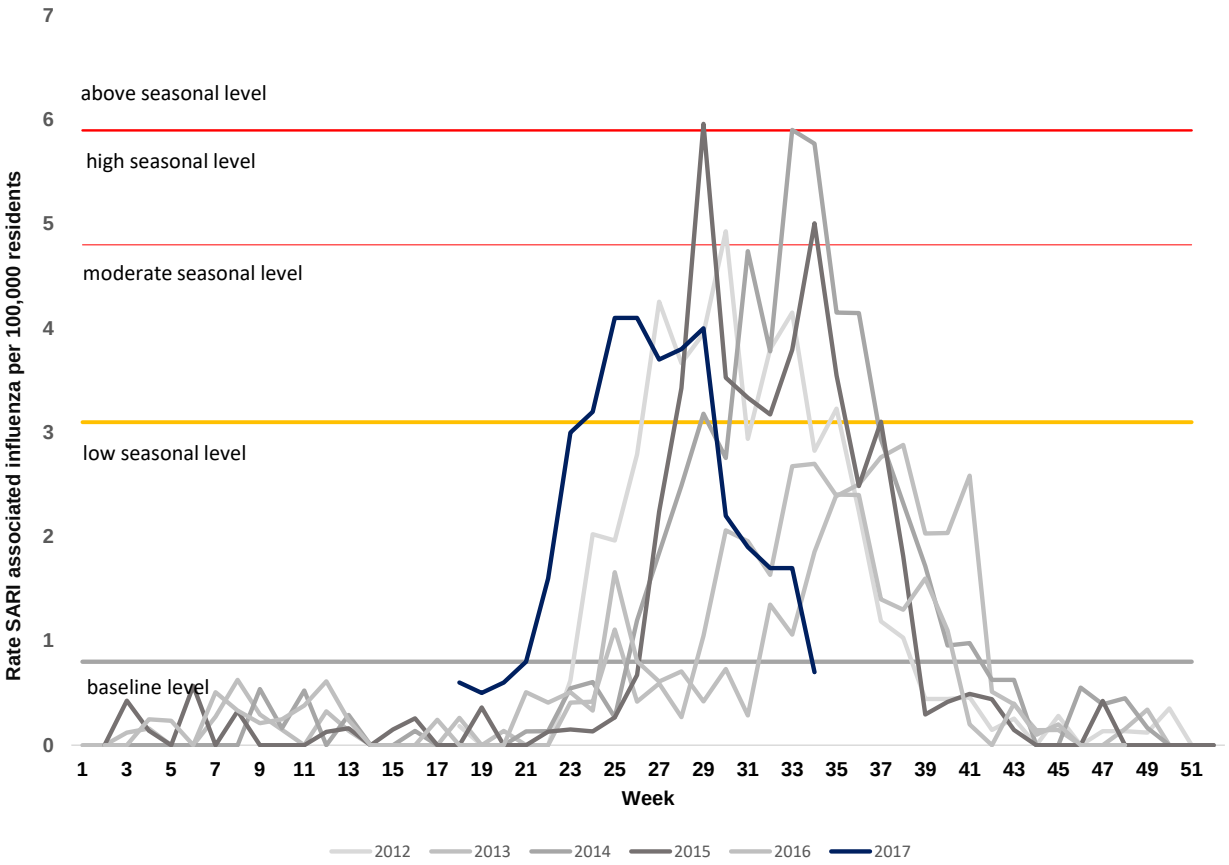


Figure 10. Weekly hospitalisation rates for SARI-associated influenza in 2017 compared to 2012–2016



Between 1 May and 27 August 2017, the 1364 SARI cases give a SARI proportion of 28.3 per 1000 acute hospitalisations (Table 6). Of these SARI cases, 34.4% were children aged less than 5 years and 31.0% were adults 65 years and older. Ninety-two SARI cases have been admitted to ICU and 21 SARI-related deaths were reported during this period.

Table 6. Demographic characteristics of SARI cases and related influenza cases, since 1 May 2017

Characteristics	Admissions	Assessed	SARI & influenza cases among all hospital patients			SARI & influenza cases among ADHB & CMDHB residents			
			SARI Cases (%)	Cases per 1000 hospitalisations	Influenza positive[1] (%)	SARI cases	SARI incidence (per 100 000)	Influenza Cases	Influenza incidence (per 100 000)
Overall	**48243**	**2544**	**1364 (53.6)**	**28.3**	**338 (33.0)**	**1055**	**116.5**	**317**	**38.5**
Age group (years)									
<1	1856		230	123.9	18 (9.1)	214	1584.5	17	144.8
1–4	3384		157	46.4	29 (22.3)	144	272.3	27	61.8
5–19	5723		76	13.3	18 (28.1)	62	32.2	12	7.3
20–34	9008		69	7.7	28 (42.4)	66	31.7	27	13.6
35–49	7015		81	11.5	31 (40.8)	76	39.8	30	16.8
50–64	8212		163	19.8	75 (49.0)	159	105.6	73	51.7
65–79	7826		202	25.8	73 (38.0)	191	261.3	67	96.7
>80	5219		146	28.0	66 (46.8)	142	606.1	64	283.1
Unknown	0		240			1		0	
Ethnicity									
Māori	6545		223	34.1	43 (21.7)	200	201.1	40	45.4
Pacific peoples	10340		395	38.2	111 (30.9)	383	277.6	104	83.2
Asian	8007		98	12.2	33 (38.4)	94	44.7	32	16.8
European and Other	23027		409	17.8	151 (39.9)	378	94.1	141	37.8
Unknown	324		239	737.7		0		0	
Hospitals									
ADHB	28190	961	664 (69.1)	23.6	170 (39.7)	418	95.8	152	38.5
CMDHB	20053	1583	700 (44.2)	34.9	168 (28.2)	637	135.7	165	38.5
Sex									
Female	25518		579	22.7	176 (33.5)	538	115.7	166	39.0
Male	22722		543	23.9	161 (32.7)	515	116.9	150	37.6
Unknown	3		242			2		1	

[1]Proportion of cases tested which were positive for influenza viruses

[2]Percentage for SARI assessed only

From 2 May to 4 September 2016, 780 SARI specimens have been tested and 104 (13.3%) were positive for influenza viruses with more influenza A (97) than influenza B (7) viruses (Table 7): A(H3N2) (23), influenza A (not sub-typed) (49), influenza B/Yamagata lineage (2) including B/Phuket/3073/2013-like (1), B/Victoria lineage (1) including B/Brisbane/60/2008-like (1), influenza B not lineage determined (4). There were 8 co-detections of influenza and non-influenza viruses among SARI specimens.

From 2 May to 4 September 2016, 314 SARI specimens were tested for non-influenza respiratory viruses (Table 7). Of these, 197 (62.7%) were positive with the following viruses: respiratory syncytial virus (111), rhinovirus (54), parainfluenza virus type 1 (14), parainfluenza virus type 2 (1), parainfluenza virus type 3 (2), adenovirus (25), human metapneumovirus (16) and enterovirus (4). 172 SARI specimens (87.3%) had single virus detection and 25 (12.7%) had multiple virus detection.

Table 7. Influenza and non-influenza respiratory viruses among SARI cases, 1 May–27 August 2017

Influenza viruses	SARI	SARI and non-SARI	
	Cases (%)	ICU (%)	Deaths (%)
No. of specimens tested	1154	203	24
No. of positive specimens (%)[1]	375 (32.5)	23 (11.3)	12 (50.0)
Influenza A	278	14	7
A (not subtyped)	106	5	1
A(H1N1)pdm09	32	3	0
A(H1N1)pdm09 by PCR	28	2	0
A/Michigan/45/2015 (H1N1)pdm09 - like	4	1	0
A/California/7/2009 (H1N1)pdm09 - like	0	0	0
A(H3N2)	140	6	6
A(H3N2) by PCR	138	6	6
A/Hong Kong/4801/2014 (H3N2) - like	2	0	0
Influenza B	97	9	5
B (lineage not determined)	58	7	4
B/Yamagata lineage	39	2	1
B/Yamagata lineage by PCR	22	2	1
B/Phuket/3073/2013 - like	17	0	0
B/Victoria lineage	0	0	0
B/Victoria lineage by PCR	0	0	0
B/Brisbane/60/2008 - like	0	0	0
Influenza and non-influenza co-detection (% +ve)	21 (5.6)	3 (13.0)	1 (8.3)

Non-influenza respiratory viruses	SARI	SARI and non-SARI	
	Cases (%)	ICU (%)	Deaths (%)
No. of specimens tested	941	155	23
No. of positive specimens (%)[1]	306 (32.5)	98 (63.2)	1 (4.3)
Respiratory syncytial virus (RSV)	163	50	1
Parainfluenza 1 (PIV1)	1	0	0
Parainfluenza 2 (PIV2)	13	4	0
Parainfluenza 3 (PIV3)	25	7	0
Rhinovirus (RV)	102	44	0
Adenovirus (AdV)	30	9	0
Human metapneumovirus (hMPV)	18	3	0
Enterovirus	15	8	0
Single virus detection (% of positives)	253 (82.7)	74 (75.5)	0 (-)
Multiple virus detection (% of positives)	53 (17.3)	24 (24.5)	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 the influenza viruses and non-influenza respiratory viruses is shown in Figure 11 and Figure 12. Influenza A(H3N2) was the predominant strain during 1 May–27 August 2017.

Figure 11. Temporal distribution of the number and proportion of influenza viruses from SARI specimens, 1 May–27 August 2017, by type and week

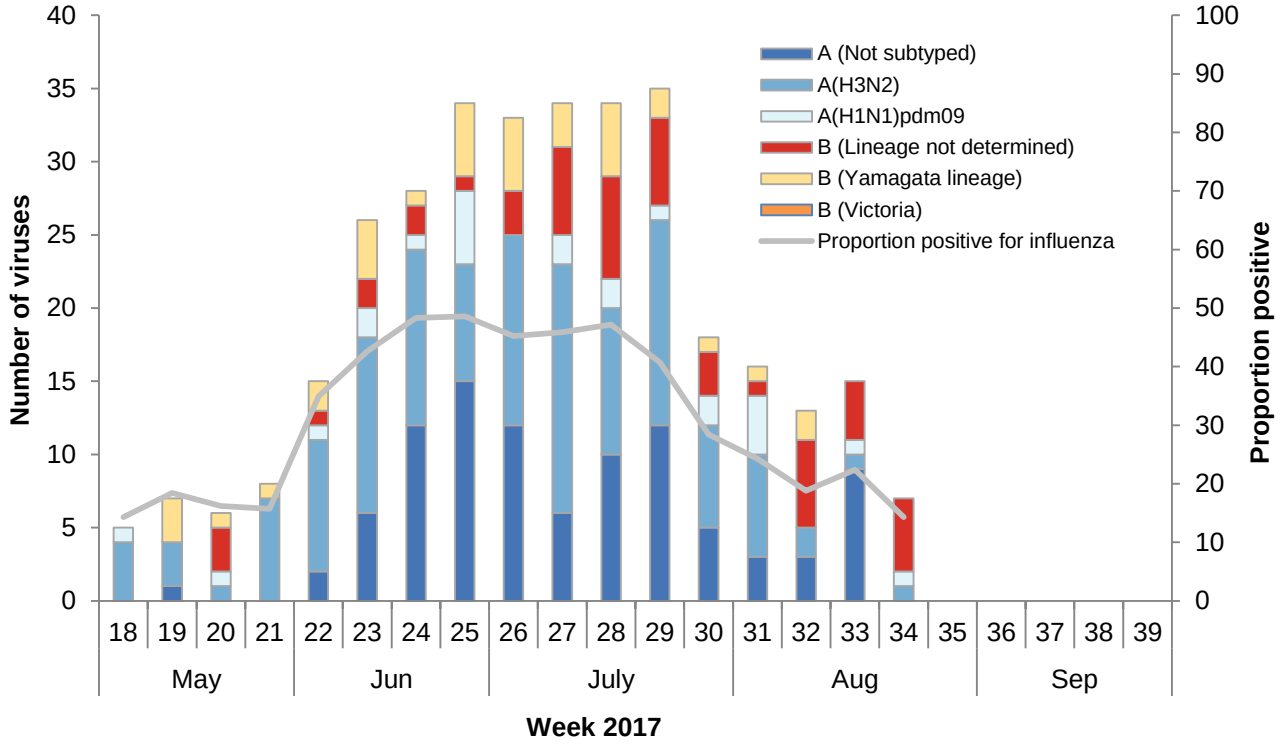
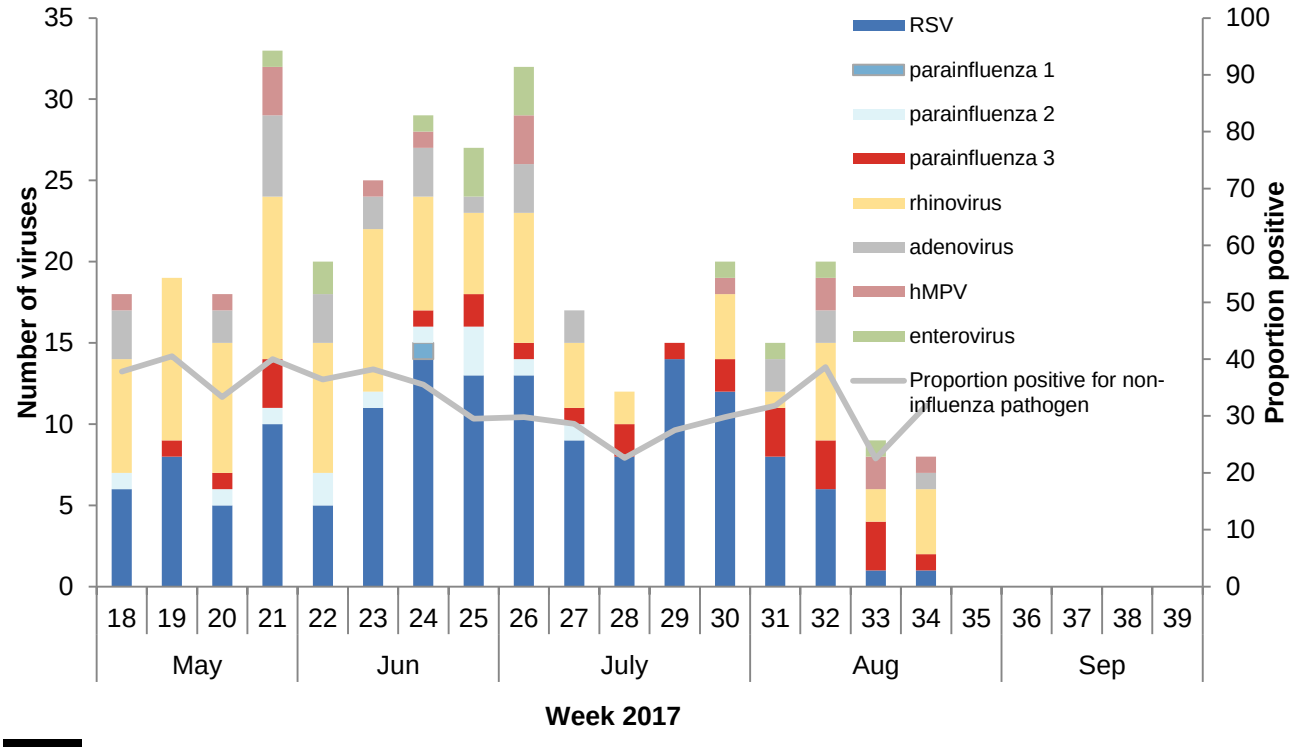


Figure 12. Temporal distribution of the number and proportion of non-influenza viruses from SARI specimens, 1 May–27 August 2017, by type and week

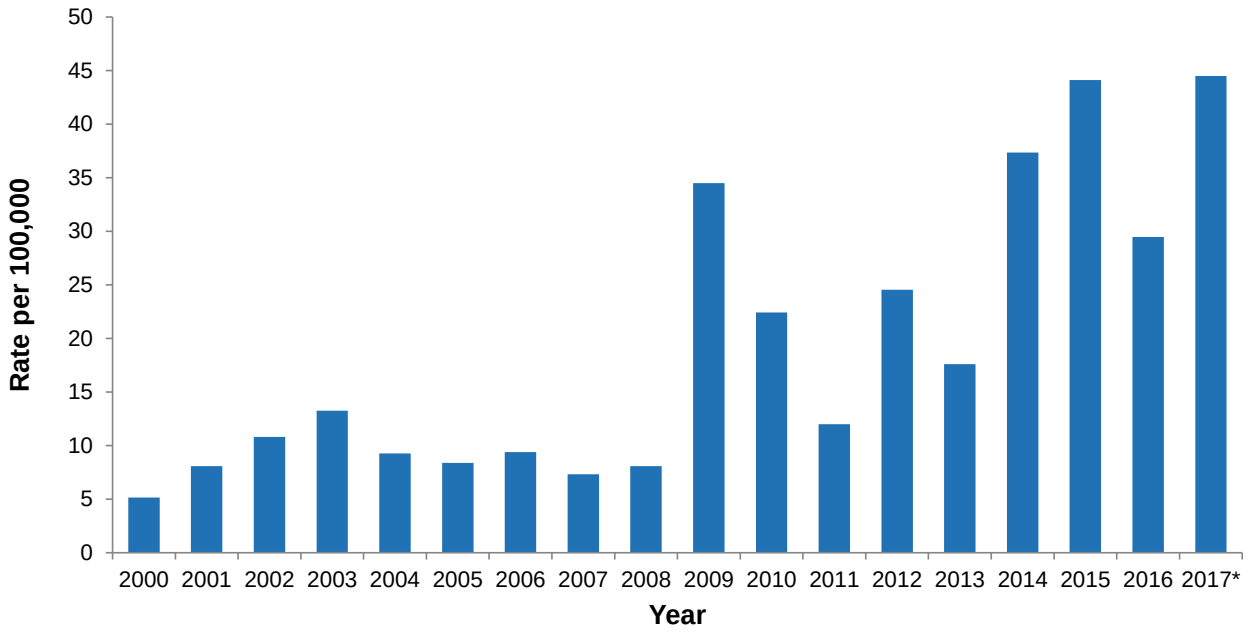


MINISTRY OF HEALTH DATA ON PUBLICLY FUNDED HOSPITAL DISCHARGES

Hospitalisation data for influenza (ICD-10AM-VI code I (J09-J11) for 2017 which correlate with previous versions of ICD-10AM codes J10-J11, were extracted from the New Zealand Ministry of Health's NMDS (by discharge date). In this dataset, people who received less than 1 day of hospital treatment in hospital emergency departments were excluded from any time series analysis of influenza hospitalisations during 2000–2017. Influenza-related hospitalisations were conservatively taken to include only those cases where influenza was the principal diagnosis. Repeat admissions were included, as infections with another influenza A subtype or B virus are possible.

From 1 January to 31 August 2017, there were a total of 2088 hospitalisations (44.5 per 100,000) for influenza (Figure 13). Influenza hospitalisation coding has not been completed for the year. This data only captured a proportion of influenza cases for the winter season of 2017.

Figure 13. Influenza hospital discharges, 2000–2017*

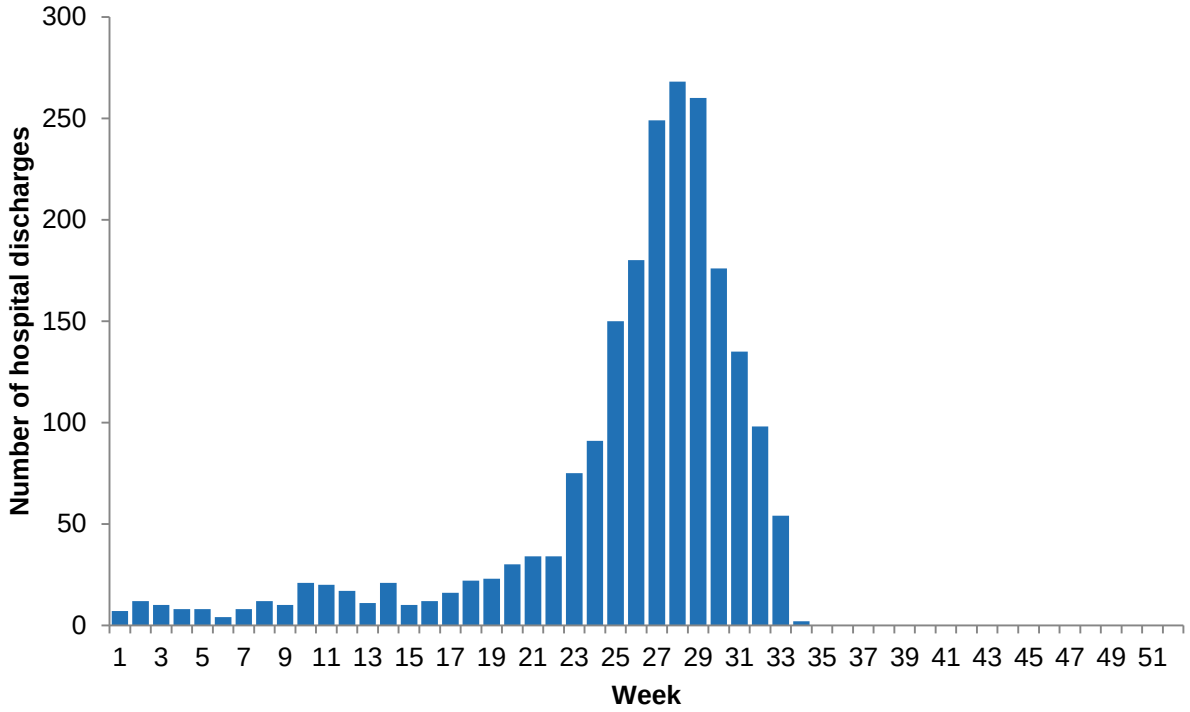


*Data from 1 Jan to 31 August only.

Source: Ministry of Health, NMDS (Hospital Events)

Figure 14 shows influenza hospitalisations by week discharged. The high number of hospitalisations (253) occurred in July (weeks 27–30).

Figure 14. Influenza hospital discharges by week, 2017*

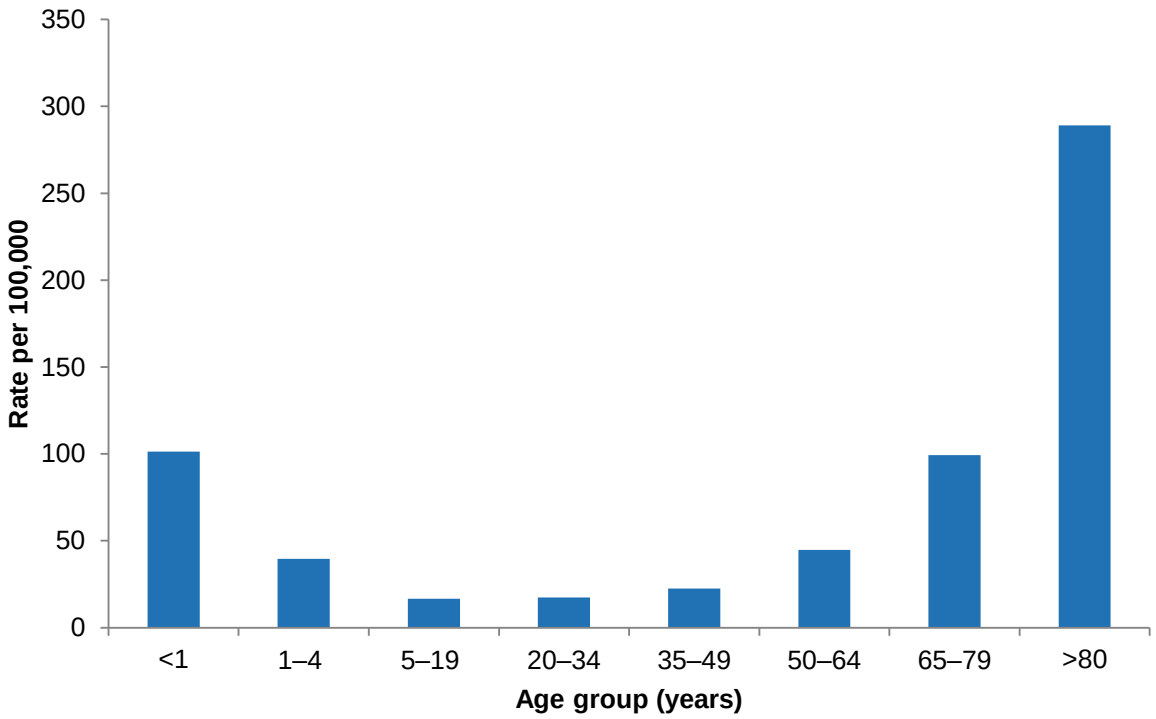


*Data from 1 Jan to 31 August only.

Source: Ministry of Health, NMDS (Hospital Events)

From 1 January to 31 August 2017, the highest influenza hospitalisation rates were recorded among adults ≥80 years (289.0 per 100,000), followed by infants aged less than one year old (101.3 per 100,000) and adults 65–79 years (99.4 per 100,000) (Figure 15).

