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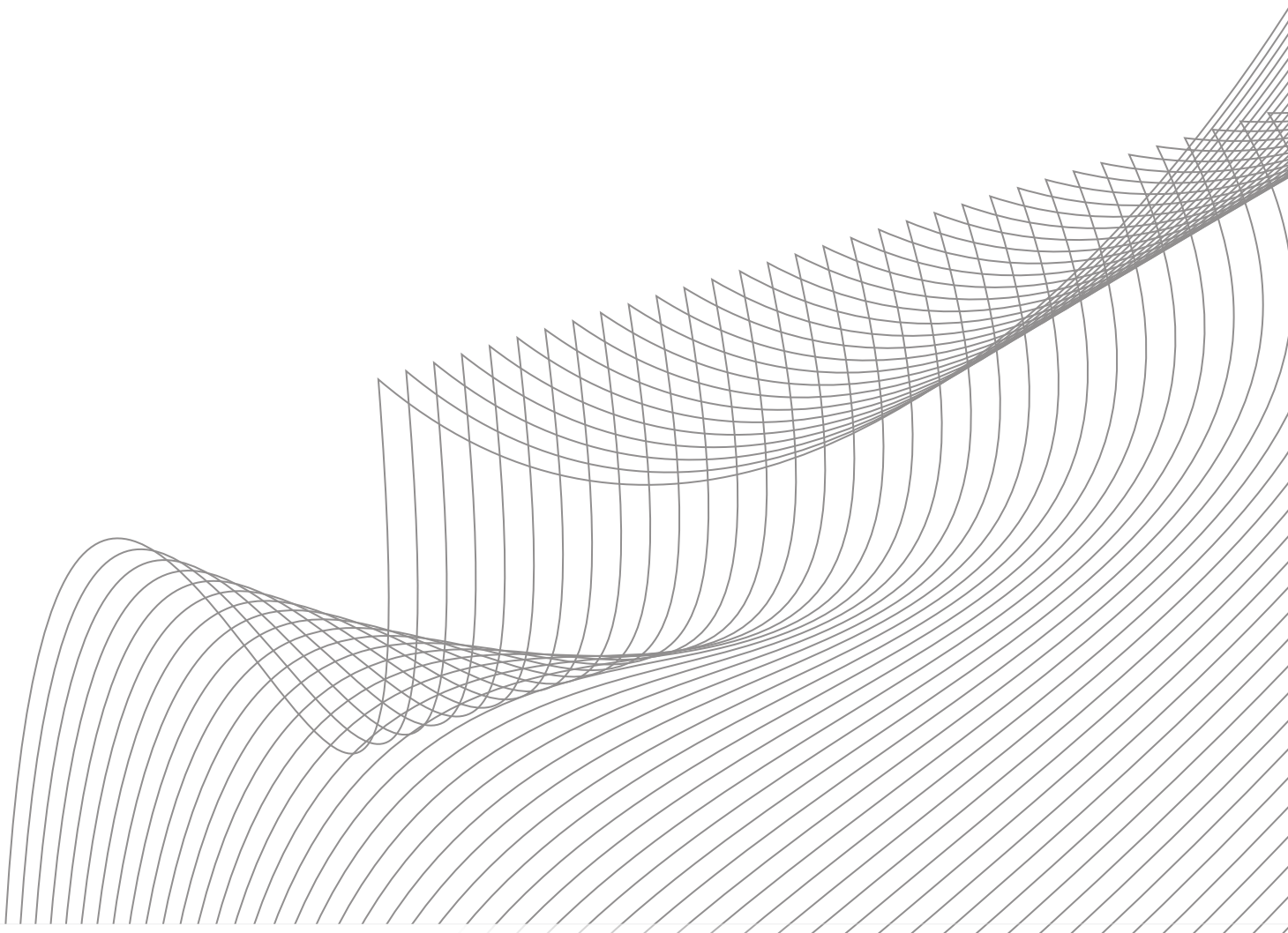
Report of the National Influenza Surveillance Scheme, 2011 to 2018

Communicable Disease Epidemiology and Surveillance Section



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Extended report

Report of the National Influenza Surveillance Scheme, 2011 to 2018

Communicable Disease Epidemiology and Surveillance Section

Abstract

This report describes influenza surveillance activities in Australia for the period 2011 to 2018. Data were extracted from several sources constituting the National Influenza Surveillance Scheme (NISS). Laboratory-confirmed influenza notification rates (per 100,000 population) increased from 122 in 2011 to 1,021 in 2017, before declining to 235 in 2018. The highest laboratory-confirmed notification rates during the eight-year period were from the smaller jurisdictions (South Australia and the Northern Territory), except in 2016 when Queensland reported the highest rate. Similar trends were observed in community reports of influenza-like illness (ILI), presentations of ILI to sentinel general practice (GP) sites, and influenza hospitalisations.