Figure 15. Influenza hospital discharge rates by age group, 2017*

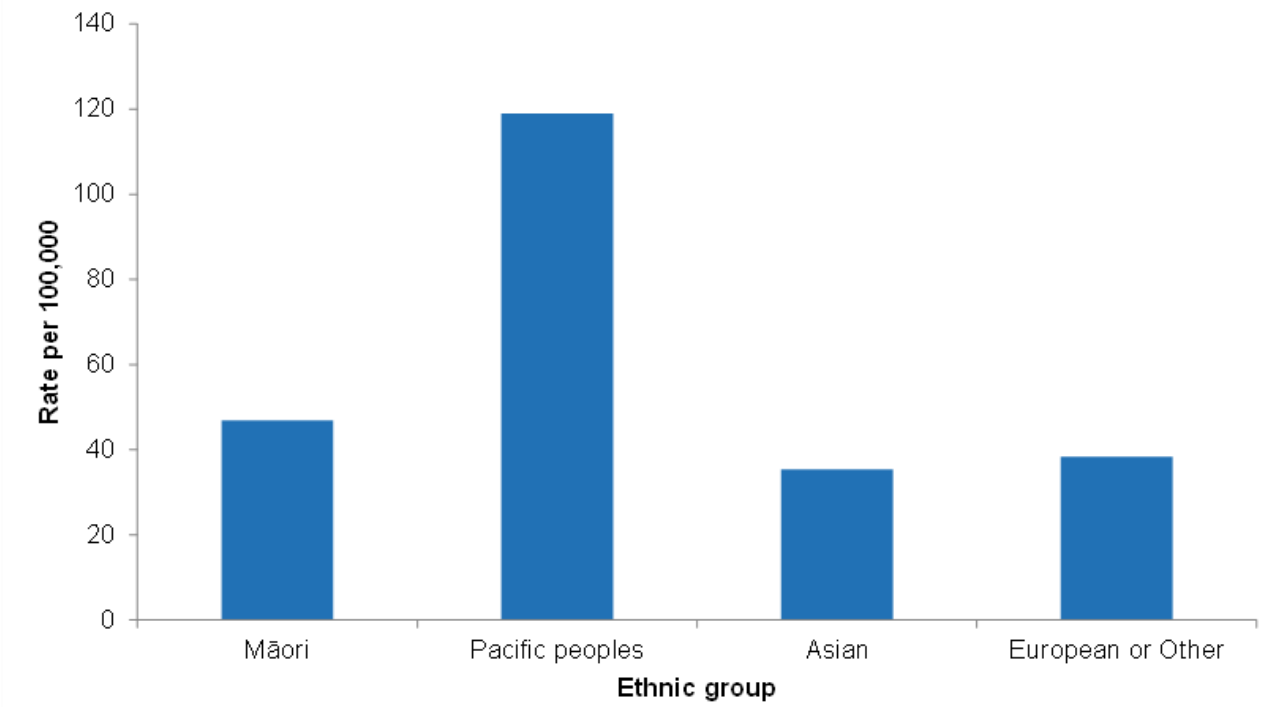


*Data from 1 Jan to 31 August only.

Source: Ministry of Health, NMDS (Hospital Events)

The ethnic distribution of influenza hospitalisations in 2017 is shown in Figure 16. Pacific peoples had the highest hospitalisation rate (119.0 per 100,000, 343 hospitalisations) followed by Maori (46.9 per 100,000, 327 hospitalisations). Asian (35.3 per 100,000 populations, 190 hospitalisations) and European or Other (27.6 per 100,000, 1214 hospitalisations) ethnic groups had the lowest rate of hospitalisations.

Figure 16. Hospital discharge rates by prioritised ethnic group, 2017*



*Data from 1 Jan to 31 August only.

Source: Ministry of Health, NMDS (Hospital Events)

NEW ZEALAND STRAIN CHARACTERISATIONS

CIRCULATING STRAINS IN 2017

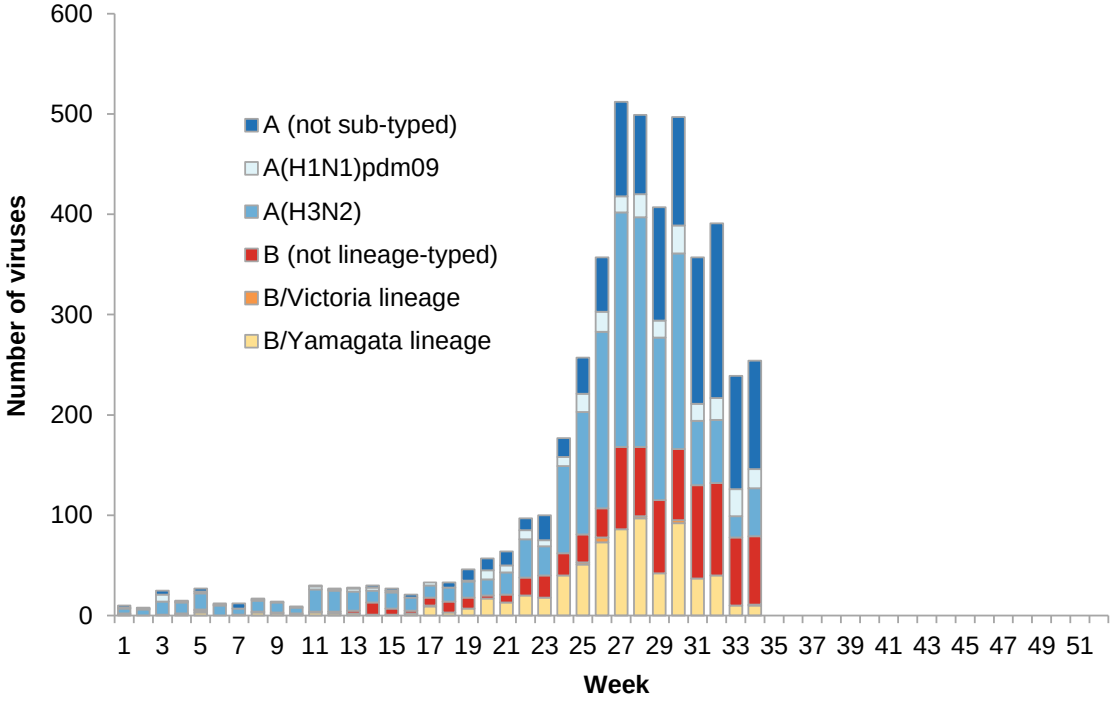
A total of 4689 influenza viruses were detected and reported through any surveillance system in 2017, with influenza A representing 67.7% (3175/4689) and influenza B 32.3% (1514/4689) of all influenza viruses (Table 8). Among A sub-typed, 86.2% (1745/2024) were A(H3N2) virus and 13.8% (279/2024) were A(H1N1) virus. Among B lineage-typed, 97.7% (688/704) were of Yamagata and 2.3% (16/704) Victoria.

Table 8. Influenza viruses by type and subtype for weeks 1–34, 2017

Viruses	All viruses (%)	Sub-typed and lineage-typed (%)
Influenza A	**3175 (67.7)**	**2024**
Influenza A (not sub-typed)	**1151 (24.5)**	
Influenza A(H1N1)pdm09	**279 (6.0)**	**279**
A(H1N1)pdm09 by PCR	237 (5.1)	237 (84.9)
A/California/7/2009 (H1N1)-like	17 (0.4)	17 (6.1)
A/Michigan/45/2015 (H1N1)-like	25 (0.5)	25 (9.0)
Influenza A(H3N2)	**1745 (37.2)**	**1745**
A(H3N2) by PCR	1635 (34.9)	1635 (93.7)
A/Hong Kong/4801/201 (H3N2)-like	110 (2.3)	110 (6.3)
Influenza B	**1514 (32.3)**	**704**
Influenza B (not lineage-typed)	**810 (17.3)**	
B/Yamagata lineage	**688 (14.7)**	**688**
B/Yamagata lineage by PCR	376 (8.0)	376 (54.7)
B/Phuket/3073/2013-like	312 (6.7)	312 (45.3)
B/Victoria lineage	**16 (0.3)**	**16**
B/Brisbane/60/2008-like	8 (0.2)	8 (50.0)
B/Victoria lineage by PCR	8 (0.2)	8 (50.0)
Total	**4689**	**2728**

Figure 17 shows the influenza virus identifications by type and sub-type for each week throughout 2017. A(H3N2) was the predominant type throughout the season.

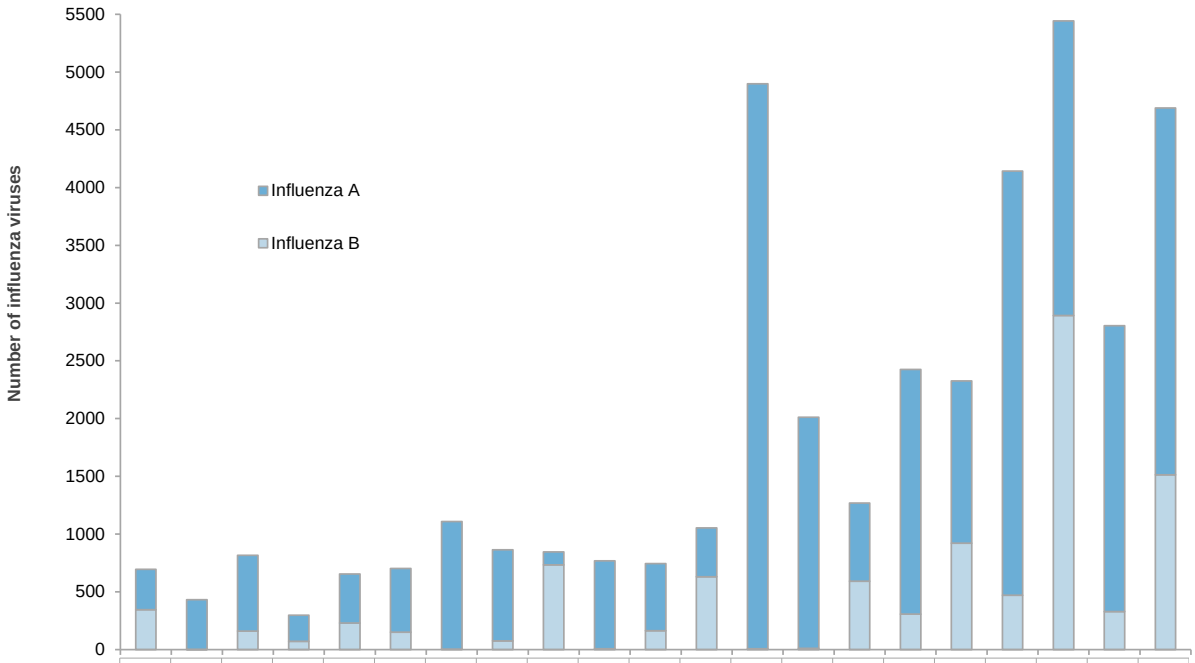
Figure 17. Total influenza viruses by type and week reported for weeks 1–34, 2017



PREDOMINANT STRAINS DURING 1997–2017

Figure 18 shows the number and percentage of typed influenza viruses from 1997 to 2017. Influenza A is the most frequent predominant influenza type. Of 21 influenza seasons during 1997–2017, influenza A predominated in 17 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 18. Influenza viruses by type, 1997–2017

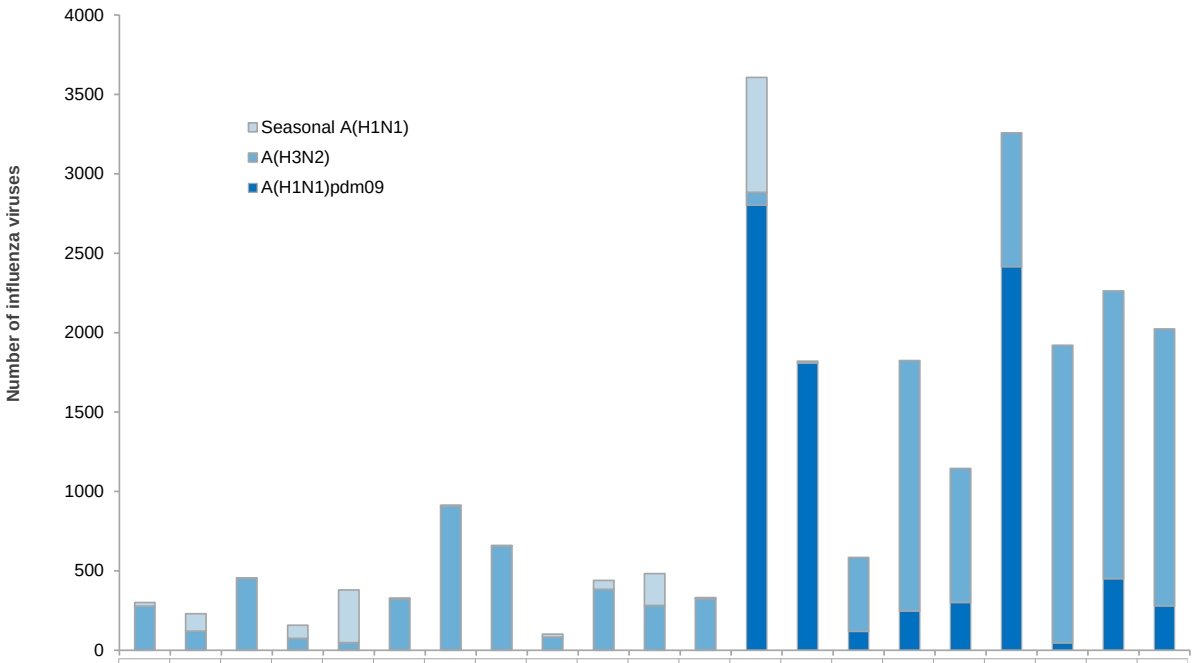


	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Influenza A (%)	50	100	80	76	65	78	100	91	13	99	78	40	100	100	53	87	60	89	47	88	68
Influenza B (%)	50	0	20	24	35	22	0	9	87	1	22	60	0	0	47	13	40	11	53	12	32

Figure 19 shows the number and percentage of all sub-typed influenza A viruses from 1997 to 2017 (excluding influenza A not sub-typed). Overall, the patterns of the predominant influenza A subtypes among all sub-typed A viruses during 1997–2017 are described below:

- Influenza A(H3N2) strain predominated for 16 seasons (1997–1999, 2002–2008, 2011–2013, 2015–2017). 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 19. Influenza A viruses by subtypes 1997–2017



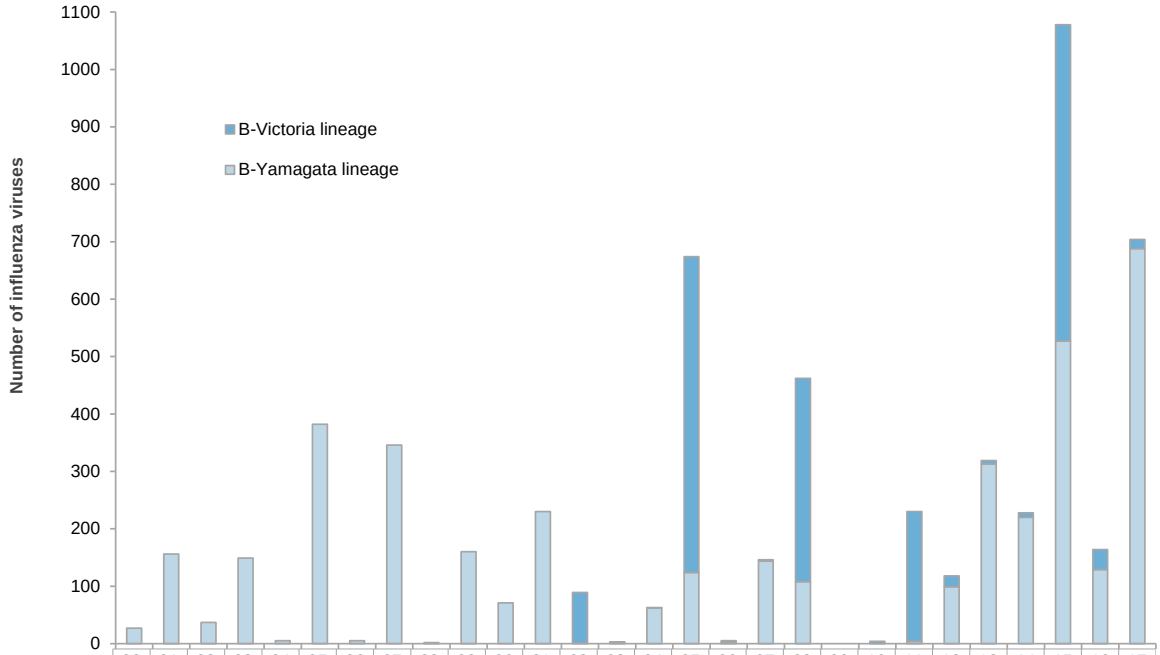
	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Seasonal A(H1N1)	8	48	0	52	87	1	0	0	18	13	42	2	20	0	0	0	0	0	0	0	0
A(H3N2)	92	52	100	48	13	99	100	100	82	87	58	98	2	1	80	86	74	26	98	80	86
A(H1N1)pdm09	0	0	0	0	0	0	0	0	0	0	0	0	78	99	20	14	26	74	2	20	14

* The data of influenza A not sub-typed was excluded from this graph.

Figure 20 shows the number and percentage of all B viruses from 1990 to 2017 (excluding influenza B not lineage-typed). Overall, the patterns of the predominant influenza B among all lineage-typed B viruses during 1990–2017 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, 2016 and 2017.
- In 2015, there were almost equal proportions of B/Yamagata and B/Victoria lineage viruses.

Figure 20. Influenza B viruses by lineages, 1990–2017



	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
B/Victoria lineage (%)	0	0	0	0	0	0	0	0	0	0	0	0	99	33	2	82	60	1	77	0	100	98	16	2	4	51	21	2
B/Yamagata lineage (%)	100	100	100	100	100	100	100	100	100	100	100	100	1	67	98	18	40	99	23	0	0	2	84	98	96	49	79	98

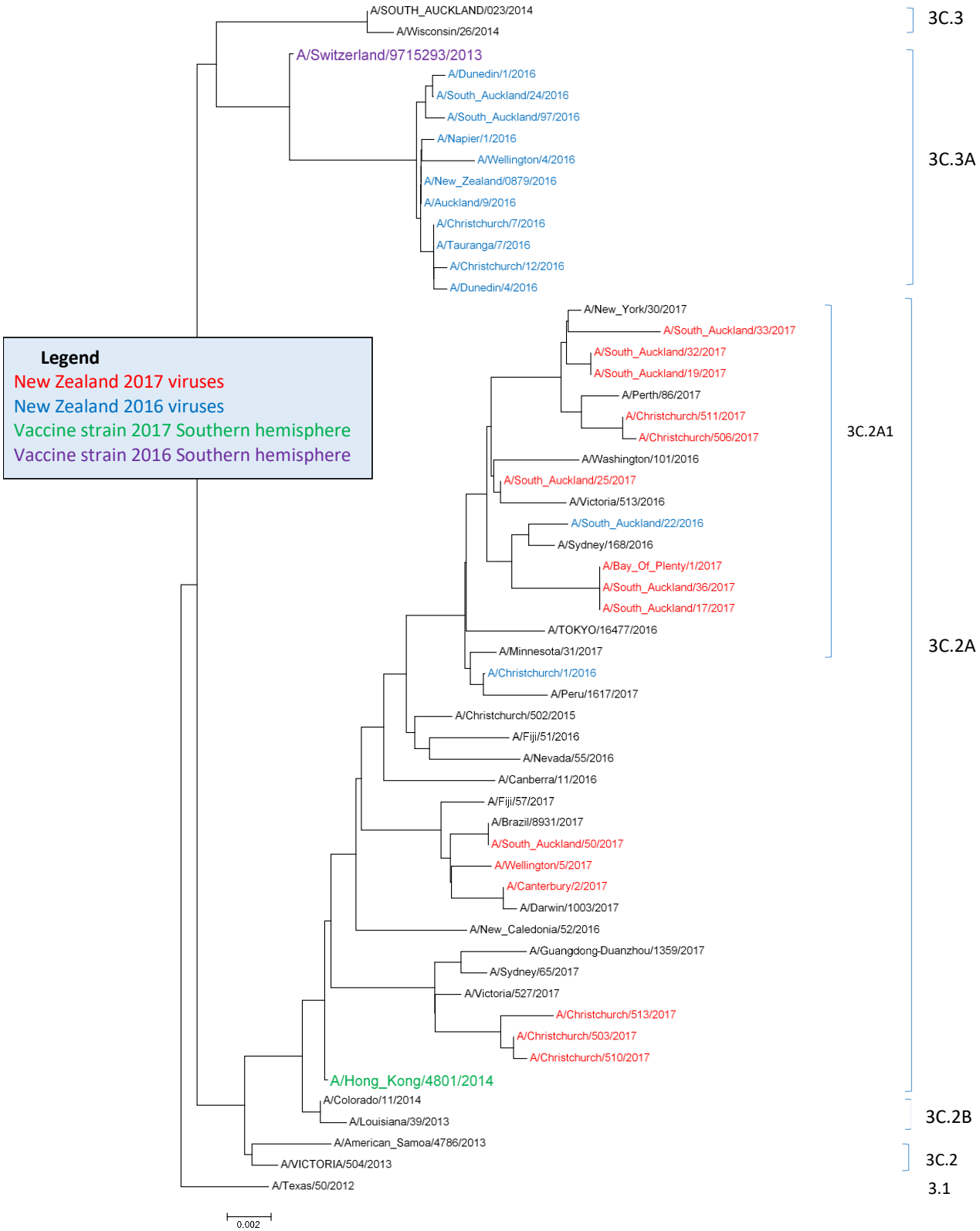
INFLUENZA A(H1N1)PDM09

Representative of influenza A(H1N1)pdm09 isolates were antigenically typed at the WHO National Influenza Centre at ESR using rabbit antisera supplied by the WHO Collaborating Centre (WHOCC) in Melbourne. Some of these isolates were also sent to WHOCC-Melbourne and CDC-Atlanta. During 1 January to 31 August 2017, a total of 49 influenza A(H1N1)pdm09 isolates were antigenically typed using antisera against A/California/7/2009 (H1N1)pdm09-like virus and A/Michigan/45/2015/A(H1N1)pdm09. Of them, 19 (38.8%, 19/49) were antigenically related to the reference strain A/California/7/2009 (H1N1)pdm09, 28 (57.1%, 28/49) to A/Michigan/45/2015/A(H1N1)pdm09 and 2 (4.1%, 2/49) had reduced reactivity against A/California/7/2009 (H1N1)pdm09.

SEASONAL INFLUENZA A(H3N2)

Representative seasonal influenza A(H3N2) isolates were antigenically typed at the WHO National Influenza Centre at ESR using HAI typing kit supplied by the WHO Collaborating Centre (WHOCC) in Melbourne. Some of these isolates were also sent to WHOCC-Melbourne and CDC-Atlanta. During 1 January to 31 August 2017, a total 125 influenza A(H3N2) isolates were antigenically typed using antisera against A/Hong Kong/480/2014 (H3N2). 14 (11%, 14/125) were antigenically related to the reference strain A/Hong Kong/480/2014, 111 (88.8%, 111/125) had reduced reactivity against the reference vaccine strain. Genetically, most of NZ influenza A(H3N2) viruses in 2016 fell into group 3C.2a1 (CDC designations, Figure 21).

Figure 21. Phylogenetic relationships among influenza A(H3N2) haemagglutinin genes



INFLUENZA B

Representative influenza B/Yamagata lineage isolates and B/Victoria lineage isolates were antigenically typed at the WHO National Influenza Centre at ESR using HAI typing kit supplied by the WHO Collaborating Centre (WHOCC) in Melbourne. Some of these isolates were also sent to WHOCC-Melbourne and CDC-Atlanta.

During 1 January to 31 August 2017, a total of 373 B/Yamagata lineages isolates were antigenically typed using antisera against B/Phuket/3073/2013-like virus. Of them, 322 (86.3%, 322/373) were antigenically related to the reference strain B/Phuket/3073/2013. In addition, a total of 11 B/Victoria lineage isolates were antigenically typed using antisera against B/Brisbane/60/2008-like virus. All of them were antigenically related to the reference strain B/Brisbane/60/2008.

OSELTAMIVIR RESISTANCE

The WHO National Influenza Centre at ESR employed a phenotypic method (fluorometric neuraminidase inhibition assay) for the surveillance of anti-viral drug resistance in influenza viruses. In addition, NIC at ESR 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 is known to confer resistance to oseltamivir.

In 2017, fluorometric neuraminidase inhibition assay was used to test a total of 171 influenza viruses against oseltamivir and zanamivir. All viruses were sensitive to both oseltamivir and zanamivir (Table 9 and Table 10).

Table 9. Antiviral susceptibility to oseltamivir for influenza viruses, 2014–2017

Influenza	NA inhibitor to Oseltamivir*	Fold change in IC50 to test viruses (No. of viruses)**			
		2014	2015	2016	2017
A(H1N1)pdm 09	Normal	0-9 (665)	0-2 (12)	0-5 (69)	0-2 (24)
	Reduced	35 (1)	-	-	-
	Highly reduced	356 (1)	-	-	-
A(H3N2)	Normal	0-8 (164)	0-5 (110)	0-10 (320)	0-4 (60)
	Reduced	-	-	-	-
	Highly reduced	-	-	-	-
Influenza B	Normal	0-4 (167)	0-5 (730)	0-3 (126)	0-2 (87)
	Reduced	-	-	-	-
	Highly reduced	-	-	-	-

*Neuraminidase inhibition was defined as:

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

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

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

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

Table 10. Antiviral susceptibility to zanamivir for influenza viruses, 2014–2017

Influenza	NA inhibitor to Zanamivir*	Fold change in IC50 to test viruses (No. of viruses)**			
		2014	2015	2016	2017
A(H1N1)pdm 09	Normal	0-6 (671)	0-2 (12)	0-5 (69)	0-2 (24)
	Reduced	-	-	-	-
	Highly reduced	-	-	-	-
A(H3N2)	Normal	0-7 (157)	0-4 (110)	0-7 (319)	0-4 (60)
	Reduced	-	-	-	-
	Highly reduced	-	-	-	-
Influenza B	Normal	0-5 (168)	0-4 (735)	0-5 (126)	0-2 (87)
	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

INFLUENZA VACCINE EFFECTIVENESS

In New Zealand seasonal trivalent influenza vaccine is offered annually free of charge to all adults aged 65 years and over, pregnant women and all those over six months of age with chronic medical conditions that are likely to increase the severity of the infection. Since 2013, free influenza vaccines have been offered to children (6-months to 4-years) who have been hospitalised or have a history of significant respiratory illness. Influenza vaccines are also available on the private market for all others over six months of age. The influenza season usually occurs between May and September.

Using the case test-negative design to estimate propensity-adjusted VE, we estimated the effectiveness of seasonal trivalent inactivated influenza vaccine in preventing laboratory-confirmed influenza in patients hospitalised with severe acute respiratory infections (SARI) and in patients presenting to general practice with an influenza-like illness (ILI) during the influenza season. The influenza season was defined as starting when there were two consecutive weeks with two or more cases; The data is contributed to I-GIVE project for the WHO vaccine strain selection meeting in September for southern hemisphere countries.

Most ILI and SARI patients with laboratory-confirmed influenza are included except those with incomplete data for vaccination status, infants under 6 months of age, children under 9 years who were only given one dose of vaccine, those vaccinated less than 14 days before admission or presentation. For patients with multiple episodes, the first influenza virus-positive episode was used for the analysis or the first illness episode if there was no influenza virus-positive episode.

The proportion vaccinated did not change throughout the season. For influenza-confirmed SARI cases, after adjustment for age, week of admission and any underlying health condition, the estimated VE was 51% (95% CI: 17 to 71). For influenza-confirmed ILI cases, after adjustment for age, week of presentation and any underlying health condition, the estimated VE was 27% (95% CI: 6 to 43) (Table 11).

Table 11. Estimated influenza vaccine effectiveness, by participant age group and by influenza virus type and subtype: crude and propensity adjusted models, New Zealand, 2017 influenza season

Age & Virus	Influenza Positive		Influenza Negative		crude			age-adjusted		
	Vaccinated-Yes	Vaccinated-Not	Vaccinated-Yes	Vaccinated-Not	VE%	LCL	UCL	VE%	LCL	UCL
ILI										
Overall	163	673	202	647	22.4	2.1	38.5	26.6	5.8	42.8
<18y	11	262	29	237	65.7	29.8	83.2	68.9	35.4	85.0
18-64y	105	392	131	382	21.9	-4.7	41.7	22.7	-4.0	42.5
65+y	47	19	42	28	NA	NA	NA	NA	NA	NA
H3	100	316	202	647	-1.4	-33.4	23.0	7.5	-24.1	31.0
<18y	6	109	29	237	55.0	-11.5	81.9	58.2	-5.2	83.4
18-64y	63	195	131	382	5.8	-33.2	33.4	3.2	-37.4	31.8
65+y	31	12	42	28	NA	NA	NA	NA	NA	NA
H1	5	46	202	647	65.2	11.2	86.4	60.0	-4.5	84.7
B	52	291	202	647	42.8	20.0	59.1	45.2	22.1	61.4
<18y	4	125	29	237	73.9	23.9	91.0	76.1	29.6	91.9
18-64y	33	159	131	382	39.5	7.5	60.4	43.1	12.6	62.9
65+y	15	7	42	28	NA	NA	NA	NA	NA	NA
SARI										
Overall	64	117	134	254	-3.7	-50.1	28.4	51.1	16.6	71.3
<18y	2	39	21	166	59.5	-80.2	90.9	70.4	-39.4	93.7
18-64y	21	59	40	68	39.5	-13.9	67.9	42.2	-9.8	69.5
65+y	41	19	73	20	40.9	-23.3	71.7	38.7	-28.6	70.8
H3	32	44	134	254	-37.9	-127.6	16.5	42.4	-6.0	68.7
<18y	1	9	21	166	NA	NA	NA	NA	NA	NA
18-64y	9	26	40	68	41.2	-38.1	74.9	41.2	-39.1	75.2
65+y	22	9	73	20	33.0	-68.0	73.3	31.6	-73.1	72.9
H1	2	18	134	254	78.9	7.9	95.2	67.1	-66.7	93.5
B	13	29	134	254	15.0	-68.9	57.3	60.9	13.1	82.4
<18y	0	11	21	166	NA	NA	NA	NA	NA	NA
18-64y	5	14	40	68	39.3	-81.2	79.7	45.9	-66.8	82.4
65+y	8	4	73	20	45.2	-100.7	85.0	43.1	-112.3	84.7

*Adjusted for week in season, any underlying health condition and age

N/A: not applicable as numbers to too low to reach any significance when the confidence interval spanned more than 250; CI: Confidence interval; ILI: Influenza-like illness;

SARI: severe acute respiratory infections.

RECENT STRAIN CHARACTERISATION FOR SOUTHERN HEMISPHERE VIRUSES AND LIKELY VACCINE CANDIDATES

INFLUENZA A(H1N1)PDM09

The influenza A(H1N1)pdm09 virus was first detected in April 2009 in the United States and was responsible for outbreaks in Mexico in March and April 2009. Outbreaks subsequently occurred in all regions of the world and, by July 2009, influenza A(H1N1)pdm09 was the predominant influenza virus circulating in many countries in the Americas, Asia, Europe and Oceania.

During the 2017 influenza season, 426 A(H1N1)pdm09 viruses were received at the Melbourne WHOCC from 8 countries with most coming from Australia and New Zealand. The WHO National Influenza Centre at ESR used the kit supplied by the Melbourne WHOCC to analyse influenza A(H1N1)pdm09 strains. The antiserum used for antigenic typing was the rabbit/sheep antisera raised against A/Michigan/45/2014-like strain. Of the 45 A(H1N1)pdm09 isolates tested at ESR by hemagglutination inhibition assay during the period of 1 January to 31 August 2017, 28 (57%, 28/49) were antigenically indistinguishable to the reference strain A/Michigan/45/2014 (H1N1)pdm09 and 19 (39%, 19/49) were antigenically indistinguishable to the reference strain A/California/7/2009 (H1N1)pdm09.

Among all of the influenza A(H1N1)pdm09 viruses analysed at the Melbourne WHOCC, most of the viruses reacted well with ferret sera to A/Michigan/45/2014 with no low reactors (≥8-fold reduction compared with the homologous titre) (Figure 3.1, Tables 3.2 in Appendix 3).

In addition, a total of 94 influenza A(H1N1)pdm09 viruses were sequenced in the HA gene. The sequence analysis indicated that most of viruses falling into genetic clade 6B.1 with no 6B.2 viruses (CDC designations, Figure 3.2 in Appendix 3). The NA (N1) genes of the A(H1N1)pdm09 viruses were also sequenced, resulting in groups similar to their HA grouping (Figure 3.3 in Appendix 3).

Furthermore, HI assays were used to measure the presence of antibodies to recent virus isolates in panels of sera from adults and older adults who received seasonal trivalent or quadrivalent inactivated vaccines. Geometric mean HI titres of antibodies against representative A(H1N1)pdm09 viruses were somewhat reduced when compared to HI titres with the vaccine virus. (WER 92(42), and Tables 3.7, 3.8, 3.11 & 3.12 in Appendix 3). (*Abridged from the Weekly Epidemiological Record, 2017 92(42):625-48 and a report to AIVC by Dr Ian Barr, WHO Collaborating Centre for Influenza, Melbourne)*

In summary, influenza A(H1N1)pdm09 viruses have replaced seasonal A(H1N1) viruses since 2009. Influenza A(H1N1)pdm09 activity was generally low in many countries. The majority of influenza A(H1N1)pdm09 viruses were antigenically indistinguishable from the current vaccine virus A/Michigan/45/2015. Based on all of the available data, the WHO consultation recommended

vaccines containing an A/Michigan/45/2015 (H1N1)pdm09-like strain. The AIVC accepted this recommendation.

SEASONAL INFLUENZA A(H3N2)

Influenza A(H3N2) has frequently been associated with severe disease and excess mortality in high-risk groups. This subtype has also shown the greatest tendency for antigenic drift as illustrated by the frequency of vaccine formulation changes recommended by the WHO and AIVC (Table 1).

During the 2017 influenza season, 1552 A(H3N2) viruses were received at the Melbourne WHOCC from 11 countries with most coming from Australia and New Zealand. The WHO National Influenza Centre at ESR used the kit supplied by the Melbourne WHOCC to analyse influenza A(H3N2) strains. The antiserum used for antigenic typing was the rabbit/sheep antisera raised against A/Hong Kong/4801/2014-like strain. Of the 125 A(H3N2) isolates tested at ESR by hemagglutination inhibition assay during the period of 1 January to 31 August 2017, 111 (88.8%, 111/125) had reduced reactivity against the reference vaccine strain.

A(H3N2) viruses have become increasingly difficult to test with the haemagglutination inhibition assay. Some viruses have low or no HA titre with guinea pig RBC even though there is ample virus present (as detected by other methods). Particular mutations or polymorphisms in the NA of recent H3N2 viruses (especially the D151G) appear to allow some level of binding to red blood cells (RBC), thus interfering with the inhibition of viruses between HA and RBC using post-infection ferret sera. To overcome this problem a number of WHOCCs have been performing their HI assays in the presence of 20nM oseltamivir carboxylate in order to prevent this NA binding. This appears to improve the discrimination between antigenically drifted vs not-drifted viruses. However, about 35% of these viruses have a drop in HA titre to a point whereby these viruses cannot be assayed by HI anymore. Alternatively virus neutralization assays such as the microneutralisation or plaque reduction assays or focus reduction assays (FRA) can be used where the NA binding is not relevant.

Among all A(H3N2) isolates analysed with oseltamivir at the Melbourne WHOCC, most of the A(H3N2) viruses tested in this period reacted well with ferret sera raised to cell propagated A/Hong Kong/4801/2014-like viruses, with only 19% of viruses tested at the Melbourne CC showing ≥8 fold reduction in HI titre compared to homologous titres. This figure rose substantially (to 55%) when a ≥4 fold reduction was used. Egg propagation is known to introduce additional changes in HA that can affect antigenicity. Such changes have been particularly problematic for recent A(H3N2) viruses. When ferret sera raised to egg grown A/Hong Kong/4801/2014 viruses were used, marked reductions in titres compared to the homologous titres were observed, with 39% of recent viruses showing ≥8 fold reduction in HI titre (Tables 4.2, 4.9 and 4.11 in Appendix 4).

In addition, a total of 852 influenza A(H3N2) viruses were sequenced in the HA gene. The phylogenetic analysis of the influenza A(H3N2) viruses showed that most of viruses fell into clade 3C2a with only a few 3C3a clade viruses and no 3C3b clade viruses being detected (CDC designations, Figure 4.2 in Appendix 4). The 3C2a viruses could be further subdivided into viruses

falling into the 3C2a1 sub-clade which also had further sub-groups. The proportions of viruses in these clades varied by country with New Zealand having more 3C2a1 viruses whereas Australia having more 3C2a viruses (Table 4.6, Figure 4.2 in Appendix 4). Sequence analysis of the N2 NA gene analysed showed that the most recent viruses grouped in a similar manner as their HA genes (Figure 4.3 in Appendix 4).

Furthermore, human serology studies were performed using serum panels from adults and older adults who had received either trivalent or quadrivalent inactivated vaccines with the composition recommended for the southern hemisphere 2017 season (A/Michigan/45/2015 (H1N1)pdm09-like, A/Hong Kong/4801/2014 (H3N2)-like, B/Brisbane/60/2008-like viruses, and B/Phuket/3073/2013-like virus in the quadrivalent vaccines). In addition, panels from adults, older adults and children who received either trivalent or quadrivalent inactivated vaccines of the composition recommended for the northern hemisphere 2016-17 season (A/California/7/2009 (H1N1)pdm09-like, A/Hong Kong/4801/2014 (H3N2)-like, B/Brisbane/60/2008-like viruses, and B/Phuket/3073/2013-like virus in the quadrivalent vaccines) were tested. Geometric mean HI titres of antibodies against all tested cell culture-propagated A(H3N2) viruses were reduced significantly compared to HI titres against the egg-propagated vaccine virus. Significant reductions in geometric mean titres against some representative cell culture-propagated A(H3N2) viruses were observed when compared to cell culture-propagated A/Hong Kong/4801/2014 (H3N2)-like viruses. Microneutralisation tests using the same serum panels and subsets of viruses showed similar results. (WER 91(41), and Tables & Figures 4.16, 4.17, 4.18 and 4.19 in Appendix 4). (Abridged from the Weekly Epidemiological Record, 2017 92(42):625-48 and a report to AIVC by Dr Ian Barr, WHO Collaborating Centre for Influenza, Melbourne)

In summary, influenza A(H3N2) viruses were predominant and associated with outbreaks in many countries. The majority of A(H3N2) viruses fell into the phylogenetic clades 3C2a and the subclade 3C.2a1. Ferret antisera raised against cell-propagated reference 3C2a A/Hong Kong/4801/2014 – like virus inhibited the majority of viruses; however ferret antisera raised against egg-propagated A/Hong Kong/4801/2014 – like reference virus failed to inhibit the majority of viruses. Based on all available data, the WHO Consultative Group recommended the H3 component of the vaccines containing an A/Singapore/INFIMH-16-0019/2016 (H3N2) - like strain. AIVC accepted this recommendation.

INFLUENZA B

Two distinct lines of influenza B have co-circulated in many countries during recent years. This dates from the late 1980s when the B/Panama/45/90 variant of influenza B was first observed. This strain and its further variants of the Yamagata/16/88 lineage (most recently representative strain-B/Phuket/3073/2013) spread worldwide, whereas strains of the previous B/Victoria/2/87-like viruses continued to circulate in Asia and subsequently underwent independent evolution as an antigenically distinct lineage (most recent representative strain-B/Brisbane/60/2008). For reasons not wholly understood, these remained geographically restricted to Asia until 2001. In 2002 the B/Victoria/2/87 lineage viruses were the predominant viruses worldwide.

Both recent B/Victoria-like strains (B/Brisbane/60/2008 is the current reference strain) and B/Yamagata-like strains (B/Phuket/3073/2013 is the current reference strain) continued to be isolated worldwide in 2017 with variable proportions in different regions. More B/Yamagata than B/Victoria lineage viruses circulated in New Zealand and Australia.

661 influenza B isolates were received in 2017 by the Melbourne WHOCC from 11 countries. The majority of isolates (604) were typed as B/Yamagata lineage with the remaining being B/Victoria lineage viruses (57). When B/Victoria-lineage viruses were reacted with ferret sera raised against egg grown B/Brisbane/60/2008-like virus, most of viruses showed reduced reactivity (≥8-fold reduction compared with the homologous titre). However, when ferret serum raised to cell propagated virus was used, all except one reacted well with ferret sera raised to cell-propagated B/Brisbane-like virus in HI assays (Figure 5.2 in Appendix 5). The B/Yamagata-lineage viruses were indistinguishable antigenically between circulating viruses and B/Phuket/3073/2013-like reference strain (Figure 5.3 in Appendix 5). The majority of recent viruses were well covered by ferret sera raised to either cell or egg propagated B/Phuket/3073/2013-like viruses. HI assays in Tables 5.2, 5.4 (Appendix 5) were performed at the Melbourne WHOCC.

In addition, sequence analysis of the HA1 gene of recent isolates showed that recent isolates fell into one of the two major lineages of B viruses (B/Victoria/2/87 or B/Yamagata/16/88) consistent with their antigenic typing. The B/Victoria lineage viruses mostly grouped in the B/Brisbane/60/2008 group (all clade V1A). The NA sequence analysis from viruses with a B/Brisbane/60/2008-like HA showed the same groupings as their HA genes (Figures 5.5, and 5.6 in Appendix 5). B/Yamagata lineage fell into the B/Phuket/3073/2013-like virus, with the majority of viruses falling in clade Y3. B/Yamagata lineage virus NA genes matched the HA genes falling into the same pattern as their HA did (Figures 5.7 and 5.8 in Appendix 5).

Furthermore, Human serology studies were performed using the same serum panels as described for the A(H3N2) virus analysis. Geometric mean HI titres of antibodies against most representative recent B/Victoria/2/87 lineage viruses tested were similar to HI titres against cell culture-propagated B/Brisbane/60/2008-like viruses. In studies using serum panels from subjects who had received quadrivalent vaccines, geometric mean titres against most representative recent B/Yamagata/16/88 lineage viruses tested were similar to those against cell culture-propagated B/Phuket/3037/2013 virus (Tables 5.8, 5.9, 5.10, 5.11, 5.18 and figures in Appendix 5). (*Abridged from the Weekly Epidemiological Record, 2017 92(42):625-48 and a report to AIVC by Dr Ian Barr, WHO Collaborating Centre for Influenza, Melbourne)*

In summary, influenza B viruses of the B/Victoria/2/87 and B/Yamagata/16/88 lineages co-circulated, with viruses of the B/Yamagata lineage predominating in many countries including New Zealand and Australia. Most of B/Victoria lineage viruses were antigenically and genetically closely related to B/Brisbane/60/2008-like virus. The majority of recent B/Yamagata lineage viruses were antigenically and genetically closely related to B/Phuket/3073/2013-like virus. Based on all available data, the WHO Consultative Group recommended the B component of the trivalent vaccines containing a B/Phuket/3073/2013-like virus (B/Yamagata/16/88-like virus). The AIVC accepted this recommendation.

SUMMARY OF VACCINE COMPOSITION RECOMMENDATION

It is recommended that the influenza vaccine formulation for New Zealand for 2018 is:

- A(H1N1) an A/Michigan/45/2015 (H1N1)pdm09-like virus
- A(H3N2) an A/Singapore/INFIMH-16-0019/2016 (H3N2)-like virus
- B a B/Phuket/3073/2013-like virus (belonging to B/Yamagata lineage)

Quadrivalent vaccines contain the above three viruses and plus one more vaccine component:

- B a B/Brisbane/60/2008-like virus (belonging to B/Victoria lineage)

EXPLANATION OF "LIKE" STRAINS SUITABLE FOR INCLUSION IN VACCINE

In the past, some strains of influenza recommended for inclusion in the vaccine formulation have been unsuitable vaccine candidates due to their poor growth potential with resulting low yields or poor serological responses in vaccinees. Under the "like" strain concession in the vaccine recommendation, an antigenically similar strain can be substituted which has the qualities that are lacking in the prototype strain.

The AIVC considered the information about international surveillance by WHO, recent data from Australia, New Zealand, South Africa and Argentina on influenza epidemiology and virus strain characterisation, and the recommendations of the WHO annual consultation on the composition of influenza vaccine for the southern hemisphere. The AIVC agreed to adopt the WHO recommendations. The influenza vaccine components for year 2018 season should contain the following:

A (H1N1):	an A/Michigan/45/2015 (H1N1)-like strain,	15 µg HA per dose
A (H3N2):	an A/Singapore/INFIMH-16-0019/2016 (H3N2)-like virus,	15 µg HA per dose
B:	a B/Phuket/3073/2013 - like virus,	15 µg HA per dose

It is recommended that quadrivalent vaccines containing two influenza B viruses include the above three viruses and a B/Brisbane/60/2008 - like virus with 15 µg HA per dose.

WHO is now listing all recommended candidate viruses and potency testing reagents for development and production of vaccines for use in specific influenza seasons at the following website: http://www.who.int/influenza/vaccines/virus/candidates_reagents/home/en/

APPENDIX 1 - COMPOSITION OF THE AUSTRALIAN INFLUENZA VACCINE COMMITTEE 2017

AIVC MEMBERS 2017

The details of the Australian Influenza Vaccine Committee Members can be accessed from the website below:

https://www.tga.gov.au/committee/australian-influenza-vaccine-committee-aivc

APPENDIX 2 – ISOLATES RECEIVED FOR ANALYSIS AT THE AUSTRALIAN WHO COLLABORATING CENTRE

Table 2.1. Influenza Viruses Analysed at the Melbourne WHO CC
1 February – 21 September 2017

Country	A(H1N1) pdm09	A(H3N2)	A Un-subtyped	B Yam	B Vic	TOTAL
Australia	289	1298	70	440	33	**2130**
Cambodia	27	3	0	0	0	**30**
Fiji	0	64	0	10	0	**74**
New Zealand	30	112	0	119	2	**263**
New Caledonia	0	3	0	8	2	**13**
Papua New Guinea	0	7	0	3	0	**10**
Philippines	5	2	0	1	3	**11**
Singapore	23	30	0	8	7	**68**
Solomon Islands	0	0	0	1	0	**1**
South Africa	3	18	0	3	0	**24**
Sri Lanka	41	9	0	1	1	**52**
Thailand	8	6	0	10	9	**33**
Total	**426**	**1552**	**70**	**604**	**57**	**2709**
%	**15.73%**	**57.29%**	**2.58%**	**22.30%**	**2.10%**	**100%**

APPENDIX 3 – INFLUENZA A(H1N1)PDM09

Figure 3.1. Antigenic cartographic representation of A(H1N1)pdm09 HI analysis

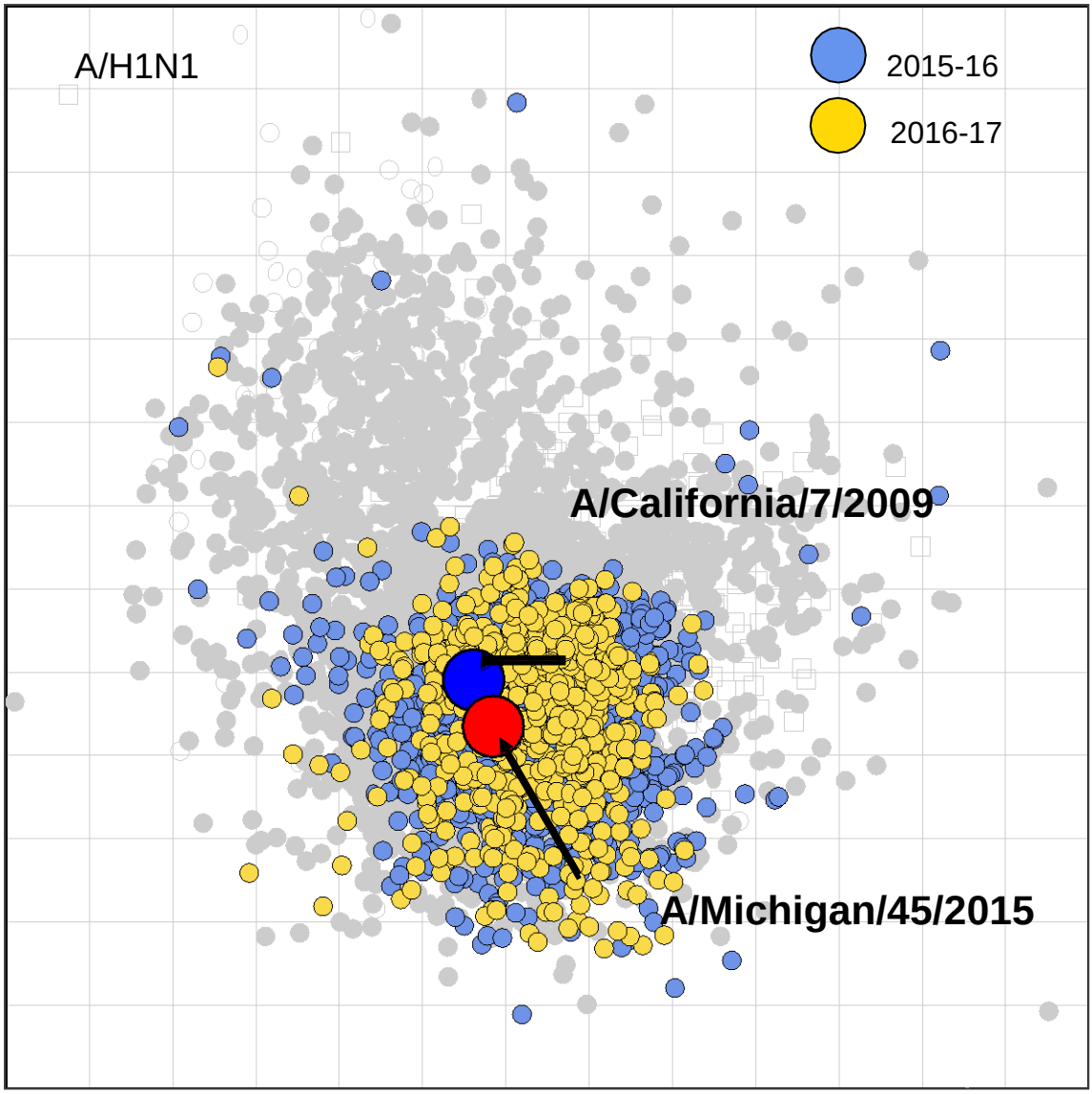


Table 3.2. – (H1N1)pdm09 viruses (1)

Haemagglutination Inhibition Assay - WHO Influenza Centre																	
			Reference Antisera														
	Sequenced		A	B	C	D	E	F	G	H	I	J	K	L			
	September 15, 2017		F2257-13D	F2771-13D	F3647-13D	F3168-14D	F3421-21D	F3520-14D	F3809-14D	F3702-12D	F3641-13D	F3646-13D	F3492-14D	F3640-13D	Passage	Sam ple	
			E4	E2	MDCK1	E3	E2	E4	M1/C2,M1	E3	E3	S1,M1	MX,M1	S1,M2	Details	Date	
			CAL/7	CHCH/16	Dar/56	Tas/24	SA/22	Mich/45	Mich/45	Sing/GP1908	FIJI/3	FIJI/3	Pth/103	VIC/503			
	Reference Antigens	**Clade**		**4**	**7**	**6B**				**6B.1**			**6B.2**				
A	A/CALIFORNIA/7/2009		**2560**	2560	1280	2560	5120	1280	2560	5120	1280	5120	1280	2560	E6		
B	A/CHRISTCHURCH/16/2010	**4**	2560	**>10240**	1280	2560	5120	1280	2560	5120	1280	5120	640	2560	E3		
C	A/DARWIN/56/2013	**7**	80	<80	**160**	<80	<80	<80	<80	80	<80	80	<80	<80	MDCK3		
D	A/TASMANIA/24/2014	**6B**	2560	2560	640	**2560**	5120	1280	2560	5120	1280	5120	1280	2560	E3		
E	A/SOUTH AUSTRALIA/22/2015	**6B**	2560	2560	1280	2560	**5120**	1280	2560	2560	1280	2560	1280	2560	E3		
F	A/MICHIGAN/45/2015	**6B.1**	2560	2560	640	2560	5120	**1280**	2560	2560	1280	5120	1280	2560	E3, E4		
G	A/MICHIGAN/45/2015	**6B.1**	640	320	160	640	1280	320	**640**	640	320	1280	320	640	M1/C2,M2		
H	A/SINGAPORE/GP1908/2015	**6B.1**	1280	640	640	1280	2560	640	2560	**2560**	1280	2560	640	2560	E3		
I	A/FIJI/3/2016	**6B.1**	5120	5120	1280	5120	>10240	2560	5120	5120	**1280**	>10240	1280	5120	E3		
J	A/FIJI/3/2016	**6B.1**	1280	640	320	1280	2560	640	1280	2560	640	**2560**	640	1280	S1,M1		
K	A/PERTH/103/2015	**6B.2**	1280	1280	320	1280	2560	640	1280	2560	640	2560	**640**	1280	MX,M4		
L	A/VICTORIA/503/2016	**6B.2**	1280	1280	320	1280	2560	640	1280	2560	640	2560	640	**2560**	S1,M1		
	Test Antigens																
1	A/Victoria/717/2017		2560	5120	1280	5120	5120	2560	5120	5120	2560	>10240	1280	5120	SIAT1	2/09/2017	
2	A/Sydney/1054/2017	**6B.1**	2560	1280	640	1280	5120	1280	2560	5120	1280	5120	1280	2560	SIAT1	7/08/2017	
3	A/Sydney/1076/2017		1280	1280	640	1280	2560	1280	2560	2560	640	2560	640	2560	SIAT1	28/07/2017	
4	A/Sydney/1077/2017	**6B.1**	2560	1280	640	1280	5120	1280	2560	2560	640	5120	1280	2560	SIAT1	3/08/2017	
5	A/Sydney/1078/2017	**6B.1**	1280	1280	640	1280	2560	1280	2560	2560	640	5120	1280	2560	SIAT1	1/08/2017	
6	A/Victoria/1013/2017		1280	1280	640	1280	5120	1280	2560	2560	1280	5120	640	2560	SIAT1	2/08/2017	
7	A/Brisbane/1030/2017	**6B.1**	2560	2560	640	2560	5120	1280	5120	5120	1280	5120	1280	2560	SIAT1	4/08/2017	
8	A/South Australia/1025/2017	**6B.1**	2560	1280	640	1280	5120	1280	2560	2560	1280	5120	640	2560	SIAT1	8/08/2017	
9	A/South-Africa/R07191/17	**6B.1**	1280	1280	320	1280	2560	1280	2560	2560	640	5120	640	2560	MDCK1	22/07/2017	
10	A/Victoria/2073/2017	**6B.1**	1280	1280	640	1280	2560	1280	2560	2560	640	5120	640	2560	SIAT1	5/08/2017	
11	A/Brisbane/115/2017		640	640	320	1280	1280	1280	640	640	1280	1280	640	1280	MDCK2	26/07/2017	
12	A/Victoria/638/2017		2560	1280	640	2560	5120	1280	2560	2560	1280	5120	1280	2560	SIAT1	7/08/2017	
13	A/Victoria/644/2017	**6B.1**	1280	1280	320	1280	2560	1280	1280	2560	640	5120	640	2560	SIAT1	8/08/2017	
14	A/Victoria/808/2017		2560	1280	640	1280	5120	1280	2560	2560	1280	5120	1280	2560	SIAT1	17/08/2017	
15	A/Sri Lanka/78/2017		1280	1280	640	1280	2560	1280	2560	2560	1280	5120	1280	2560	MDCK1	12/08/2017	
16	A/Sri Lanka/82/2017	**6B.1**	2560	2560	640	1280	5120	1280	2560	2560	640	5120	1280	2560	MDCK1	14/08/2017	
17	A/Perth/137/2017		1280	1280	320	1280	2560	1280	1280	2560	1280	5120	1280	2560	MDCK2	28/07/2017	
18	A/Perth/169/2017		2560	1280	640	1280	5120	1280	2560	2560	1280	5120	1280	2560	MDCK2	18/08/2017	
19	A/Sri Lanka/77/2017		1280	1280	640	1280	2560	1280	2560	2560	1280	5120	1280	2560	SIAT2	11/08/2017	
20	A/Sri Lanka/83/2017		2560	2560	640	2560	5120	1280	2560	2560	1280	5120	1280	2560	SIAT2	22/08/2017	
21	A/Victoria/698/2017		2560	1280	640	2560	5120	1280	2560	5120	1280	5120	1280	5120	SIAT1	2/09/2017	
22	A/Perth/235/2017		5120	5120	640	2560	5120	1280	2560	5120	1280	5120	1280	5120	SIAT1	30/08/2017	
23	A/Canberra/1002/2017	**6B.1**	1280	1280	320	1280	2560	640	2560	2560	640	2560	640	2560	SIAT1	2/08/2017	
24	A/Tasmania/1005/2017	**6B.1**	1280	1280	320	1280	2560	640	1280	2560	640	2560	640	2560	SIAT1	4/08/2017	
25	A/South-Africa/R05836/17	**6B.1**	640	320	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK1	3/07/2017	
26	A/South-Africa/R06491/17		1280	640	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK1	10/07/2017	
27	A/Brisbane/111/2017		1280	1280	320	1280	2560	640	1280	2560	640	2560	640	2560	MDCK2	18/07/2017	
28	A/Tasmania/56/2017	**6B.1**	1280	1280	640	1280	5120	640	2560	2560	640	5120	640	2560	SIAT1	12/08/2017	
29	A/Victoria/2058/2017	**6B.1**	1280	1280	640	1280	2560	640	2560	2560	640	2560	640	2560	SIAT1	2/08/2017	
30	A/Victoria/807/2017		1280	1280	320	1280	2560	640	1280	1280	640	2560	640	2560	SIAT1	17/08/2017	
31	A/Auckland/503/2017		1280	1280	320	1280	2560	640	1280	2560	640	2560	640	2560	MDCK1	4/08/2017	
32	A/Auckland/517/2017	**6B.1**	640	640	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK1	17/08/2017	
33	A/New castle/109/2017		640	640	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK1	11/08/2017	
34	A/Sri Lanka/61/2017	**6B.1**	1280	1280	640	1280	5120	640	2560	2560	640	2560	640	2560	MDCK1	11/07/2017	
35	A/Brisbane/130/2017		1280	1280	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK2	7/08/2017	
36	A/Brisbane/134/2017		640	320	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK2	10/08/2017	
37	A/Brisbane/145/2017		1280	640	320	1280	2560	640	1280	1280	640	2560	640	2560	MDCK2	21/08/2017	
38	A/Brisbane/131/2017		640	640	320	640	1280	640	1280	1280	640	2560	640	1280	MDCK2	7/08/2017	
39	A/Tow nsville/11/2017	**6B.1**	320	160	160	320	640	320	640	640	320	640	320	640	MDCK2	22/07/2017	
40	A/Brisbane/114/2017		320	320	160	320	640	320	640	640	320	1280	320	640	MDCK2	25/07/2017	
41	A/Brisbane/117/2017	**6B.1**	320	320	160	640	640	320	1280	640	320	1280	320	1280	MDCK2	29/07/2017	

Figure 3.2. Phylogenetic relationships among influenza A(H1N1)pdm09 HA genes

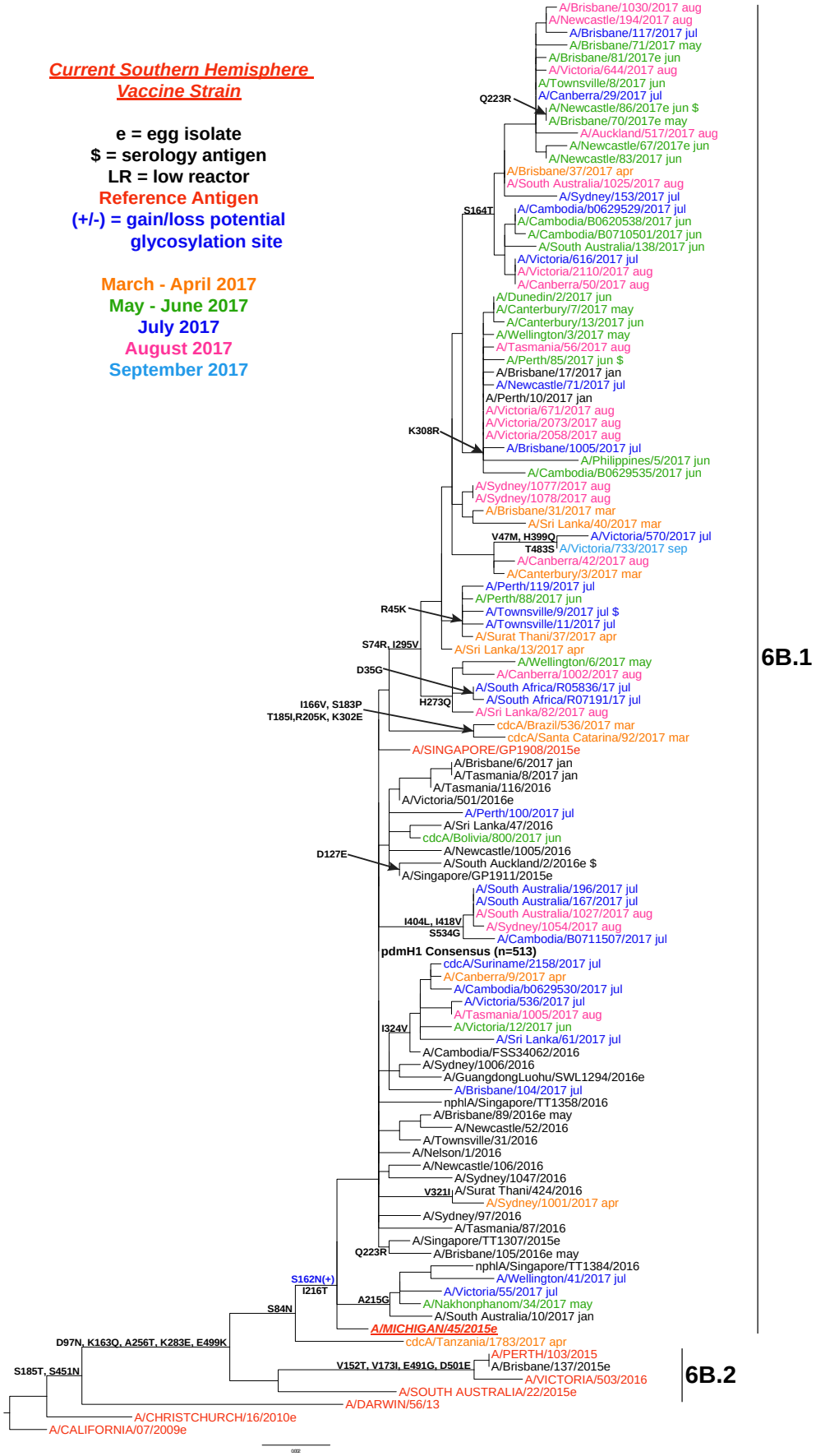


Figure 3.3. Phylogenetic relationships among influenza A(H1N1)pdm09 N1 neuraminidase genes

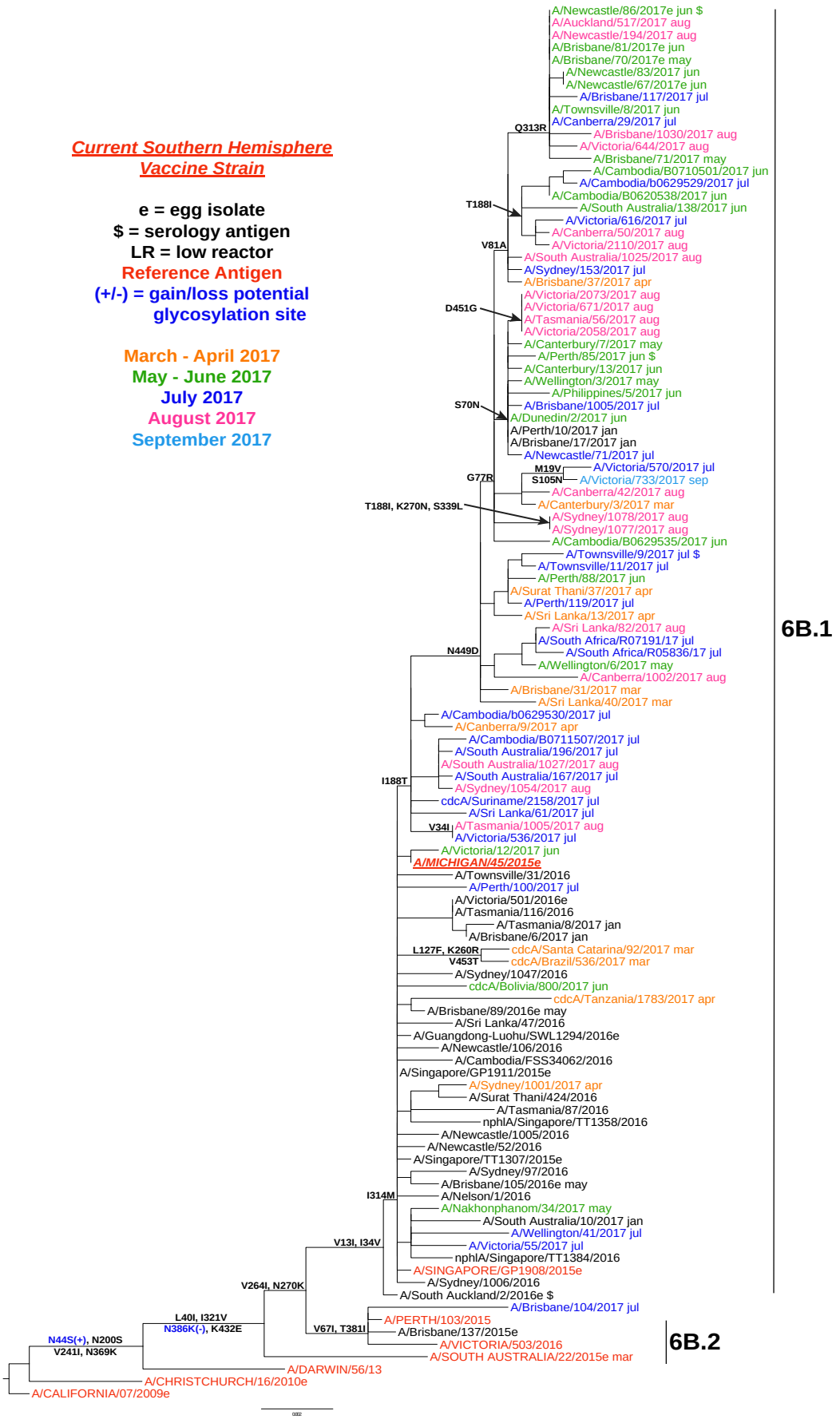


Table 3.5: Analysis of A(H1N1)pdm09 Viruses with Ferret and Human Sera – CDC

Table 5-12. Antigenic analyses of influenza A(H1N1)pdm09 viruses (2017-09-19)

Viruses	Other information	Passage history Ferret number Genetic group	Collection date	Passage history	Haemagglutination inhibition titre Post-infection ferret anticera A/Mich 46/16 Egg NIB F42/16[*1] 6B.1	A/Cal 7/09 Egg F06/18[*1]	A/Bayern 68/09 MDCK F09/15[*1]	A/Lviv N8/09 MDCK F14/13[*1]	A/Astrak 1/11 MDCK F22/13[*1] 5	A/St. P 27/11 Egg F26/14[*1] 8	A/St. P 100/11 Egg F24/11[*1] 7	A/HK 5868/12 MDCK F30/12[*1] 6A	A/Sth Afr 3626/13 Egg F03/14[*1] 6B	A/Slov 2903/2015 Egg F02/16[*2] 6B.1	A/Israel Q-504/16 MDCK F08/16[*2] 6B.2	
REFERENCE VIRUSES																
A/Michigan/45/2016		6B.1	2015-09-07	E3/E2	1280	1280	640	320	1280	640	2560	1280	1280	2560	1280	
A/California/7/2009	clone 38-32		2009-04-09	E3/E3	320	320	320	160	640	320	1280	640	640	1280	640	G156E
A/Bayern/68/2009			2009-07-01	MDCK6/MDCK1	< 40	320	160	40	< 80	40	40	80	40	G156E>G, D222G		
A/Lviv/N8/2009			2009-10-27	MDCK4/SIAT1/MDCK3	40	80	640	640	160	80	160	160	80	320	80	
A/Astrakhan/1/2011		5	2011-02-28	MDCK1/MDCK5	640	640	640	320	2560	640	2560	2560	1280	2560	1280	
A/St. Petersburg/27/2011		8	2011-02-14	E1/E3	640	640	640	320	1280	320	2560	1280	640	1280	1280	
A/St. Petersburg/100/2011		7	2011-03-14	E1/E6	640	640	640	320	1280	320	2560	1280	640	2560	1280	
A/Hong Kong/5868/2012		6A	2012-06-21	MDCK4/MDCK2	160	320	160	80	320	160	1280	640	320	640	320	
A/South Africa/3626/2013		6B	2013-06-06	E1/E3	640	320	320	320	640	320	1280	640	1280	1280	640	
A/Slovenia/2903/2015	clone 37	6B.1	2015-10-26	E4/E1	640	640	320	320	1280	640	2560	1280	1280	2560	1280	
A/Israel/Q-504/2015		6B.2	2015-12-15	C1/MDCK2	1280	640	320	320	1280	320	2560	1280	1280	2560	2560	
TEST VIRUSES																
A/Hong Kong/2106/2017		6B.1	2017-06-10	MDCK2	640	640	640	160	640	320	2560	1280	1280	2560	1280	
A/Hong Kong/2109/2017		6B.1	2017-06-12	MDCK2	640	640	640	160	640	320	1280	1280	640	2560	1280	
A/Hong Kong/2111/2017		6B.1	2017-06-15	MDCK2	640	640	640	160	640	320	2560	1280	640	2560	1280	
A/Hong Kong/2113/2017		6B.1	2017-06-13	MDCK2	640	640	320	160	640	320	1280	640	640	2560	1280	
A/Hong Kong/2198/2017		6B.1	2017-06-16	MDCK2	640	640	320	160	640	320	2560	1280	640	2560	1280	
A/Hong Kong/2201/2017		6B.1	2017-06-18	MDCK2	640	640	640	320	640	320	2560	1280	640	2560	1280	
A/Hong Kong/2238/2017		6B.1	2017-06-19	MDCK1	640	640	320	160	640	320	2560	1280	640	2560	1280	
A/Hong Kong/2240/2017		6B.1	2017-06-20	MDCK1	640	640	320	160	640	320	1280	640	640	1280	1280	
A/Hong Kong/2242/2017		6B.1	2017-06-20	MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	2560	2560	
A/Hong Kong/2243/2017		6B.1	2017-06-21	MDCK1	640	640	320	160	640	320	1280	640	640	1280	640	
A/Hong Kong/2246/2017		6B.1	2017-06-21	MDCK1	640	640	320	160	640	320	2560	1280	640	2560	1280	
A/Hong Kong/2311/2017		6B.1	2017-06-24	MDCK1	640	640	320	320	640	320	2560	1280	640	2560	1280	

* Superscripts refer to anticerum properties (< relates to the lowest dilution of anticerum used)

1 < = <40; 2 < = <80

Vaccine

Sequences in phylogenetic trees

Table 3.7: HI Human Antibody Responses pre and post vaccination to H1N1 pdm09 Viruses – YOUNG ADULTS

Test Antigen	Panel	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Michigan/45/2016	AUS	24	E4	75.0	44.9	207.5	2.2	62.5	91.7	87.5	79.2
A/Newcastle/86/2017	AUS	24	MDCK2	66.7	9.2	41.2	2.2	12.5	70.8	45.8	25.0
A/Newcastle/86/2017	AUS	24	E3	70.8	14.1	67.3	2.3	29.2	83.3	66.7	33.3
A/Perth/85/2017	AUS	24	MDCK3	70.8	10.6	55.0	2.4	25.0	75.0	50.0	37.5
A/Townsville/9/2017	AUS	24	MDCK3	62	10	40	1.9	17	67	38	33
A/South Auckland/2/2016	AUS	24	SIATX/MDCK2	75.0	13.0	80.0	2.6	29.2	79.2	75.0	45.8
A/South Auckland/2/2016	AUS	24	E3	58.3	14.6	61.7	2.1	25.0	62.5	62.5	45.8

Table 3.8: HI Human Antibody Responses pre and post vaccination to H1N1 pdm09 Viruses – OLDER ADULTS

Test Antigen	Panel	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Michigan/45/2016	AUS	24	E4	66.7	37.8	169.5	2.2	45.8	100.0	87.5	66.7
A/Newcastle/86/2017	AUS	24	MDCK2	41.7	9.7	25.2	1.4	16.7	45.8	29.2	12.5
A/Newcastle/86/2017	AUS	24	E3	50.0	13.7	42.4	1.6	20.8	70.8	37.5	20.8
A/Perth/85/2017	AUS	24	MDCK3	41.7	8.9	26.7	1.6	12.5	45.8	29.2	16.7
A/Townsville/9/2017	AUS	24	MDCK3	41.7	7.7	20.6	1.4	8.3	29.2	20.8	8.3
A/South Auckland/2/2016	AUS	24	SIATX/MDCK2	54.2	11.6	55.0	2.3	25.0	79.2	50.0	25.0
A/South Auckland/2/2016	AUS	24	E3	58.3	11.9	43.6	1.9	16.7	75.0	37.5	16.7

APPENDIX 4 - INFLUENZA A (H3N2)

Table 4.2 Summary – HI Characterization of Influenza A(H3N2) Isolates

	Australia New Zealand	Pacific	SE Asia	Africa	East Asia	South Asia	Total (%)
1 February – 16 September 2015 (Based on Sample Date)							
A/Switzerland/9715293/2013-like (cell)	228	4	39	0	0	1	272 (97%)
A/Switzerland/9715293/2013 (low)* (cell)	7	0	2	0	0	0	9 (3%)
A/Switzerland/9715293/2013-like (egg)	108	1	9	0	0	1	119 (42%)
A/Switzerland/9715293/2013 (low)* (egg)	127	3	32	0	0	0	162 (58%)
1 September 2015 – 18 February 2016 (Based on Sample Date)							
A/Switzerland/9715293/2013-like (cell)	56	0	0	0	0	0	56 (98%)
A/Switzerland/9715293/2013 (low)* (cell)	1	0	0	0	0	0	1 (2%)
A/Switzerland/9715293/2013-like (egg)	40	0	0	0	0	0	40 (70%)
A/Switzerland/9715293/2013 (low)* (egg)	17	0	0	0	0	0	17 (30%)
A/Hong Kong/4801/2014-like (cell)	17	2	38	0	0	8	65 (100%)
A/Hong Kong/4801/2014 (low)** (cell)	0	0	0	0	0	0	0 (0%)
A/Hong Kong/4801/2014-like (egg)	10	2	32	0	0	3	47 (72%)
A/Hong Kong/4801/2014-like (low)** (egg)	7	0	6	0	0	5	18 (28%)
1 February – 22 September 2016 (Based on Sample Date)							
A/Hong Kong/4801/2014-like (cell)	294	2	25	7	0	1	329 (92%)
A/Hong Kong/4801/2014 (low)* (cell)	25	1	1	0	0	0	27 (8%)
A/Hong Kong/4801/2014-like (egg)	160	2	19	0	0	0	181 (51%)
A/Hong Kong/4801/2014-like (low)* (egg)	159	1	7	7	0	1	175 (49%)
A/Hong Kong/4801/2014-like (cell)	165	1	16	5	0	1	188 (53%)
A/Hong Kong/4801/2014 (low)** (cell)	154	2	10	2	0	0	168 (47%)
A/Hong Kong/4801/2014-like (egg)	42	0	7	0	0	0	49 (14%)
A/Hong Kong/4801/2014-like (low)** (egg)	277	3	19	7	0	1	307 (86%)
1 September 2016 – 21 February 2017 (Based on Sample Date)							
A/Hong Kong/4801/2014-like (cell)	86	0	0	0	0	0	86 (63%)
A/Hong Kong/4801/2014 (low)* (cell)	50	0	0	0	0	0	50 (37%)
A/Hong Kong/4801/2014-like (egg)	94	1	5	0	0	3	103 (37%)
A/Hong Kong/4801/2014-like (low)* (egg)	169	0	6	0	0	0	175 (63%)
A/Hong Kong/4801/2014-like (cell)	46	0	0	0	0	0	46 (34%)
A/Hong Kong/4801/2014 (low)** (cell)	90	0	0	0	0	0	90 (66%)
A/Hong Kong/4801/2014-like (egg)	14	0	0	0	0	2	16 (6%)
A/Hong Kong/4801/2014-like (low)** (egg)	249	1	11	0	0	1	262 (94%)
1 February – 19 September 2017 (Based on Sample Date)							
A/Michigan/15/2014-like* (cell)	433	13	31	10	1	3	491 (81%)
A/Michigan/15/2014-like (low)* (cell)	103	6	5	2	0	0	116 (19%)
A/Hong Kong/4801/2014-like* (egg)	340	5	27	9	1	1	383 (61%)
A/Hong Kong/4801/2014-like (low)* (egg)	216	16	9	3	0	2	246 (39%)
A/Michigan/15/2014-like** (cell)	242	9	15	7	1	0	274 (45%)
A/Michigan/15/2014-like (low)** (cell)	294	10	21	5	0	3	333 (55%)
A/Hong Kong/4801/2014-like** (egg)	112	1	9	6	0	0	128 (20%)
A/Hong Kong/4801/2014-like (low)** (egg)	444	20	27	6	1	3	501 (80%)

* 8 fold lower in HI assays

** 4 fold lower in HI assays

Table 4.3
HI summary of fold differences for different ferret antisera

Antisera against	Clade	Substitutions	<4-fold	4-fold	≥8-fold (%)	Total
A/Alaska/232/2015 egg	3C.2a1	N171K,I406V,G484E	20	5	**0 (100)**	25
A/Brisbane/296/2016 cell	3C.2a1	N121K,G479E	286	41	**9 (3)**	336
A/Brisbane/32/2017 cell	3C.2a	N31S,D53N,R142G,S144R	32	46	**258 (77)**	336
A/Brisbane/32/2017 egg	3C.2a	N31S,D53N,R142G,S144R	41	49	**115 (56)**	205
A/Brisbane/321/2016 cell	3C.2a	T131,R142K,R261Q	24	41	**66 (50)**	131
A/Brisbane/321/2016 egg	3C.2a	T131,R142K,R261Q	0	0	**131 (100)**	131
A/Christchurch/5/2016 cell	3C.3a	-	124	107	**43 (16)**	274
A/Hong Kong/4801/2014 cell	3C.2a	-	18	55	**58 (44)**	131
A/Hong Kong/4801/2014 egg	3C.2a	-	114	214	**307 (48)**	635
A/Hong Kong/50/2014 egg	3C.2a	-	3	6	**306 (97)**	315
A/Hong Kong/7127/2014 cell	3C.2a	-	247	50	**2 (1)**	299
A/Michigan/15/2014 cell	3C.2a	-	286	224	**125 (20)**	635
A/Newcastle/22/2014 cell	3C.3b	-	0	0	**289 (100)**	289
A/Newcastle/30/2016 cell	3C.2a1	N121K,G479E	372	169	**94 (15)**	635
A/Norway/3806/2016 egg	3C.2a1	N121K,G479E	100	155	**249 (50%)**	504
A/Singapore/GP2646/2016 cell	3C.2a1	K92R,H311Q	29	67	**178 (65)**	274
A/Singapore/GP2646/2016 egg	3C.2a1	K92R,H311Q	49	3	**222 (81)**	274
A/SINGAPORE/INFMHI-16-0019/2016 egg	3C.2a1	N121K,G479E	14	14	**15 (35)**	43
A/Singapore/TT1374/2016 cell	3C.2a	N121K,S144K	109	22	**0 (0)**	131
A/Singapore/TT1374/2016 egg	3C.2a	N121K,S144K	8	56	**67 (51)**	131
A/South Auckland/23/2016 cell	3C.3a	-	18	5	**2 (8)**	25
A/South Auckland/43/2017 cell	3C.3a	-	157	28	**20 (10)**	205
A/South Australia/40/2016 cell	3C.2a1	N121K, I58V, I214V	401	85	**18 (4)**	504
A/South Australia/84/2017 cell	3C.2a1	K92R,H311Q,I58V,I214T	130	10	**3 (2)**	143
A/Switzerland/9715293/2013 cell	3C.3a	-	192	229	**169 (29)**	590
A/Switzerland/9715293/2013 egg	3C.3a	-	21	22	**318 (88)**	361
IVR182 (A/Norway/3806/2016)	3C.2a1	N121K,G479E	0	1	**9 (90)**	10

Table 4.6: A(H3N2) HA gene clades distribution by country (2017) sequenced by Melbourne CC

Country	3C.2a	3C.2a1	3C.3a	Total
Australia	392	328	16	**736**
Fiji	20	0	0	**20**
New Zealand	34	39	0	**73**
Nouvelle Caledonia	1	0	0	**1**
Papua New Guinea	0	1	0	**1**
Philippines	0	2	0	**2**
Sri Lanka	1	5	0	**6**
South Africa	1	6	0	**7**
Thailand	2	2	0	**4**
Other	2	0	0	**2**
Total	**453**	**383**	**16**	**852**

Table 4.9: A(H3) A(H3) viruses (1)

			Haemagglutination Inhibition Assay - WHO Influenza Centre															
			Reference Antisera															
	September 19, 2017		A	B	C	D	E	F	G	H	I	J	K	L				
			F3814-14D	F3491-14D	F3419-14D	F4212-13D	F4294-13D	F4295-13D	F4293-13D	F4297-13D	F3644-13D	F4264-13D	F4265-13D	F4296-13D	Passage	Sam ple		
			M1,S1,SIAT3	MX,M1,S1	E6	E4	M1,S1	E6	M1,S1	E6	SIAT1	M1,S2	E6	E5	Details	Date		Group
			Mich/15	HK/4801	HK/4801	Bris/32	BRIS/321	BRIS/321	Sing/TT1374	Sing/TT1374	NEWC/30	Sing/GP2646	Sing/GP2646	Sing16-0019				
	Reference Antigens	**Clade**	3C.2a						3c.2a1									
A	A/MICHIGAN/15/2014	**3c.2a**	**160**	160	160	80	80	40	80	160	320	160	80	160	M1,S1,SIAT3			
B	A/HONG KONG/4801/2014	**3c.2a**	320	**320**	320	160	320	320	320	640	640	640	160	640	MX,M1,S3			
C	A/HONG KONG/4801/2014	**3c.2a**	320	160	**320**	40	320	320	320	160	640	160	160	640	E7			
D	A/BRISBANE/32/2017	**3c.2a**	160	40	160	**320**	40	80	160	80	640	80	160	160	E4			N31S,D53N
E	A/BRISBANE/321/2016	**3c.2a**	80	80	80	40	**640**	160	80	320	320	160	40	160	M1,S2			T131K,R142G
F	A/BRISBANE/321/2016	**3c.2a**	320	320	640	80	2560	**2560**	320	320	1280	320	320	640	E6			T131K,R142G
G	A/SINGAPORE/TT1374/2016	**3c.2a1**	40	40	40	40	80	<40	**80**	320	320	160	40	80	M1,S2			N121K,S144K
H	A/SINGAPORE/TT1374/2016	**3c.2a1**	160	160	160	80	160	160	640	**640**	640	320	320	320	E6			N121K,S144K
I	A/NEWCASTLE/30/2016	**3c.2a1**	320	160	80	80	160	80	80	160	**640**	160	80	160	S1,S5			
J	A/SINGAPORE/GP2646/2016	**3c.2a1**	160	160	160	320	320	160	320	640	1280	**1280**	320	320	M1,S2			K92R,H311Q
K	A/SINGAPORE/GP2646/2016	**3c.2a1**	160	80	80	80	80	80	160	80	160	640	**1280**	160	E6			K92R,H311Q
L	A/SINGAPORE/INFMHI-16-0019/2016	**3c.2a1**	80	80	320	80	80	160	320	160	1280	320	320	**320**	E5			
	Test Antigens																	
1	A/Tasmania/37/2017		640	160	320	160	320	80	160	160	640	160	160	320	E7	20/07/2017		K92R,I58V,I214T,H311Q
2	A/Victoria/107/2017		160	80	160	40	160	40	80	320	320	320	40	320	SIAT1	15/08/2017		
3	A/Victoria/120/2017		160	160	160	80	640	320	160	320	320	320	80	320	SIAT1	19/08/2017		
4	A/Victoria/149/2017		160	80	80	40	320	160	80	320	320	320	40	160	SIAT1	18/08/2017		
5	A/Victoria/76/2017		80	80	40	40	160	40	80	160	160	80	40	80	SIAT1	3/08/2017		
6	A/Victoria/89/2017		80	40	80	<40	40	<40	80	160	160	80	<40	80	SIAT1	20/07/2017		
7	A/Victoria/92/2017		80	80	80	80	80	40	80	160	160	160	40	160	SIAT1	25/07/2017		
8	A/Victoria/102/2017		80	80	80	40	80	40	80	320	320	160	40	160	SIAT1	10/08/2017		
9	A/Victoria/106/2017		80	80	80	40	320	160	80	160	320	160	40	160	SIAT1	15/08/2017		
10	A/Victoria/113/2017		80	80	80	40	320	80	80	160	320	160	<40	80	SIAT1	9/08/2017		
11	A/Victoria/114/2017		80	40	40	40	40	<40	80	160	320	160	40	160	SIAT1	12/08/2017		
12	A/Victoria/142/2017		80	40	40	<40	160	40	80	320	160	160	40	80	SIAT1	26/07/2017		
13	A/Victoria/145/2017		80	40	40	<40	80	40	80	160	160	160	40	80	SIAT1	29/07/2017		
14	A/Victoria/147/2017		80	80	40	160	80	<40	40	40	160	80	40	160	SIAT1	21/08/2017		
15	A/Victoria/148/2017		80	80	80	40	160	40	80	320	320	320	40	160	SIAT1	19/08/2017		
16	A/Victoria/179/2017		80	80	80	40	320	320	80	160	320	160	40	160	SIAT2	29/08/2017		
17	A/Sri Lanka/60/2017		40	40	40	40	40	<40	80	160	80	80	40	40	SIAT2	10/07/2017		
18	A/Sri Lanka/67/2017		40	40	40	40	80	40	40	160	160	160	40	80	SIAT2	16/07/2017		
19	A/Victoria/65/2017		40	40	40	160	40	<40	40	40	160	40	40	80	SIAT1	20/07/2017		
20	A/Victoria/74/2017		40	40	40	<40	40	<40	40	80	160	160	40	80	SIAT1	25/07/2017		
21	A/Victoria/86/2017		40	40	40	80	80	<40	40	80	40	40	<40	40	SIAT1	3/08/2017		
22	A/Victoria/124/2017		40	80	80	160	80	40	80	160	320	160	40	160	SIAT1	8/08/2017		
23	A/Victoria/126/2017		40	40	<40	<40	80	80	40	40	160	80	<40	40	SIAT1	14/08/2017		
24	A/Victoria/134/2017		40	40	40	<40	80	40	<40	80	160	160	<40	80	SIAT1	4/08/2017		
25	A/Victoria/135/2017		40	40	40	40	80	<40	40	160	160	80	40	80	SIAT1	3/08/2017		
26	A/Victoria/136/2017		40	40	40	40	40	<40	40	80	160	80	<40	40	SIAT1	27/07/2017		
27	A/Victoria/137/2017		40	80	80	40	40	<40	80	160	320	160	80	160	SIAT1	21/08/2017		
28	A/Victoria/146/2017		40	40	40	80	80	<40	40	40	160	80	40	80	SIAT1	24/08/2017		
29	A/Victoria/150/2017		40	80	80	160	80	<40	80	80	160	80	40	80	SIAT1	22/08/2017		
30	A/Victoria/151/2017		40	80	40	80	80	<40	40	40	80	40	40	40	SIAT1	7/08/2017		
31	A/Victoria/153/2017		40	80	80	<40	80	<40	80	160	80	160	40	160	SIAT1	4/08/2017		
32	A/Brisbane/152/2017		40	40	40	<40	40	<40	40	160	160	80	40	80	SIAT1	17/08/2017		
33	A/Brisbane/153/2017		40	<40	<40	<40	40	<40	40	80	160	80	<40	40	SIAT1	17/08/2017		
34	A/Perth/236/2017		40	40	40	40	80	40	80	160	160	160	40	40	SIAT1	21/08/2017		
35	A/Victoria/713/2017		40	40	40	<40	40	<40	40	80	80	40	<40	80	SIAT1	30/08/2017		
36	A/Victoria/723/2017		40	40	40	80	40	<40	80	40	40	40	40	40	SIAT1	3/09/2017		
37	A/Victoria/79/2017		<40	<40	<40	160	<40	40	40	40	<40	<40	<40	<40	SIAT1	1/08/2017		
38	A/Victoria/128/2017		<40	<40	<40	40	40	<40	<40	40	80	40	<40	40	SIAT1	3/08/2017		
39	A/Victoria/700/2017		<40	<40	<40	<40	40	<40	<40	40	40	40	<40	40	SIAT1	30/08/2017		
40	A/Victoria/704/2017		<40	<40	<40	<40	40	<40	<40	80	80	40	<40	40	SIAT1	30/08/2017		
41	A/Victoria/715/2017		<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	SIAT1	31/08/2017		
42	A/Victoria/718/2017		<40	<40	40	<40	<40	<40	<40	40	40	<40	<40	<40	SIAT1	31/08/2017		
43	A/Victoria/720/2017		<40	<40	<40	80	40	<40	<40	40	40	<40	<40	<40	SIAT1	2/09/2017		

Table 4.9: A(H3) viruses (2)

Haemagglutination Inhibition Assay - WHO Influenza Centre																	
			Reference Antisera														
	September 6, 2017, Part A		A	B	C	D	E	F	G	H	I	J	K	L			
			F3419-14D	F3814-14D	F4160-13D	F4212-13D	F3813-14D	F3644-13D	F3966-13D	F4214-13D	F4264	F4265	F4266	F3418 - 15D	Passage	Sam ple	
			E6	M1,S1,S3	MX,S2	E4	S1,M1	SIAT1	E8	S1,S4	M1,S1	E6	SIAT1	S1/S4	Details	Date	Group
			HK/4801	Mich/15	Bris/32	Bris/32	S.Aus/40	NEWC/30	NWY/3806	S.Auck/43	Sing/GP2646	Sing/GP2646	S.Aus/84	Sw itz/9715293			
	Reference Antigens	**Clade**	**3c.2a**				**3c.2a1**							**3C.3a**			
A	A/HONG KONG/4801/2014	**3c.2a**	**640**	640	40	160	160	2560	640	80	640	640	320	80	E7		
B	A/MICHIGAN/15/2014	**3c.2a**	160	**320**	40	160	640	640	160	160	320	160	320	160	M1,S1,S4		
C	A/BRISBANE/32/2017	**3c.2a**	80	160	**640**	640	320	320	80	160	80	80	160	80	M2,S2		N31S,D53N
D	A/BRISBANE/32/2017	**3c.2a**	160	160	320	**640**	80	640	320	80	160	160	80	40	E4		N31S,D53N
E	A/SOUTH AUSTRALIA/40/2016	**3c.2a1**	160	160	<40	160	**320**	320	160	160	320	80	160	80	S1,M1,S2		
F	A/NEWCASTLE/30/2016	**3c.2a1**	160	320	<40	160	320	**640**	160	160	320	160	320	160	S1,S5		
G	A/NORWAY/3806/2016	**3c.2a1**	640	320	40	160	160	2560	**640**	160	320	640	640	80	E8		
H	A/SOUTH AUCKLAND/43/2017	**3c.2a1**	80	80	<40	80	160	320	80	**320**	160	<40	160	80	S1,S4		
I	A/Singapore/GP2646/2016	**3c.2a1**	160	160	40	160	320	640	160	160	**640**	160	320	160	M1,S2		K92R,H311Q
J	A/Singapore/GP2646/2016	**3c.2a1**	160	160	40	160	160	160	160	320	640	**1280**	80	80	E6		K92R,H311Q
K	A/South Australia/84/2017	**3c.2a1**	40	40	<40	40	40	80	80	80	80	<40	**80**	40	SIAT3		
L	A/SWITZERLAND/9715293/2013	**3c.3a**	80	80	<40	40	80	160	40	80	80	160	80	**320**	S1/S7		
	Test Antigens																
1	A/Tasmania/18/2017		640	640	40	80	160	1280	640	80	640	640	640	80	E4	16/07/2017	T131K,R142K,R261Q
2	A/Brisbane/122/2017		320	320	80	160	320	640	320	320	640	160	320	320	M3,S1	19/07/2017	
3	A/Brisbane/124/2017		320	320	320	640	640	640	320	320	320	160	320	160	SIAT2	7/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
4	A/Tow nsville/12/2017		320	320	320	640	640	640	320	320	320	160	320	320	SIAT4	10/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
5	A/Tow nsville/13/2017		320	320	80	160	640	640	320	320	640	160	160	320	M3,S1	19/07/2017	N121K,S144K
6	A/Brisbane/119/2017		160	320	<40	160	320	320	160	320	80	80	160	160	M1,S1	1/08/2017	N121K,T135K,G479E
7	A/Brisbane/125/2017		160	320	40	160	160	320	160	640	80	80	160	160	M1,S1	6/08/2017	K92R,H311Q
8	A/Brisbane/113/2017		160	160	160	640	640	320	80	80	40	160	80	80	M1,S1	24/07/2017	
9	A/South-Africa/R04177/17		160	160	40	160	320	320	160	320	320	80	320	160	M1,S2	6/06/2017	
10	A/Tasmania/45/2017		160	160	<40	80	160	320	160	160	320	80	160	80	SIAT1	13/08/2017	T131K,R142K,R261Q
11	A/Tasmania/54/2017		160	160	40	160	320	320	160	320	320	80	320	160	SIAT1	10/08/2017	K92R,H311Q
12	A/Victoria/2074/2017		160	160	160	80	160	320	160	80	320	80	160	160	SIAT1	6/08/2017	T131K,R142K,R261Q
13	A/Brisbane/116/2017		80	160	80	320	640	320	80	80	40	80	80	40	M1,S1	27/07/2017	Other
14	A/Brisbane/120/2017		80	160	40	80	160	160	80	160	80	80	160	80	M2,S1	21/07/2017	
15	A/Brisbane/121/2017		80	160	640	640	320	320	160	160	80	80	160	80	M2,S1	25/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
16	A/Tasmania/48/2017		80	160	40	80	80	320	160	160	160	40	160	160	SIAT1	15/08/2017	K92R,H311Q
17	A/Tasmania/50/2017		80	160	40	160	160	320	160	320	320	80	160	160	SIAT1	5/08/2017	K92R,H311Q
18	A/Tow nsville/1006/2017		80	160	<40	40	320	320	80	160	80	40	80	80	SIAT1	2/08/2017	K92R,H311Q
19	A/Victoria/2060/2017		80	160	40	80	160	320	160	160	320	80	160	160	SIAT1	28/07/2017	N121K,S144K
20	A/Victoria/2071/2017		80	160	40	80	160	320	80	320	160	80	160	160	SIAT1	24/07/2017	
21	A/Brisbane/1027/2017		80	80	80	320	320	320	80	80	40	80	80	40	SIAT1	2/08/2017	Other
22	A/South-Africa/R03755/17		80	80	<40	80	160	160	80	80	160	40	80	80	M1,S2	31/05/2017	
23	A/Sydney/1066/2017		80	80	40	40	80	160	160	160	160	40	160	160	SIAT1	27/07/2017	N121K,S144K
24	A/Tasmania/44/2017		80	80	<40	40	80	160	80	80	160	<40	80	80	SIAT1	11/08/2017	T131K,R142K,R261Q
25	A/Wellington/10/2017		80	80	40	80	160	320	80	160	160	80	160	160	SX,S2	5/07/2017	
26	A/Sydney/1067/2017		40	80	40	80	160	320	80	160	160	80	160	80	SIAT1	31/07/2017	N121K,S144K
27	A/Victoria/2069/2017		40	80	<40	80	160	160	80	160	80	80	160	80	SIAT1	4/08/2017	K92R,H311Q
28	A/Tasmania/49/2017		<40	80	<40	40	80	160	<40	40	80	40	80	40	SIAT1	11/08/2017	T131K,R142K,R261Q
29	A/South Australia/209/2017		80	40	160	320	80	320	160	80	160	160	80	<40	E4	14/07/2017	
30	A/Papua New Guinea/15/2017		40	40	<40	80	80	80	40	80	80	<40	80	40	SIAT1	14/02/2017	
31	A/Sydney/1058/2017		40	40	<40	80	80	160	80	80	80	<40	80	40	SIAT1	1/08/2017	K92R,H311Q
32	A/Tow nsville/1005/2017		40	40	<40	40	40	160	80	80	80	40	80	80	SIAT1	4/08/2017	N121K,S144K
33	A/Wellington/12/2017		40	40	40	80	160	160	80	80	40	40	80	40	SX,S2	4/07/2017	
34	A/Wellington/23/2017		40	40	40	80	80	160	40	80	80	40	80	40	SX,S2	13/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
35	A/Wellington/32/2017		40	40	40	160	80	160	40	80	40	40	80	40	SX,S2	17/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
36	A/Papua New Guinea/14/2017		<40	40	<40	80	80	80	<40	80	80	<40	80	40	SIAT1	9/02/2017	
37	A/Papua New Guinea/17/2017		<40	40	<40	80	80	80	<40	40	80	<40	80	<40	SIAT1	28/02/2017	
38	A/South-Africa/R04960/17		<40	40	<40	40	80	160	40	80	160	<40	40	80	M1,S2	19/06/2017	Other
39	A/Papua New Guinea/16/2017		40	<40	<40	40	80	80	<40	80	80	<40	80	<40	SIAT1	15/02/2017	
40	A/Papua New Guinea/13/2017		<40	<40	<40	40	80	80	<40	40	40	<40	80	<40	SIAT1	6/02/2017	
41	A/Wellington/18/2017		<40	<40	40	40	40	80	40	40	40	<40	40	<40	SX,S2	5/07/2017	
42	A/Wellington/27/2017		<40	<40	<40	40	40	40	40	40	40	<40	40	<40	SX,S2	11/07/2017	K92R,H311Q
43	A/Wellington/28/2017		<40	<40	40	40	40	80	40	40	40	<40	40	<40	MX,S2	12/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
44	A/Wellington/29/2017		<40	<40	40	80	40	80	40	40	40	40	80	<40	SX,S2	4/07/2017	
45	A/Wellington/9/2017		<40	<40	<40	40	40	80	40	40	40	40	80	<40	SX,S2	4/07/2017	

Table 4.11: A(H3) Focus Reduction Assay (1)

			Focus Reduction Assay													
			Reference Antisera													
	September 19, 2017, Part A		A	B	C	D	E	F	G	H	I	J	K			
			F3491-14D	F3419-14D	F4212 - 12D	F4293 - 13D	F4297 - 13D	F4294 - 13D	F4295 - 13D	F3644-13D	F2464 - 13D	F2565 - 13D	F4296 - 13D			
			X/M1/S1	E6	E4	M1,S1	E6	M1,S1	E6	SIAT1	M1,S2	E6	E5			
			HK/4801	HK/4801	BRIS/32	SING/TT1374	SING/TT1374	BRIS/321	BRIS/321	NEWC/30	SING/GP2646	SING/GP2646	SING/16-0019	Passage	Sam ple	
	Reference Antigens	**Clade**	3c.2a							3c.2a1				History	Date	Group
A	A/HONG KONG/4801/2014	**3c.2a**	**640**	1280	640	320	640	640	320	640	640	320	1280	M4/S2		
B	A/HONG KONG/4801/2014	**3c.2a**	640	**1280**	640	2560	2560	1280	2560	5120	1280	1280	2560	E7		
C	A/BRISBANE/32/2017	**3c.2a**	320	320	**5120**	1280	1280	1280	320	2560	1280	640	1280	E4		N31S,D53N
D	A/SINGAPORE/TT1374/2016	**3c.2a**	640	320	640	**2560**	10240	1280	160	640	640	80	640	M1,S1		N121K,S144K
E	A/SINGAPORE/TT1374/2016	**3c.2a**	1280	1280	640	5120	**10240**	640	640	2560	640	1280	1280	E6		N121K,S144K
F	A/BRISBANE/321/2016	**3c.2a**	<80	80	80	80	320	**640**	160	160	320	80	160	M1,S1		T131K,R142G
G	A/BRISBANE/321/2016	**3c.2a**	1280	5120	640	640	5120	>10240	**5120**	2560	2560	1280	2560	E6		T131K,R142G
H	A/NEWCASTLE/30/2016	**3c.2a1**	640	1280	1280	1280	1280	1280	320	**2560**	640	640	1280	SIAT5		
I	A/SINGAPORE/GP2646/2016	**3c.2a1**	320	160	640	160	1280	320	320	320	**640**	640	320	M1,S2		K92R,H311Q
J	A/SINGAPORE/GP2646/2016	**3c.2a1**	320	640	640	640	320	640	1280	640	2560	**5120**	1280	E6		K92R,H311Q
K	A/SINGAPORE/INFIMH-16-0019/2016	**3c.2a1**	320	640	320	1280	1280	320	640	5120	640	640	**1280**	E5		
	Test Antigens															
1	A/TASMANIA/44/2017	**3c.2a**	5120	2560	1280	5120	10240	>10240	10240	2560	2560	640	2560	SIAT1	11/08/2017	T131K,R142K,R261Q
2	A/SYDNEY/1081/2017	**3c.2a**	2560	1280	2560	10240	>10240	2560	640	2560	2560	640	1280	SIAT1	7/08/2017	N121K,S144K
3	A/VICTORIA/2080/2017	**3c.2a**	2560	1280	10240	5120	5120	2560	640	2560	640	640	1280	SIAT1	8/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
4	A/SYDNEY/1085/2017	**3c.2a**	2560	1280	640	1280	2560	>10240	5120	1280	1280	640	1280	SIAT1	31/07/2017	T131K,R142K,R261Q
5	A/TASMANIA/1002/2017	**3c.2a**	2560	2560	640	1280	2560	>10240	5120	1280	2560	640	2560	SIAT1	4/08/2017	T131K,R142K,R261Q
6	A/TASMANIA/1003/2017	**3c.2a**	2560	1280	640	1280	2560	>10240	5120	2560	1280	320	2560	SIAT1	8/08/2017	T131K,R142K,R261Q
7	A/TASMANIA/47/2017	**3c.2a**	2560	2560	1280	10240	10240	>10240	5120	2560	1280	640	1280	SIAT1	10/08/2017	T131K,R142K,R261Q
8	A/TASMANIA/49/2017	**3c.2a**	2560	2560	5120	10240	10240	>10240	>10240	2560	2560	640	2560	SIAT1	11/08/2017	T131K,R142K,R261Q
9	A/WELLINGTON/27/2017	**3c.2a1**	2560	640	1280	1280	5120	2560	320	2560	1280	640	1280	SX,S2	11/07/2017	K92R,H311Q
10	A/TASMANIA/50/2017	**3c.2a1**	2560	1280	2560	5120	10240	2560	1280	5120	1280	640	1280	SIAT1	5/08/2017	K92R,H311Q
11	A/VICTORIA/2074/2017	**3c.2a1**	2560	1280	640	1280	5120	>10240	5120	2560	2560	320	1280	SIAT1	6/08/2017	T131K,R142K,R261Q
12	A/VICTORIA/627/2017	**3c.2a**	1280	1280	640	2560	5120	2560	640	1280	1280	320	1280	SIAT1	4/08/2017	N121K,S144K
13	A/CANBERRA/31/2017	**3c.2a**	1280	640	5120	1280	2560	2560	80	1280	80	<80	1280	SIAT1	24/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
14	A/CANBERRA/36/2017	**3c.2a**	1280	320	5120	1280	2560	2560	320	2560	320	160	2560	SIAT1	27/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
15	A/CANBERRA/38/2017	**3c.2a**	1280	320	5120	2560	2560	5120	320	2560	640	640	1280	SIAT1	28/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
16	A/SYDNEY/1091/2017	**3c.2a**	1280	320	5120	1280	2560	2560	320	1280	640	640	1280	SIAT1	1/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
17	A/SYDNEY/1093/2017	**3c.2a**	1280	320	5120	1280	2560	2560	320	1280	320	320	1280	SIAT1	3/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
18	A/WELLINGTON/28/2017	**3c.2a**	1280	320	5120	1280	2560	1280	320	1280	320	320	640	MX,S2	12/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
19	A/WELLINGTON/31/2017	**3c.2a**	1280	640	5120	2560	2560	2560	640	1280	640	320	1280	SX,S2	14/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
20	A/VICTORIA/2075/2017	**3c.2a**	1280	640	10240	2560	5120	5120	320	2560	640	320	2560	SIAT1	28/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
21	A/TASMANIA/15/2017	**3c.2a1**	1280	320	640	1280	5120	2560	320	2560	1280	320	2560	SIAT1	15/07/2017	K92R,H311Q
22	A/TASMANIA/32/2017	**3c.2a1**	1280	640	1280	2560	2560	1280	640	2560	1280	640	1280	SIAT1	16/07/2017	K92R,H311Q
23	A/SYDNEY/1057/2017	**3c.2a1**	1280	320	640	1280	5120	2560	320	1280	1280	320	1280	SIAT1	1/08/2017	K92R,H311Q
24	A/SYDNEY/1060/2017	**3c.2a1**	1280	640	1280	2560	2560	1280	640	2560	1280	1280	640	SIAT1	1/08/2017	K92R,H311Q

Table 4.11: A(H3) Focus Reduction Assay (2)

			Focus Reduction Assay													
			Reference Antisera													
	September 19, 2017, Part B		A	B	C	D	E	F	G	H	I	J	K			
			F3491-14D	F3419-14D	F4212 - 12D	F4293 - 13D	F4297 - 13D	F4294 - 13D	F4295 - 13D	F3644-13D	F2464 - 13D	F2565 - 13D	F4296 - 13D			
			X/M1/S1	E6	E4	M1,S1	E6	M1,S1	E6	SIAT1	M1,S2	E6	E5			
			HK/4801	HK/4801	BRIS/32	SING/TT1374	SING/TT1374	BRIS/321	BRIS/321	NEWC/30	SING/GP2646	SING/GP2646	SING/16-0019	Passage	Sam ple	
	Reference Antigens	**Clade**	3c.2a							3c.2a1				**History**	**Date**	**Group**
A	A/HONG KONG/4801/2014	**3c.2a**	**640**	1280	640	320	640	640	320	640	640	320	1280	M4/S2		
B	A/HONG KONG/4801/2014	**3c.2a**	640	**1280**	640	2560	2560	1280	2560	5120	1280	1280	2560	E7		
C	A/BRISBANE/32/2017	**3c.2a**	320	320	**5120**	1280	1280	1280	320	2560	1280	640	1280	E4		N31S,D53N
D	A/SINGAPORE/TT1374/2016	**3c.2a**	640	320	640	**2560**	10240	1280	160	640	640	80	640	M1,S1		N121K,S144K
E	A/SINGAPORE/TT1374/2016	**3c.2a**	1280	1280	640	5120	**10240**	640	640	2560	640	1280	1280	E6		N121K,S144K
F	A/BRISBANE/321/2016	**3c.2a**	<80	80	80	80	320	**640**	160	160	320	80	160	M1,S1		T131K,R142G
G	A/BRISBANE/321/2016	**3c.2a**	1280	5120	640	640	5120	>10240	**5120**	2560	2560	1280	2560	E6		T131K,R142G
H	A/NEWCASTLE/30/2016	**3c.2a1**	640	1280	1280	1280	1280	1280	320	**2560**	640	640	1280	SIAT5		
I	A/SINGAPORE/GP2646/2016	**3c.2a1**	320	160	640	160	1280	320	320	320	**640**	640	320	M1,S2		K92R,H311Q
J	A/SINGAPORE/GP2646/2016	**3c.2a1**	320	640	640	640	320	640	1280	640	2560	**5120**	1280	E6		K92R,H311Q
K	A/SINGAPORE/INFIMH-16-0019/2016	**3c.2a1**	320	640	320	1280	1280	320	640	5120	640	640	**1280**	E5		
	Test Antigens															
1	A/SYDNEY/1062/2017	**3c.2a1**	1280	640	640	1280	2560	1280	320	1280	1280	320	640	SIAT1	30/07/2017	K92R,H311Q
2	A/CANBERRA/1001/2017	**3c.2a1**	1280	320	1280	2560	5120	640	320	1280	1280	640	640	SIAT1	31/07/2017	K92R,H311Q
3	A/TASMANIA/54/2017	**3c.2a1**	1280	1280	1280	5120	10240	5120	1280	2560	1280	640	640	SIAT1	10/08/2017	K92R,H311Q
4	A/VICTORIA/2087/2017	**3c.2a1**	1280	1280	1280	2560	5120	5120	1280	2560	2560	320	1280	SIAT1	5/08/2017	K92R,H311Q
5	A/VICTORIA/628/2017	**3c.2a1**	1280	2560	2560	1280	5120	2560	640	5120	1280	1280	1280	SIAT1	4/08/2017	N121K,T135K,G479E
6	A/VICTORIA/2060/2017	**3c.2a**	640	640	320	1280	2560	1280	320	640	1280	160	640	SIAT1	28/07/2017	N121K,S144K
7	A/BRISBANE/1022/2017	**3c.2a**	640	320	2560	640	1280	1280	320	2560	320	320	640	SIAT1	7/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
8	A/WELLINGTON/24/2017	**3c.2a**	640	320	2560	1280	2560	1280	320	640	320	160	640	SX,S2	12/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
9	A/BRISBANE/116/2017	**3c.2a**	640	1280	5120	1280	1280	640	160	1280	320	640	640	M1,S1	27/07/2017	Other
10	A/TASMANIA/12/2017	**3c.2a1**	640	320	640	1280	2560	640	320	2560	640	320	640	640	14/07/2017	K92R,H311Q
11	A/TASMANIA/38/2017	**3c.2a1**	640	320	160	640	2560	640	160	1280	640	320	640	SIAT1	26/07/2017	K92R,H311Q
12	A/TASMANIA/10/2017	**3c.2a1**	640	320	320	1280	2560	640	320	1280	1280	320	640	M1,S1	13/07/2017	K92R,H311Q
13	A/SYDNEY/1049/2017	**3c.2a1**	640	320	640	640	2560	2560	320	1280	640	320	1280	SIAT1	7/08/2017	K92R,H311Q
14	A/BRISBANE/1017/2017	**3c.2a1**	640	320	160	320	1280	640	320	1280	640	320	640	SIAT1	7/08/2017	K92R,H311Q
15	A/VICTORIA/2069/2017	**3c.2a1**	640	320	320	1280	2560	1280	640	1280	1280	320	640	SIAT1	4/08/2017	K92R,H311Q
16	A/SYDNEY/1100/2017	**3c.2a1**	640	640	320	1280	2560	1280	640	2560	2560	640	1280	SIAT1	2/08/2017	N121K,T135K,G479E
17	A/BRISBANE/1019/2017	**3c.2a1**	640	320	320	640	5120	1280	640	2560	1280	640	1280	SIAT1	3/08/2017	N121K,T135K,G479E
18	A/CANBERRA/45/2017	**3c.2a1**	640	2560	1280	2560	5120	2560	640	2560	2560	640	1280	SIAT1	9/08/2017	N121K,T135K,G479E
19	A/VICTORIA/2093/2017	**3c.2a1**	640	640	320	1280	2560	640	320	1280	1280	640	640	SIAT1	1/08/2017	N121K,T135K,G479E
20	A/WELLINGTON/23/2017	**3c.2a**	320	160	2560	320	640	640	320	640	320	320	640	SX,S2	13/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
21	A/TOWNSVILLE/13/2017	**3c.2a**	160	160	160	320	640	160	80	160	160	80	160	M3,S1	19/07/2017	N121K,S144K
22	A/WELLINGTON/32/2017	**3c.2a**	160	80	1280	160	320	320	80	160	80	80	160	SX,S2	17/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
23	A/TOWNSVILLE/12/2017	**3c.2a**	160	80	1280	160	320	320	80	320	80	80	320	SIAT4	10/07/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
24	A/BRISBANE/124/2017	**3c.2a**	160	320	1280	640	640	640	160	320	320	320	320	SIAT2	7/08/2017	N31S,D53N,R142G,S144R,N171K,I192T,K160T
25	A/BRISBANE/125/2017	**3c.2a1**	160	640	640	640	320	320	320	640	320	320	640	M1,S1	6/08/2017	K92R,H311Q

Figure 4.2. Phylogenetic relationships among influenza A(H3) HA genes

Current Southern Hemisphere Vaccine Strain

e = Egg Isolate
$ = Serology Antigen
LR = Low Reactor
Reference Antigen
(+/-) = gain/loss potential glycosylation site

March - April 2017
May - June 2017
July 2017
August 2017
September 2017

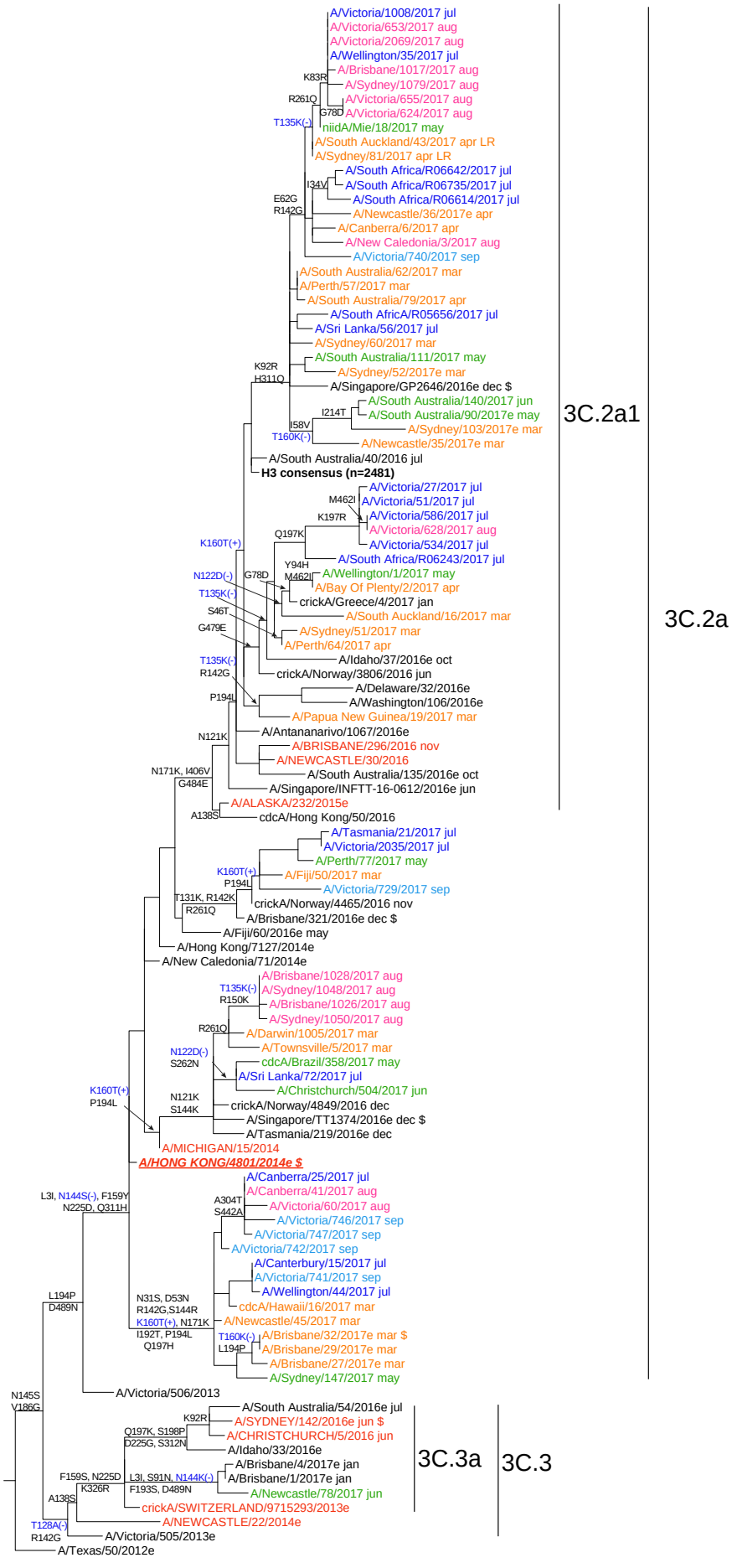


Figure 4.3 Phylogenetic relationships among influenza A (H3) N2 genes

Current Southern Hemisphere Vaccine Strain

e = Egg Isolate
$ = Serology Antigen
LR = Low Reactor
Reference Antigen
(+/-) = gain/loss potential glycosylation site

March - April 2017
May - June 2017
July 2017
August 2017
September 2017

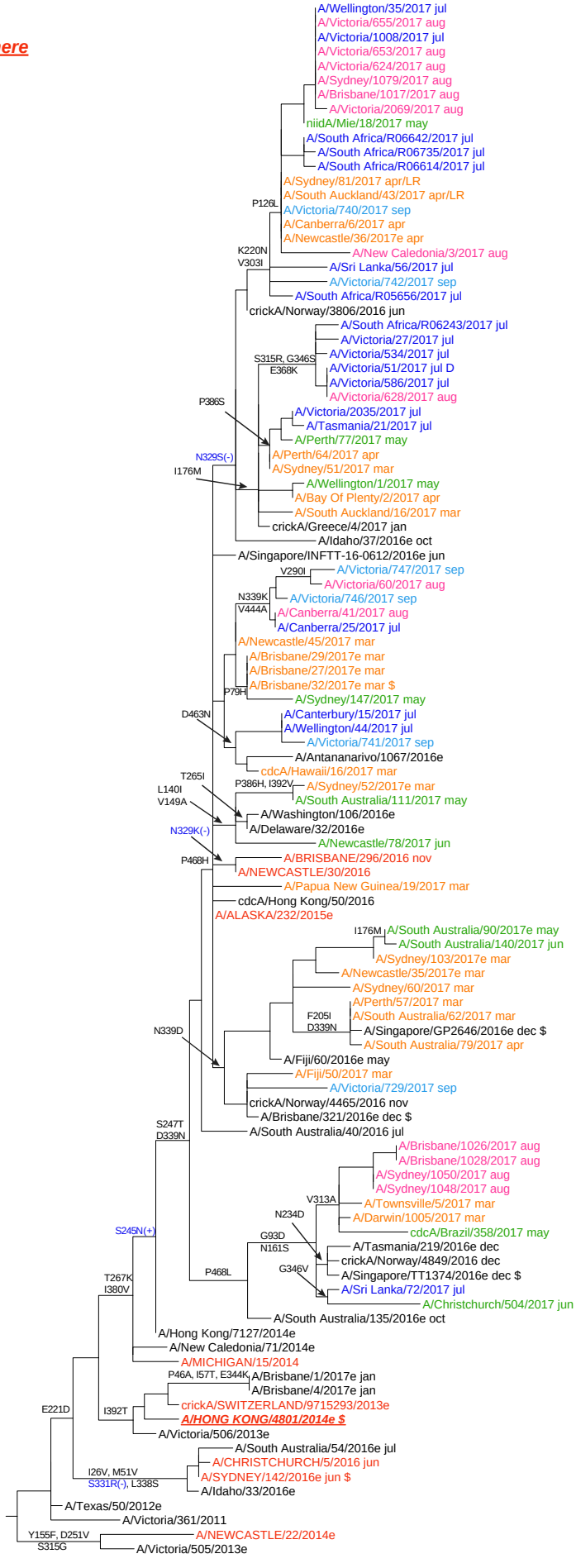


Table 4.16: HI Human Antibody Responses pre and post vaccination to A(H3N2) Viruses – YOUNG ADULTS

Test Antigen	Clade	Subs	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	E7-oselt	54.2	50.4	219.8	2.1	83.3	100.0	100.0	62.5
A/Michigan/15/2014	3C.2a	-	AUS	24	M1/S1/SIAT4-oselt	16.7	10.6	15.9	0.5	0.0	16.7	12.5	4.2
A/Brisbane/321/2017	3C.2a	T131K,R142G	AUS	24	MDCK1/SIAT2-oselt	20.8	10.6	17.8	0.6	8.3	41.7	16.7	0.0
A/Brisbane/321/2017	3C.2a	T131K,R142G	AUS	24	E6-oselt	29.2	47.6	113.1	1.3	87.5	100.0	91.7	37.5
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	MDCK1/SIAT2-oselt	8.3	15.4	15.4	0.0	12.5	16.7	4.2	0.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	E6	45.8	25.9	77.7	1.6	45.8	95.8	58.3	29.2
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	MDCK2/SIAT2-oselt	33.3	55.0	138.5	1.3	75.0	95.8	75.0	50.0
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	E4-oselt	41.7	28.3	100.8	1.8	58.3	100.0	79.2	29.2
A/Sydney/142/2016	3C.3a		AUS	24	SIAT5-oselt	38	27	78	1.5	33	75	54	46
A/Sydney/142/2016	3C.3a		AUS	24	E4-oselt	37.5	47.6	134.5	1.5	70.8	100.0	91.7	50.0
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	E6-oselt	37.5	75.5	184.9	1.3	95.8	100.0	100.0	66.7
A/Hong Kong/4801/2014	3C.2a	-	US	20	E7-oselt	80.0	12.3	226.3	3.7	35.0	95.0	90.0	70.0
A/Michigan/15/2014	3C.2a	-	US	20	M1/S1/SIAT4-oselt	45.0	5.0	27.3	1.6	0.0	45.0	20.0	10.0
A/Brisbane/321/2017	3C.2a	T131K,R142G	US	20	E6-oselt	75	10	117	2.95	20	90	70	45
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	US	20	MDCK1/SIAT2-oselt	20.0	5.0	18.0	1.1	0.0	20.0	15.0	0.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	US	20	E6-oselt	85	11	211	3.7	25	95	90	70
A/Brisbane/32/2017	3C.2a	N31S,D53N	US	20	MDCK2/SIAT2-oselt	75.0	27.3	171.5	2.5	55.0	100.0	95.0	55.0
A/Brisbane/32/2017	3C.2a	N31S,D53N	US	20	E4-oselt	80	14	226	3.55	30	100	90	70
A/Sydney/142/2016	3C.3a		US	20	SIAT5-oselt	75.0	9.0	105.6	2.9	10.0	85.0	70.0	45.0
A/Sydney/142/2016	3C.3a		US	20	E4-oselt	80.0	14.6	160.0	3.1	25.0	90.0	85.0	60.0
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	US	20	E6-oselt	70	21	178	2.75	45	95	95	70

Table 4.17: HI Human Antibody Responses pre and post vaccination to A(H3N2) Viruses – OLDER ADULTS

Test Antigen	Clade	Subs	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	E7-oselt	33.3	103.7	232.9	1.2	87.5	100.0	95.8	75.0
A/Michigan/15/2014	3C.2a	-	AUS	24	M1/S1/SIAT4-oselt	12.5	13.0	18.3	0.4	4.2	20.8	8.3	0.0
A/Brisbane/321/2017	3C.2a	T131K,R142G	AUS	24	MDCK1/SIAT2-oselt	12.5	22.4	32.7	0.5	41.7	58.3	29.2	8.3
A/Brisbane/321/2017	3C.2a	T131K,R142G	AUS	24	E6-oselt	8.3	73.4	116.5	0.7	100.0	100.0	91.7	41.7
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	MDCK1/SIAT2-oselt	8.3	18.3	25.2	0.4	29.2	45.8	12.5	0.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	E6	33.3	41.2	97.9	1.3	70.8	91.7	79.2	41.7
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	MDCK2/SIAT2-oselt	12.5	113.1	184.9	0.7	87.5	100.0	91.7	62.5
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	E4	33.3	49.0	103.7	1.1	70.8	91.7	79.2	41.7
A/Sydney/142/2016	3C.3a	-	AUS	24	SIAT5-oselt	25.0	56.6	103.7	0.9	75.0	91.7	70.8	41.7
A/Sydney/142/2016	3C.3a	-	AUS	24	E4-oselt	16.7	106.8	174.5	0.7	91.7	95.8	87.5	66.7
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	E6-oselt	8.3	100.8	169.5	0.8	100.0	100.0	87.5	66.7
A/Hong Kong/4801/2014	3C.2a	-	US	24	E7-oselt	66.7	23.1	151.0	2.4	37.5	95.8	75.0	62.5
A/Michigan/15/2014	3C.2a	-	US	24	M1/S1/SIAT4-oselt	16.7	8.2	18.3	0.8	12.5	37.5	20.8	4.2
A/Brisbane/321/2017	3C.2a	T131K,R142G	US	24	E6-oselt	50.0	27.5	77.7	1.4	62.5	83.3	62.5	41.7
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	US	24	MDCK1/SIAT2-oselt	20.8	6.9	13.0	0.7	4.2	29.2	16.7	0.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	US	24	E6	50.0	14.1	58.2	2.0	25.0	75.0	50.0	41.7
A/Brisbane/32/2017	3C.2a	N31S,D53N	US	24	MDCK2/SIAT2-oselt	33.3	43.6	134.5	1.4	70.8	87.5	70.8	62.5
A/Brisbane/32/2017	3C.2a	N31S,D53N	US	24	E4	58.3	17.3	75.5	2.1	37.5	66.7	62.5	45.8
A/Sydney/142/2016	3C.3a	-	US	24	SIAT5-oselt	41.7	14.6	59.9	1.7	25.0	75.0	58.3	33.3
A/Sydney/142/2016	3C.3a	-	US	24	E4-oselt	41.7	27.5	100.8	1.7	45.8	83.3	79.2	45.8
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	US	24	E6-oselt	37.5	20.6	82.3	1.7	41.7	83.3	66.7	45.8

Table 4.18: Summary of FRA Antigen Response: A(H3N2) viruses – YOUNG ADULTS

Test Antigen	Clade	Subs	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	E7	79.2	403.2	2416.3	2.6	100.0	100.0	100.0	100.0
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	MDCK4/SIAT2	54.2	55.0	184.9	1.8	79.2	95.8	87.5	62.5
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	MDCK2/SIAT1	29.2	95.1	232.9	1.3	83.3	91.7	79.2	66.7
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS		E4	75.0	329.4	1863.2	2.5	100.0	100.0	100.0	100.0
A/Brisbane/321/2016	3C.2a	T131K,R142G	AUS	24	MDCK1/SIAT1	20.8	30.0	56.6	0.9	37.5	70.8	37.5	25.0
A/Brisbane/321/2016	3C.2a	T131K,R142G	AUS	24	E6	79.2	359.2	2152.7	2.6	100.0	100.0	100.0	100.0
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	MDCK1/SIAT1	12.5	27.5	47.6	0.8	33.3	66.7	33.3	16.7
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	E6	66.7	403.2	1522.2	1.9	100.0	100.0	100.0	100.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	MDCK1/SIAT1	45.8	100.8	302.0	1.6	87.5	100.0	87.5	75.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	E6	54.2	329.4	1208.2	1.9	100.0	100.0	100.0	100.0

Table 4.19: Summary of FRA Antigen Response: A(H3N2) viruses – OLDER ADULTS

Test Antigen	Clade	Subs	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	E7	45.8	1107.9	3517.3	1.7	100.0	100.0	100.0	100.0
A/Hong Kong/4801/2014	3C.2a	-	AUS	24	MDCK4/SIAT2	33.3	219.8	522.9	1.3	91.7	95.8	95.8	95.8
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	MDCK2/SIAT1	16.7	239.7	415.0	0.8	100.0	100.0	95.8	91.7
A/Brisbane/32/2017	3C.2a	N31S,D53N	AUS	24	E4	58.3	931.6	2791.7	1.6	100.0	100.0	100.0	100.0
A/Brisbane/321/2016	3C.2a	T131K,R142G	AUS	24	MDCK1/SIAT1	20.8	53.4	77.7	0.5	58.3	75.0	54.2	29.2
A/Brisbane/321/2016	3C.2a	T131K,R142G	AUS	24	E6	54.2	739.4	2280.7	1.6	100.0	100.0	100.0	100.0
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	MDCK1/SIAT1	8.3	35.6	58.2	0.7	54.2	87.5	37.5	25.0
A/Singapore/GP2646/2016	3C.2a1	K92R,H311Q	AUS	24	E6	29.2	1208.2	2560.0	1.1	100.0	100.0	100.0	100.0
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	MDCK1/SIAT1	25.0	261.4	479.5	0.9	100.0	100.0	100.0	91.7
A/Singapore/TT1374/2016	3C.2a	N121K,S144K	AUS	24	E6	25.0	761.1	1566.8	1.0	100.0	100.0	100.0	100.0

APPENDIX 5 - INFLUENZA B

Figure 5.2. Antigenic cartographic representation of B Victoria viruses

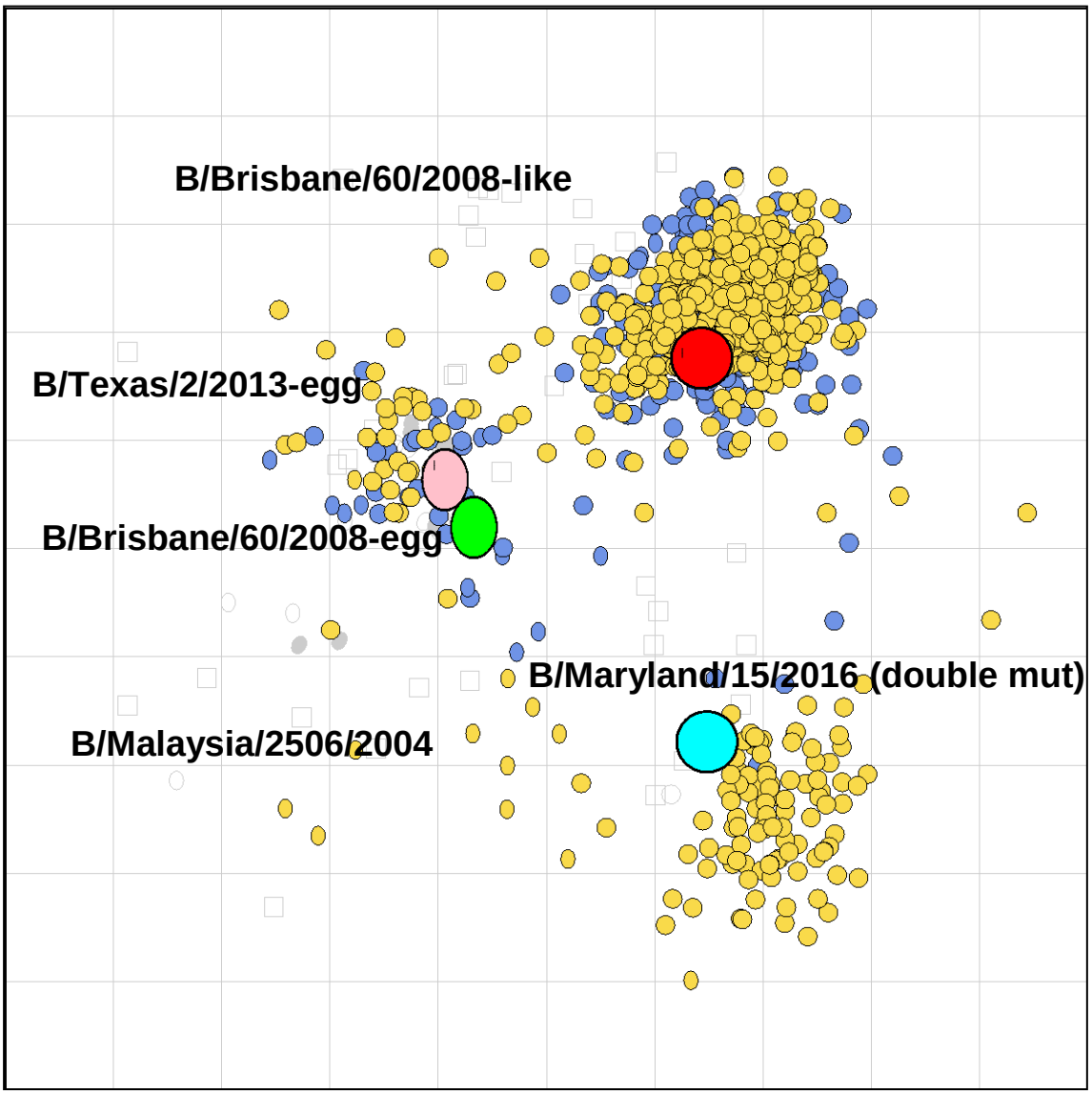


Table 5.2: B viruses (B/Victoria lineage) (1)

			Haemagglutination Inhibition Assay - WHO Influenza Centre													
			Reference Antisera													
	Sequenced		A	B	C	D	E	F	G	H	I	J	K	L		
	July 25, 2017 Part A & B		F2256-22D	F2425-21D	F2315-21D	F2897-21D	F3228-21D	F3414-21D	F3366-21D	F3413-21D	F3643-21D	F2253-22D	F4066-21D	F4067-21D		
			MX,M1	E4	MDCK1	MDCK2	E6	E3	E4	MDCK2	MDCK3	E2	C2,M2	E3/D1	Passage	Date
			BRIS/60	BRIS/60	DAR/40	BRIS/18	TEXAS/02	Vic/502	Bris/46	Bris/46	Tow ns/8	SYD/508	New York/52	M.land/15	History	
	Reference Antigens	**Clade**	V1A									V1B	DEL			
A	B/BRISBANE/60/2008	**V1A**	**160**	80	320	320	320	80	160	320	160	80	<20	<20	MX,M5	
B	B/BRISBANE/60/2008	**V1A**	160	**1280**	320	320	>2560	640	1280	80	160	640	<20	320	E7	
D	B/DARWIN/40/2012	**V1A**	320	160	**640**	320	320	80	160	320	160	80	<20	<20	MDCK4	
E	B/BRISBANE/18/2013	**V1A**	320	160	640	**320**	320	80	160	160	160	80	<20	<20	MDCK3	
F	B/TEXAS/02/2013	**V1A**	80	640	160	160	**>2560**	640	640	80	80	640	<20	640	E7	
G	B/VICTORIA/502/2015	**V1A**	160	1280	320	320	>2560	**1280**	1280	160	160	1280	<20	320	E4	
H	B/BRISBANE/46/2015	**V1A**	160	1280	320	320	>2560	1280	**>2560**	160	160	640	<20	640	E4	
I	B/BRISBANE/46/2015	**V1A**	160	80	320	320	320	80	160	**320**	80	80	<20	<20	MDCK3	
J	B/TOWNSVILLE/8/2016	**V1A**	160	80	320	320	160	80	160	160	**160**	80	<20	<20	MDCK3	
C	B/SYDNEY/508/2010	**V1B**	80	1280	320	160	>2560	640	640	80	160	**1280**	<20	320	E3	
K	B/NEW YORK/52/2016	**DEL**	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	**320**	160	C2,M2	
L	B/MARYLAND/15/2016	**DEL**	<20	320	<20	<20	640	160	320	<20	20	80	160	**>2560**	E5	
	Test Antigens															
1	B/Singapore/GP0756/2017		320	80	640	320	160	80	160	320	160	160	<20	<20	MDCK2	2/05/2017
2	B/Singapore/GP0466/2017		320	80	640	320	160	80	320	320	160	160	<20	<20	MDCK2	24/03/2017
3	B/South Australia/63/2017	**1A**	320	80	640	640	160	80	160	320	320	160	<20	<20	MDCK1	28/06/2017
4	B/Singapore/GP0061/2017		320	80	640	320	160	80	160	160	160	80	<20	<20	MDCK2	13/01/2017
5	B/Sydney/24/2017		320	80	640	320	160	80	160	320	160	80	<20	<20	MX,M1	28/05/2017
6	B/Phetchaburi/4/2017		160	80	320	320	320	40	160	160	160	80	<20	<20	1, MDCK1	17/02/2017
7	B/Mahasarakham/5/2017		160	80	320	320	160	80	160	160	160	80	<20	<20	1, MDCK1	7/02/2017
8	B/Nakhonsithammarat/8/2017		160	80	320	320	160	80	160	160	160	80	<20	<20	1, MDCK1	10/02/2017
9	B/Chanthaburi/9/2017		160	80	320	320	160	40	160	160	160	80	<20	<20	1, MDCK1	30/01/2017
10	B/Nakhonsithammarat/11/2017	**1A**	160	80	320	320	320	80	160	160	160	80	<20	<20	1, MDCK1	14/02/2017
11	B/Chiang Mai/13/2017		160	80	320	320	160	40	160	160	160	80	<20	<20	1, MDCK1	7/03/2017
12	B/Surat Thani/15/2017		160	80	320	320	160	80	160	160	160	80	<20	<20	1, MDCK1	7/03/2017
13	B/Lopburi/16/2017		160	80	320	320	320	80	160	160	160	80	<20	<20	1, MDCK1	7/03/2017
14	B/Chiang Mai/21/2017		160	80	320	320	160	80	160	160	160	80	<20	<20	1, MDCK1	9/03/2017
15	B/Surat Thani/22/2017		160	80	320	320	160	80	160	160	160	80	<20	<20	1, MDCK1	10/03/2017
16	B/Philippines/2/2017		160	80	320	320	160	40	80	160	160	40	<20	<20	M2,M1	15/03/2017
17	B/Philippines/3/2017		160	160	320	160	160	80	160	160	160	80	<20	<20	M2,M1	5/04/2017
18	B/Brisbane/9/2017	**1A**	160	80	160	160	160	80	160	160	160	80	<20	<20	M1,S1	18/05/2017
19	B/Philippines/5/2017		160	1280	320	320	1280	640	1280	320	160	1280	40	640	M2,M1	2/03/2017
20	B/Brisbane/12/2017		160	80	320	160	160	40	160	160	80	80	<20	<20	M1,M1	13/06/2017
21	B/Singapore/TT0131/2017		160	80	320	320	160	40	160	160	80	80	<20	<20	MDCK2	3/02/2017
22	B/Singapore/KK0171/2017		160	80	320	320	160	40	160	160	80	40	<20	<20	MDCK2	20/02/2017
23	B/Singapore/KK0364/2017		160	80	320	160	80	40	80	160	80	40	<20	<20	MDCK2	11/04/2017
24	B/Singapore/TT0476/2017		160	80	320	320	160	40	160	160	160	40	<20	<20	MDCK2	28/04/2017
25	B/Victoria/6/2017		160	40	320	320	80	80	160	160	80	80	<20	<20	MDCK1	28/06/2017
26	B/Singapore/KK0073/2017		160	40	320	320	160	80	160	160	160	80	<20	<20	MDCK2	31/01/2017
27	B/Sydney/25/2017		160	80	640	320	160	80	160	320	160	160	<20	<20	MX,M1	28/05/2017
28	B/Victoria/3/2017	**DEL**	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	320	160	MDCK1	5/06/2017

Table 5.3: B viruses (B/Victoria lineage) - CDC

		REFERENCE FERRET ANTISERA										
		V1A					V1A-2 DEL					
		N129D, V146I,I117V							D129G			
		Unboosted			Unboosted							
	REFERENCE VIRUSES	EGG BRI/60	MDCK BRI/60	MDCK TX/02	EGG ST.P/293	MDCK ST.P/293	EGG MD/15	MDCK MD/15	EGG CO/06	HA GROUP	Date Collected	Passage
1	B/BRISBANE/60/2008	**1280**	640	320	1280	320	320	10	640	V1A	2008/08/04	E4/E4
2	B/BRISBANE/60/2008	160	**320**	160	320	160	40	20	20	V1A	2008/04/08	CX,C4/C2
3	B/TEXAS/02/2013	160	320	**320**	320	160	40	20	10	V1A	2013/01/09	M1/C2
4	B/ST. PETERSBURG/293/16	640	640	160	**1280**	160	320	10	320	V1A	2016/04/20	E1/E3
5	B/ST. PETERSBURG/293/16	320	320	320	320	**160**	40	20	10	V1A	2016/04/20	C1/C2
6	B/MARYLAND/15/2016	320	160	80	640	10	**640**	160	320	V1A-2 DEL	2016/12/27	E4
7	B/MARYLAND/15/2016	160	40	20	40	10	160	**160**	160	V1A-2 DEL	2016/12/27	C3
8	B/COLORADO/06/2017	160	80	40	160	10	320	160	**320**	V1A-2 DEL	2017/02/25	E5
TEST VIRUSES												
9	B/ARIZONA/47/2017	160	320	160	160	160	40	20	10	V1A	2017/07/28	C1
10	B/CONNECTICUT/31/2017	80	20	20	20	10	80	160	160	V1A-2 DEL	2017/04/28	C1
11	B/NEW YORK/20/2017	80	20	20	20	10	80	160	160	V1A-2 DEL	2017/04/02	C1
12	B/TEXAS/62/2017	80	20	20	20	10	80	160	80	V1A-2 DEL	2017/04/24	C1
13	B/UTAH/22/2017	80	20	10	20	10	80	160	80	V1A-2 DEL	2017/04/17	C1
14	B/ARGENTINA/6/2017	320	640	320	640	320	80	20	40	V1A	2017/01/15	C1/C1
15	B/GUATEMALA/78/2017	320	640	320	640	320	40	20	20	V1A	2017/04/03	C1
16	B/PERU/9217/2017	160	320	160	320	160	20	10	10	V1A	2017/04/19	C2
17	B/KALININGRAD/22/2017	1280	1280	640	2560	1280	640	20	640	V1A	2017/02/08	C1/S1
18	B/MOSCOW/63/2017	320	640	320	640	320	80	40	20	V1A	2017/02/14	C1/C1
19	B/MOSCOW/68/2017	320	640	320	640	160	80	40	20	V1A	2017/02/14	C1/C1
20	B/MOSCOW/78/2017	320	640	320	640	320	80	40	20	V1A	2017/02/22	C1/C1
21	B/MOSCOW/99/2017	640	640	320	640	640	640	80	80	V1A	2017/03/31	C1/C2
22	B/IRKUTSK/11/2017	320	320	160	320	160	40	20	10	V1A	2017/03/20	C1/C2
23	B/PETROPAVLOVSK/201/2017	320	1280	640	640	320	160	10	80	V1A	2017/01/23	CX/C1
24	B/URALSK/397/2016	640	640	320	2560	640	1280	20	320	V1A	2016/11/20	CX/C1
25	B/URALSK/401/2016	1280	640	640	1280	640	640	20	640	V1A	2016/11/22	CX/C1
26	B/URALSK/403/2016	320	640	320	320	320	80	40	20	V1A	2016/11/22	CX/C1
27	B/URALSK/416/2017	640	640	320	1280	320	320	10	320	V1A	2016/12/07	CX/C1
28	B/ALMATINSKAY/224/2017	160	320	160	320	160	40	20	20	V1A	2017/02/02	CX/C1
29	B/PETROPAVLOVSK/416/2016	160	320	160	320	160	40	20	20	V1A	2017/01/08	CX/C1
30	B/TARAZ/238/2016	160	320	160	640	160	20	20	10	V1A	2016/12/03	CX/C1
31	B/NEW ZEALAND/290/2017	160	320	160	320	640	40	20	10	V1A	2017/06/13	CX/C1
32	B/BANGLADESH/5012/2017	320	640	640	1280	320	160	40	40	V1A	2017/04/20	C1
33	B/HONG KONG/283/2017	320	640	320	1280	320	160	20	160	V1A	2017/06/06	C1
34	B/HONG KONG/269/2017	160	40	20	40	10	80	40	40	V1A-3 DEL	2017/05/24	C1
35	B/HONG KONG/286/2017	160	40	20	40	10	80	40	20	V1A-3 DEL	2017/06/06	C1
36	B/HONG KONG/296/2017	160	40	20	40	10	80	40	40	V1A-3 DEL	2017/06/14	C1
37	B/HONG KONG/348/2017	80	40	20	10	10	40	10	10	V1A	2017/07/15	C1

Test Date: 8/23/2017

Table 5.4: B viruses (B/Yamagata lineage) (1)

			Haemagglutination Inhibition Assay - WHO Influenza Centre												
			Reference Antisera												
			A	B	C	D	E	F	G	H	I	J	K		
	September 15, 2017, Part A		F3187-21D	F3227-21D	F3184-21D	F3186-21D	F3525-20D	F3524-20D	F3128-20D	F3196-21D	F3645-21D	F4213-20D	F4215-20D		
			E3/E1	M1/C2,M1	E4	E4	E5	MDCK1	E4	MDCK1	MX,M2	MDCK,M1	MDCK2	Passage	Date
			MASS/2	MASS/2	HBEI/158	WISC/1	PHK/3073	PHK/3073	BRIS/9	SYD/39	SYD/10	Cbry/5	PERTH/4	History	
	Reference Antigens	**Clade**	Y2		Y3										
A	B/MASSACHUSETTS/02/2012	**Y2**	**640**	160	320	40	320	40	20	80	80	<20	<20	E3.E2	
B	B/MASSACHUSETTS/02/2012	**Y2**	320	**320**	80	20	320	160	80	160	160	80	80	M1/C2,M4	
C	B/HUBEI WUJIAGANG/158/2009	**Y3**	80	160	**160**	20	320	80	80	160	80	<20	20	E7	
D	B/WISCONSIN/1/2010		320	160	320	**80**	640	80	80	160	160	20	40	E5	
E	B/PHUKET/3073/2013		320	160	320	40	**640**	80	80	160	160	<20	20	E6	
F	B/PHUKET/3073/2013		160	160	160	40	320	**160**	160	320	160	40	80	MDCK4	
G	B/BRISBANE/9/2014		160	160	160	40	320	80	**80**	160	160	<20	20	E5	
H	B/SYDNEY/39/2014		80	160	40	40	160	160	160	**320**	320	80	80	MDCK6	
I	B/SYDNEY/10/2016		40	160	20	20	160	160	160	320	**160**	40	80	MX,M3	
J	B/CANTERBURY/5/2017		40	160	80	20	160	160	160	320	320	**80**	160	MX,M2	
K	B/PERTH/4/2017		40	160	80	20	160	160	160	320	320	80	**160**	MDCK3	
	Test Antigens														
1	B/Victoria/2043/2017		160	640	320	80	640	640	320	640	1280	320	320	MDCK1	18/08/2017
2	B/New Caledonia/9/2017		80	320	80	40	320	320	320	640	640	160	320	MDCK1	21/08/2017
3	B/Auckland/526/2017		80	160	80	20	320	320	160	320	320	80	160	MDCK1	31/07/2017
4	B/Shanghai-Huangpu/1633/2017		40	160	80	20	320	320	160	320	320	80	160	C3,M1	6/04/2017
5	B/Sri Lanka/4/2017		40	160	80	20	160	320	160	320	320	80	320	MDCK1	18/07/2017
6	B/Sydney/1081/2017		80	320	80	40	320	320	320	640	640	160	320	MDCK1	18/08/2017
7	B/New castle/24/2017		20	160	160	<20	160	160	80	160	320	40	160	MDCK1	8/08/2017
8	B/Victoria/528/2017		40	160	80	20	160	160	160	320	160	40	80	MDCK2	12/08/2017
9	B/Auckland/532/2017		40	160	80	20	160	160	160	320	320	80	160	MDCK1	9/08/2017
10	B/Auckland/539/2017		40	160	80	20	160	160	160	320	160	40	160	MDCK1	14/08/2017
11	B/New castle/18/2017		40	80	80	20	160	160	80	160	160	40	80	MDCK1	12/08/2017
12	B/New castle/22/2017		40	160	80	20	160	160	160	160	160	40	80	MDCK1	11/08/2017
13	B/New castle/25/2017		40	80	80	20	160	160	80	320	160	40	80	MDCK1	7/08/2017
14	B/New Caledonia11/2017		40	160	80	20	160	160	160	160	160	40	80	SIAT1	3/08/2017
15	B/Solomon Islands/1/2017		40	160	80	20	160	160	160	160	160	40	80	SIAT1	17/07/2017
16	B/Fujian-Tongan/1907/2016		40	80	80	20	160	160	80	160	160	40	80	C3,M1	14/11/2016
17	B/Victoria/540/2017		40	160	80	20	160	160	160	320	160	40	160	MDCK1	25/08/2017
18	B/Victoria/547/2017		40	160	80	20	160	160	160	320	160	80	160	MDCK1	24/08/2017
19	B/Brisbane/30/2017		40	160	80	20	160	160	80	160	160	40	80	MDCK2	11/08/2017
20	B/Brisbane/31/2017		40	80	80	20	160	160	80	160	160	40	80	MDCK2	11/08/2017
21	B/Auckland/510/2017		20	80	40	20	160	160	80	160	160	40	80	MDCK1	13/07/2017
22	B/Auckland/521/2017		40	80	40	20	160	160	80	160	160	40	80	MDCK1	20/07/2017
23	B/Auckland/522/2017		20	80	40	20	160	160	80	160	160	40	80	MDCK1	21/07/2017
24	B/AucklandD/529/2017		20	80	40	20	160	160	80	160	160	40	80	MDCK1	29/07/2017
25	B/Auckland/533/2017		20	80	40	20	160	160	80	160	160	40	80	MDCK1	5/08/2017
26	B/Auckland/534/2017		40	80	40	20	160	160	80	160	160	40	80	MDCK1	4/08/2017
27	B/Auckland/537/2017		20	160	40	20	160	160	80	160	160	40	80	MDCK1	5/08/2017
28	B/New castle/600/2017		20	80	40	20	160	160	80	160	160	40	80	MDCK1	15/08/2017
29	B/New castle/601/2017		40	80	40	20	160	160	80	160	160	40	80	MDCK1	12/08/2017
30	B/Victoria/903/2017		40	160	40	20	160	160	80	160	160	40	80	MDCK1	8/08/2017
31	B/Canberra/1002/2017		40	160	40	20	160	160	160	320	320	80	160	MDCK1	16/08/2017
32	B/New castle/606/2017		20	80	20	20	160	160	80	160	160	40	80	MDCK1	18/08/2017
33	B/New castle/607/2017		20	80	20	<20	160	160	80	160	160	40	80	MDCK1	14/08/2017
34	B/Auckland/538/2017		20	80	20	<20	160	80	80	160	160	20	80	MDCK1	6/08/2017

Table 5.4: B viruses (B/Yamagata lineage) (2)

			Haemagglutination Inhibition Assay - WHO Influenza Centre												
			Reference Antisera												
			A	B	C	D	E	F	G	H	I	J	K		
	August 29, 2017		F3187-21D	F3227-21D	F3184-21D	F3186-21D	F3525-20D	F3524-20D	F3128-20D	F3196-21D	F3645-21D	F4213-20D	F4215-20D		
			E3/E1	M1/C2,M1	E4	E4	E5	MDCK1	E4	MDCK1	MX,M2	MDCK, M1	MDCK2	Passage	Sam ple
			MASS/2	MASS/2	HBEI/158	WISC/1	PHK/3073	PHK/3073	BRIS/9	SYD/39	SYD/10	Cby/5	PERTH/4	History	Date
	Reference Antigens	**Clade**	**Y2**		**Y3**										
A	B/MASSACHUSETTS/02/2012	**Y2**	**640**	320	160	40	320	20	20	80	40	<20	<20	E3.E2	
B	B/MASSACHUSETTS/02/2012	**Y2**	160	**320**	160	40	320	80	40	160	80	40	20	M1/C2,M4	
C	B/HUBEI WUJIAGANG/158/2009	**Y3**	80	80	**160**	<20	320	80	80	160	80	<20	<20	E7	
D	B/WISCONSIN/1/2010	**Y3**	320	160	320	**80**	640	160	80	160	160	<20	<20	E5	
E	B/PHUKET/3073/2013	**Y3**	320	160	320	40	**320**	80	80	160	160	<20	<20	E6	
F	B/PHUKET/3073/2013	**Y3**	80	160	80	40	320	**160**	160	160	160	40	40	MDCK4	
G	B/BRISBANE/9/2014	**Y3**	160	160	320	40	320	80	**80**	160	160	<20	<20	E5	
H	B/SYDNEY/39/2014	**Y3**	80	160	<20	40	160	320	160	**320**	160	40	80	MDCK6	
I	B/SYDNEY/10/2016	**Y3**	40	80	<20	20	160	160	160	160	**160**	40	80	MX,M3	
J	B/CANTERBURY/5/2017	**Y3**	40	80	<20	20	160	160	160	320	320	**40**	80	MX,M2	
K	B/PERTH/4/2017	**Y3**	40	80	<20	20	160	160	160	320	320	40	**80**	MDCK3	
	Test Antigens														
1	B/Papua New Guinea/1/2017		<20	160	<20	<20	160	320	160	320	320	40	160	MDCK1	27/03/2017
2	B/South-Africa/R07361/17		40	160	<20	20	320	320	160	320	320	80	160	MDCK1	25/07/2017
3	B/Darw in/24/2017		<20	80	<20	20	80	160	160	320	160	40	80	MDCK1	6/08/2017
4	B/Darw in/26/2017		<20	80	<20	<20	80	160	80	320	160	40	80	MDCK1	4/08/2017
5	B/Darw in/29/2017		<20	80	<20	<20	160	160	80	320	160	40	80	MDCK1	27/05/2017
6	B/Sydney/1042/2017		<20	80	<20	<20	80	160	160	320	160	40	20	MDCK1	8/08/2017
7	B/Sydney/1043/2017		<20	80	<20	<20	40	160	80	160	160	40	80	MDCK1	28/07/2017
8	B/Sydney/1045/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MDCK1	28/07/2017
9	B/Sydney/1047/2017		<20	80	<20	<20	80	160	80	320	160	80	80	MDCK1	25/07/2017
10	B/Sydney/1054/2017		<20	80	<20	<20	80	160	<20	160	160	40	80	MDCK1	8/08/2017
11	B/South Australia/1006/2017		<20	80	<20	<20	80	160	160	320	320	40	160	MDCK1	10/08/2017
12	B/Victoria/2028/2017		<20	80	<20	<20	80	160	80	160	160	20	40	MDCK1	9/08/2017
13	B/Papua New Guinea/3/2017		40	160	<20	20	320	160	160	320	320	80	160	MDCK1	17/05/2017
14	B/Brisbane/26/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MDCK2	19/07/2017
15	B/Brisbane/27/2017		<20	80	<20	<20	160	160	80	160	160	40	80	MDCK2	23/07/2017
16	B/Brisbane/28/2017		<20	80	<20	<20	160	160	160	160	160	40	80	MDCK2	30/08/2017
17	B/Brisbane/29/2017		40	80	<20	20	160	160	80	160	160	40	80	MDCK2	2/08/2017
18	B/Tasmania/30/2017		20	80	<20	<20	80	160	80	160	160	40	80	MDCK1	13/08/2017
19	B/Tasmania/31/2017		20	80	<20	<20	160	160	80	160	160	40	80	MDCK1	13/08/2017
20	B/Tasmania/32/2017		20	80	<20	<20	160	160	80	160	160	20	80	MDCK1	13/08/2017
21	B/Tasmania/34/2017		<20	80	<20	<20	160	160	160	320	320	40	80	MDCK1	1/08/2017
22	B/Victoria/2029/2017		20	160	<20	<20	160	160	80	320	320	40	80	MDCK1	22/07/2017
23	B/Victoria/2036/2017		<20	80	<20	<20	160	160	160	320	320	40	80	MDCK1	8/08/2017
24	B/Victoria/530/2017		<20	80	<20	<20	160	160	80	160	160	40	80	MDCK1	6/08/2017
25	B/Victoria/537/2017		<20	80	<20	<20	160	160	80	160	160	40	80	MDCK1	10/08/2017
26	B/Victoria/539/2017		<20	80	<20	<20	80	160	80	160	160	20	40	MDCK1	11/08/2017
27	B/Canberra/15/2017		20	80	<20	<20	160	160	80	160	160	20	40	SIAT1	10/08/2017
28	B/Auckland/504/2017		20	160	<20	<20	160	160	80	320	320	80	80	MDCK1	10/07/2017
29	B/Sydney/35/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MX,M1	20/06/2017
30	B/Sydney/36/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MX,M1	19/06/2017
31	B/Sydney/38/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MX,M1	25/06/2017
32	B/Sydney/41/2017		<20	80	<20	<20	80	160	80	160	160	40	80	MX,M1	28/06/2017
33	B/South-Africa/R07025/17		20	160	<20	<20	160	160	80	320	160	40	80	MDCK1	22/07/2017
34	B/South-Africa/R07074/17		20	80	<20	<20	160	160	80	160	160	20	80	MDCK1	22/07/2017
35	B/Darw in/30/2017		<20	80	<20	<20	80	80	80	160	160	20	80	MDCK1	24/05/2017
36	B/Sydney/1035/2017		<20	80	<20	<20	80	80	80	160	160	20	40	MDCK1	1/08/2017
37	B/Sydney/1037/2017		<20	80	<20	<20	80	80	40	160	160	20	40	MDCK1	28/07/2017
38	B/Sydney/1063/2017		<20	80	<20	<20	80	80	160	320	160	40	160	MDCK1	1/08/2017
39	B/South Australia/1005/2017		<20	40	<20	<20	80	80	80	160	160	40	80	MDCK1	11/08/2017
40	B/Brisbane/23/2017		<20	40	<20	<20	80	80	<20	160	160	160	160	MDCK2	17/07/2017
41	B/Brisbane/24/2017		<20	40	<20	<20	80	80	<20	160	80	20	40	MDCK2	18/07/2017
42	B/Brisbane/25/2017		<20	40	<20	<20	80	80	<20	80	<20	20	40	MDCK2	19/07/2017
43	B/Victoria/529/2017		<20	80	<20	<20	80	80	80	160	160	40	40	MDCK1	12/08/2017
44	B/Sydney/37/2017		<20	80	<20	<20	80	80	<20	160	160	20	40	MX,M1	23/06/2017
45	B/Canberra/16/2017		20	40	<20	<20	40	40	<20	80	160	20	40	MDCK1	14/08/2017

Figure 5.5. Phylogenetic relationships among influenza B neuraminidase genes B/Victoria Lineage

Current Southern Hemisphere Vaccine Strain

e = Egg Isolate
$ = Serology Antigen
LR = Low Reactor
Reference Antigen
(+/-) = gain/loss potential glycosylation site

March - April 2017
May - June 2017
July 2017
August 2017

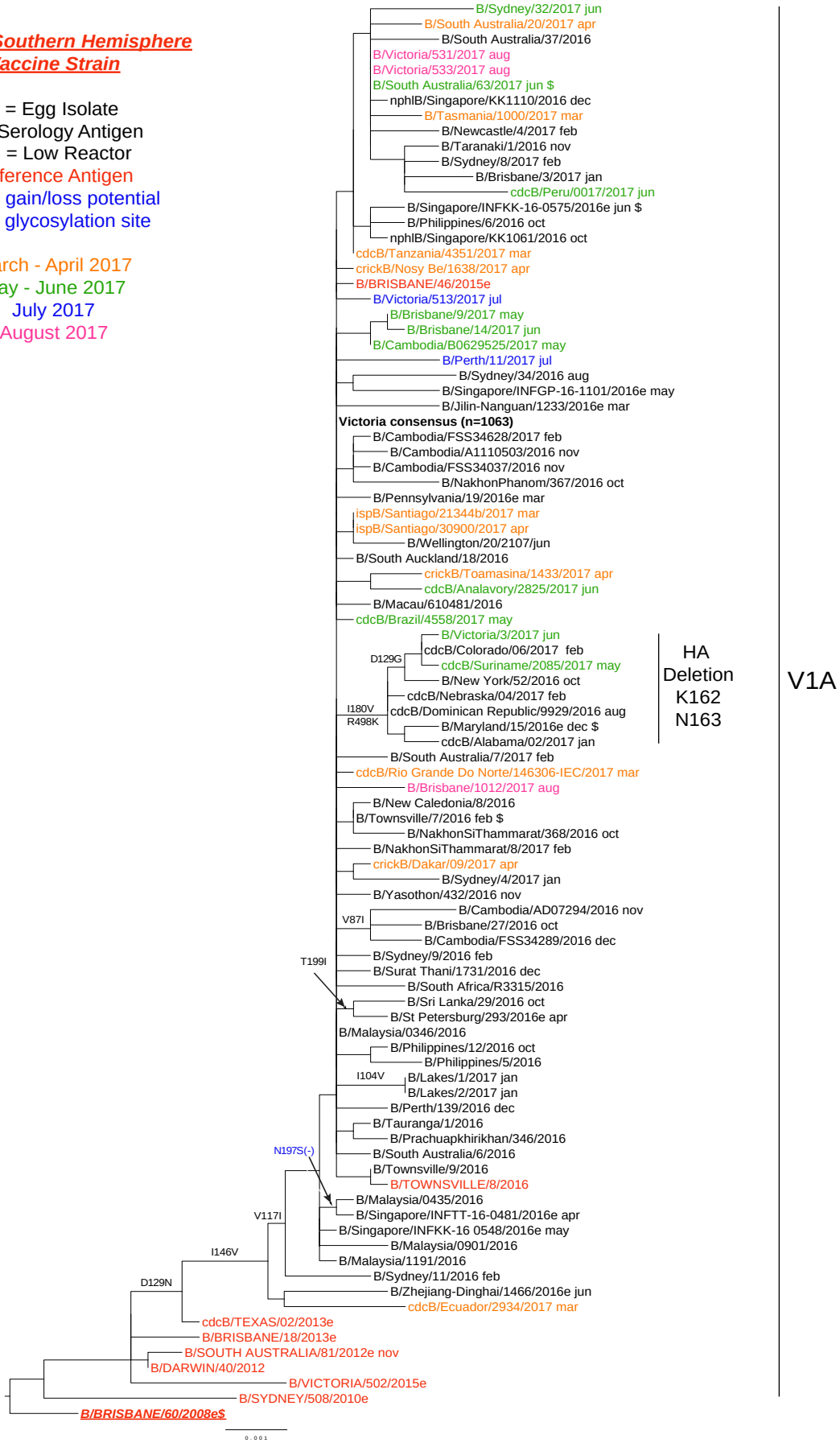


Figure 5.6. Phylogenetic relationships among influenza B neuraminidase genes B/Victoria Lineage

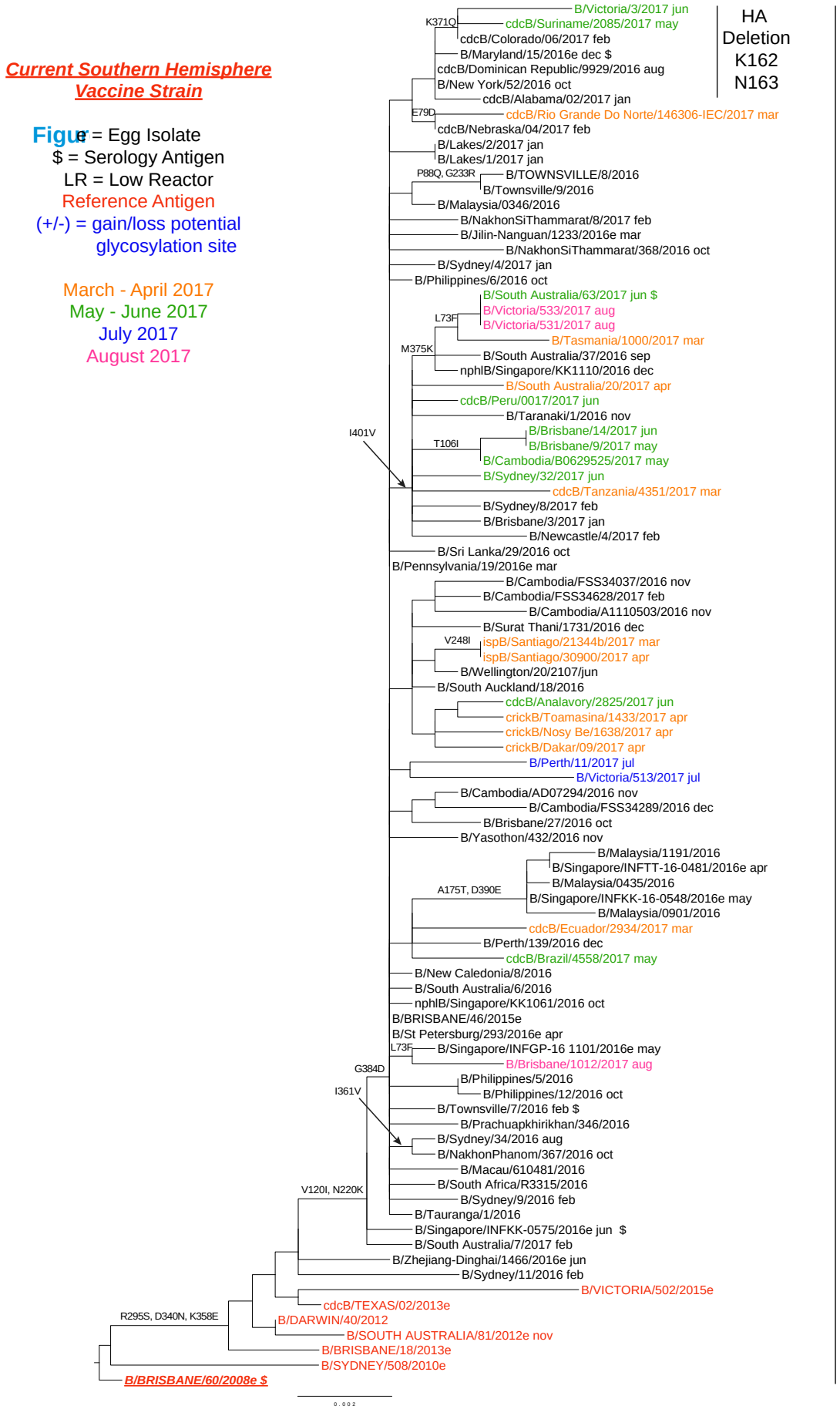


Figure 5.7. Phylogenetic relationships among influenza B HA genes
B/Yamagata Lineage

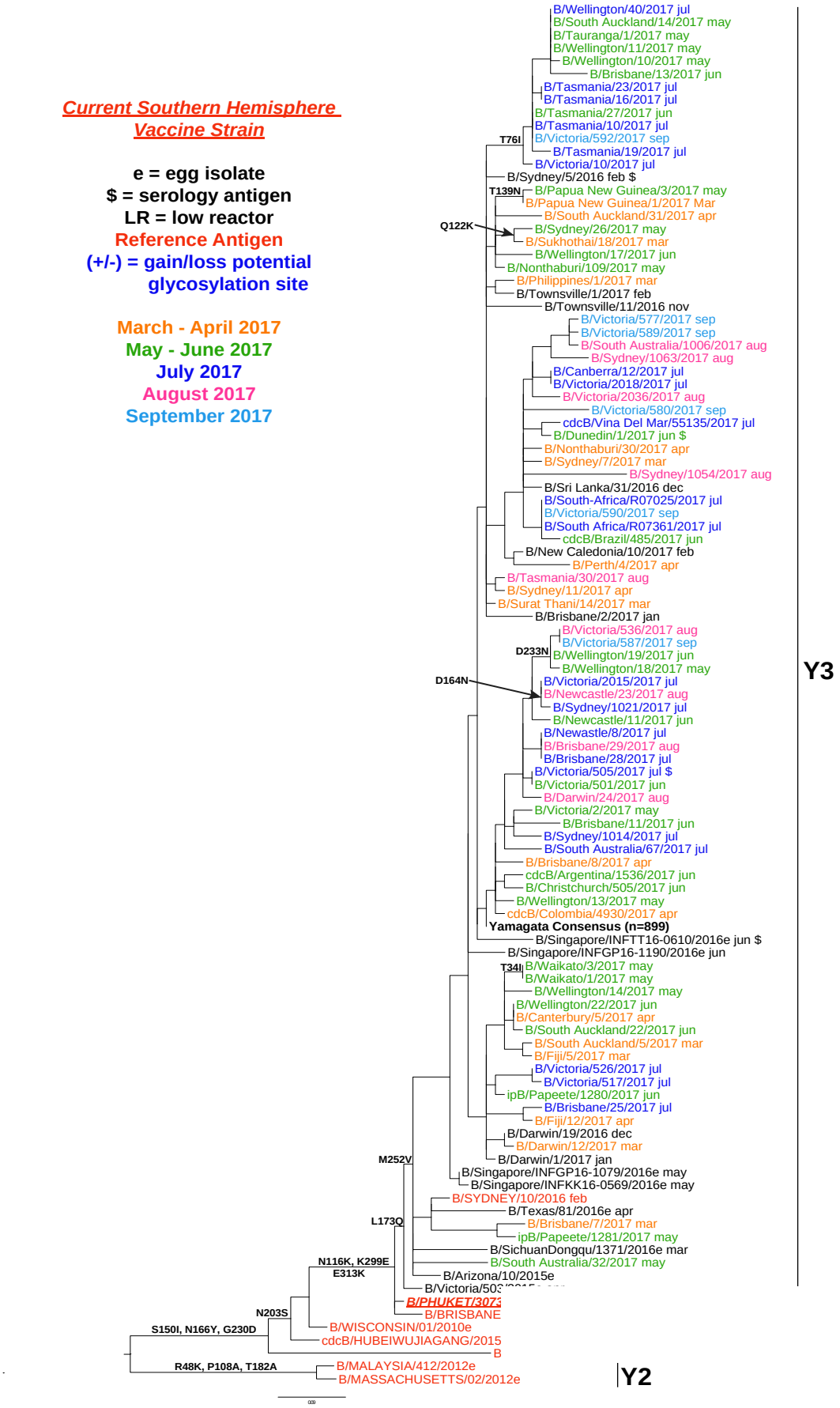


Figure 5.8 Phylogenetic relationships among influenza B neuraminidase genes B/Yamagata Lineage

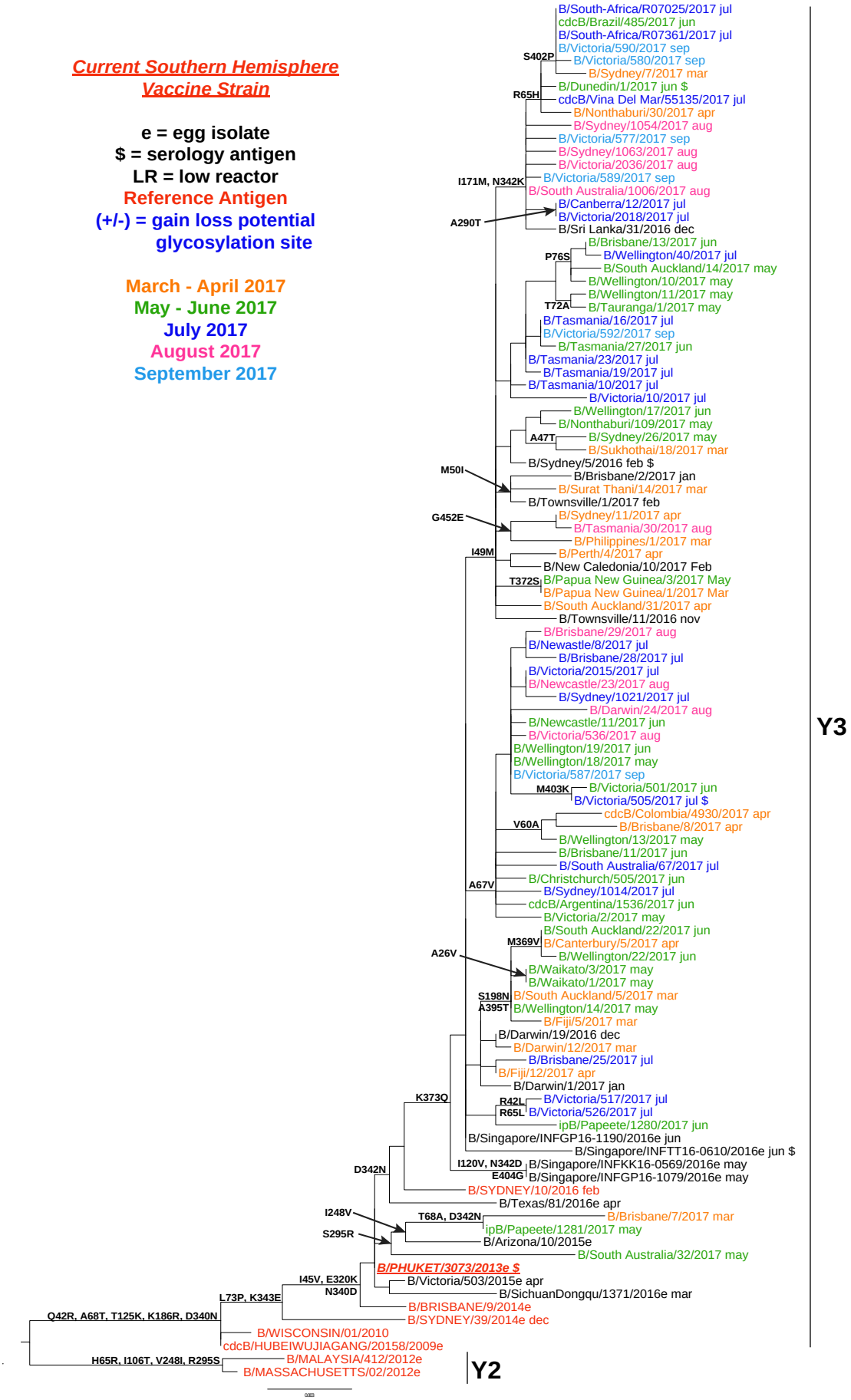


Table 5.8: HI Human Antibody Responses pre and post vaccination to B/Victoria Viruses – YOUNG ADULTS

Test Antigen	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
B/Brisbane/60/2008	AUS	24	E5	41.7	51.9	142.5	1.5	75.0	91.7	87.5	66.7
B/Maryland/15/2016	AUS	24	C3/MDCK2	41.7	38.9	87.2	1.2	54.2	83.3	62.5	45.8
B/Maryland/15/2016	AUS	24	E5	50.0	25.2	95.1	1.9	41.7	87.5	70.8	50.0
B/South Australia/63/2017	AUS	24	MDCK2	25.0	21.8	44.9	1.0	54.2	75.0	58.3	25.0
B/Townsville/7/2016	AUS	24	MDCK3	37.5	14.6	35.6	1.3	33.3	66.7	45.8	16.7
B/Singapore/INFKK-16-0575/2016	AUS	24	E5	45.8	37.8	109.9	1.5	62.5	100.0	87.5	50.0
B/Brisbane/60/2008	US	20	E5	80	18	139	2.95	35	100	70	55
B/Maryland/15/2016	US	20	C3/MDCK2	70	17	92	2.45	35	85	75	40
B/Maryland/15/2016	US	20	E5	70	17	102	2.55	35	80	70	50
B/South Australia/63/2017	US	20	MDCK2	60	9	37	2.1	5	60	35	10
B/Townsville/7/2016	US	20	MDCK3	60	7	32	2.2	5	55	35	15
B/Singapore/INFKK-16-0575/2016	US	20	E5	70	13	70	2.45	20	70	60	45

Table 5.9: HI Human Antibody Responses pre and post vaccination to B/Victoria Viruses – OLDER ADULTS

Test Antigen	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
B/Brisbane/60/2008	AUS	24	E5	25.0	44.9	97.9	1.1	70.8	87.5	83.3	54.2
B/Maryland/15/2016	AUS	24	C3/MDCK2	16.7	36.7	77.7	1.1	58.3	83.3	62.5	45.8
B/Maryland/15/2016	AUS	24	E5	29.2	30.8	67.3	1.1	54.2	83.3	66.7	37.5
B/South Australia/63/2017	AUS	24	MDCK2	20.8	23.8	49.0	1.0	37.5	79.2	41.7	12.5
B/Townsville/7/2016	AUS	24	MDCK3	12.5	13.7	26.7	1.0	25.0	45.8	25.0	4.2
B/Singapore/INFKK-16-0575/2016	AUS	24	E5	25.0	29.1	67.3	1.2	54.2	87.5	62.5	25.0
B/Brisbane/60/2008	US	24	E5	41.7	16.3	58.2	1.8	25.0	66.7	45.8	29.2
B/Maryland/15/2016	US	24	C3/MDCK2	16.7	12.6	26.7	1.1	20.8	37.5	29.2	16.7
B/Maryland/15/2016	US	24	E5	37.5	11.2	27.5	1.3	20.8	37.5	20.8	20.8
B/South Australia/63/2017	US	24	MDCK2	25.0	8.9	17.8	1.0	16.7	25.0	16.7	12.5
B/Townsville/7/2016	US	24	MDCK3	33.3	8.4	20.0	1.3	12.5	37.5	16.7	8.3
B/Singapore/INFKK-16-0575/2016	US	24	E5	37.5	10.6	25.2	1.3	20.8	41.7	25.0	12.5

Table 5.10: HI Human Antibody Responses pre and post vaccination to B/Yamagata Viruses – ADULT

Test Antigen	Cen tre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
B/Phuket/3073/2013	AUS	24	E9	62.5	41.2	174.5	2.1	62.5	95.8	95.8	66.7
B/Tasmania/27/2017	AUS	24	MDCK2	54	34	110	1.71	54	96	83	38
B/Victoria/505/2017	AUS	24	MDCK2	54	21	80	1.96	38	88	67	21
B/Dunedin/1/2017	AUS	24	MDCKX/MDCK2	50	18	60	1.75	29	88	46	17
B/Sydney/5/2016	AUS	24	MDCKX/MDCK2	45.8	11.9	38.9	1.7	25.0	66.7	50.0	12.5
B/Singapore/INFTT16-0610/2015	AUS	24	E3	66.7	32.7	160.0	2.3	58.3	100.0	91.7	58.3
B/Phuket/3073/2013	US	20	E9	70.0	20.7	171.5	3.1	45.0	95.0	90.0	75.0
B/Tasmania/27/2017	US	20	MDCK2	80	16	109	2.8	30	95	75	50
B/Victoria/505/2017	US	20	MDCK2	75.0	13.7	95.1	2.8	30.0	85.0	75.0	50.0
B/Dunedin/1/2017	US	20	MDCKX/MDCK2	70.0	11.9	72.1	2.6	20.0	75.0	60.0	45.0
B/Sydney/5/2016	US	20	MDCKX/MDCK2	65.0	10.7	72.1	2.8	20.0	75.0	65.0	50.0
B/Singapore/INFTT16-0610/2015	US	20	E3	70.0	27.3	211.1	3.0	55.0	95.0	90.0	85.0

Table 5.11: HI Human Antibody Responses pre and post vaccination to B/Yamagata Viruses – ELDERLY

Test Antigen	Centre	n	Passage history	% 4-fold rise	Pre-GMT	Post-GMT	Mean fold rise	% ≥40 pre	% ≥40 post	% ≥80 post	% ≥160 post
B/Phuket/3073/2013	AUS	24	E9	33.3	58.2	155.4	1.4	79.2	95.8	91.7	79.2
B/Tasmania/27/2017	AUS	24	MDCK2	16.7	30.0	56.6	0.9	50.0	91.7	54.2	8.3
B/Victoria/505/2017	AUS	24	MDCK2	33.3	20.6	51.9	1.3	41.7	83.3	54.2	8.3
B/Dunedin/1/2017	AUS	24	MDCKX/MDCK2	25.0	22.4	51.9	1.2	37.5	87.5	50.0	4.2
B/Sydney/5/2016	AUS	24	MDCKX/MDCK2	16.7	15.4	26.7	0.8	33.3	58.3	33.3	8.3
B/Singapore/INFTT16-0610/2015	AUS	24	E3	29.2	46.2	106.8	1.2	75.0	91.7	83.3	58.3
B/Phuket/3073/2013	US	24	E9	54.2	27.5	119.9	2.1	41.7	95.8	70.8	41.7
B/Tasmania/27/2017	US	24	MDCK2	45.8	17.8	53.4	1.6	37.5	70.8	45.8	29.2
B/Victoria/505/2017	US	24	MDCK2	45.8	15.9	47.6	1.6	25.0	62.5	41.7	29.2
B/Dunedin/1/2017	US	24	MDCKX/MDCK2	33.3	10.6	25.9	1.3	16.7	45.8	20.8	8.3
B/Sydney/5/2016	US	24	MDCKX/MDCK2	41.7	14.1	37.8	1.4	25.0	58.3	41.7	20.8
B/Singapore/INFTT16-0610/2015	US	24	E3	50.0	25.9	95.1	1.9	37.5	87.5	62.5	33.3

APPENDIX 6 - WHO RECOMMENDATION FOR INFLUENZA VACCINES

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