Children aged 14 years or younger, and adults 65 years of age or older, had the highest notification rates of laboratory-confirmed influenza. Adults aged 65 years or older and patients with comorbidities had higher rates of influenza-associated hospitalisations and mortality. Over half of eligible patients admitted to sentinel hospitals (57%) received oseltamivir treatment, with 17% receiving the treatment within 48 hours of symptom onset.

Influenza type A predominated over the eight years, except in 2015 when type B predominated. This trend was consistent with Australian World Health Organization Collaborating Centre (WHOCC) data for influenza isolates tested. Of influenza viruses circulating during the reporting period, A(H1N1) viruses were mostly antigenically similar to the vaccine strain A/California/7/2009 (H1N1), except in 2017 and 2018 when they were mostly similar to A/Michigan/45/2015. The A(H3N2) strains varied over the years but included the vaccine strains A/Perth/16/2009, A/Switzerland/9715293/2013, A/Hong Kong/4801/2014, and A/Singapore/INFIMH/2016. The B/Victoria/2/87 lineage (represented by the 2016 vaccine strain B/Brisbane/60/2008) and the B/Yamagata/16/88 lineage (represented by the southern hemisphere 2015 vaccine strain B/Phuket/3073/2013) were the circulating influenza B viruses during the reporting period. Influenza B accounted for just under a third of notifications (32%) from 2011 to 2018. Fifty-four per cent of influenza B viruses characterised by the Australian WHOCC site during the eight-year period were from the Yamagata lineage, although the proportion was higher (67%) when analysing the most recent four years (2015 to 2018). In contrast, during the 2010 season, 99% of all influenza B viruses characterised by the Australian WHOCC site were in the B-Victoria lineage.

During the 2018 season the Australian WHOCC site detected, for the first time, swine A(H3N2)v virus from a human patient in Australia, highlighting the need to maintain vigilance for zoonotic infections.

Keywords: influenza, surveillance, influenza-like illness, sentinel surveillance

Introduction

Influenza is an infectious acute respiratory disease caused when influenza viruses spread from person to person by droplets or contact with fomites.[1] Patients with influenza typically present with a combination of cough, fever, sore throat, runny nose, headache, fatigue, and myalgia.[1] It is estimated the viral infection affects up to 5–10% of the population each year globally.[2] In Australia, the influenza season usually occurs from April or May to the end of October. Influenza outbreaks usually occur annually during the influenza season, often resulting in increased hospitalisations from pneumonia and other complications, particularly in high-risk population groups.[3] The individuals most at risk of acquiring severe forms of influenza include children, the elderly (65 years or older), those with chronic medical comorbidities (such as cardiac, renal, liver, metabolic, autoimmune diseases, HIV/AIDS or malignancies), and those on immunosuppressive treatments.[1]

Influenza types A, B, and C are known to cause respiratory illness in humans. Type A and B viruses cause seasonal epidemics, while type C is detected less frequently and is usually associated with mild infections.[3] There are two forms of influenza reported globally: epidemic (seasonal or interpandemic) caused by type A and B viruses, and sporadic pandemics caused by type A viruses.[3]

Influenza A viruses are further classified into subtypes based on the combinations of the haemagglutinin (HA) and neuraminidase (NA) viral surface proteins. The currently-circulating A viruses in humans are A(H1N1)pdm09 and A(H3N2). The influenza B viruses are further classified into lineages rather than subtypes, with the B/Victoria and B/Yamagata lineages currently circulating.[1]

Laboratory-confirmed influenza is a notifiable disease in all Australian states and territories. Laboratory-confirmed influenza data are reported from each state or territory health department to the National Notifiable Diseases Surveillance System (NNDSS).

Surveillance methods

Data for this report were extracted from the following influenza surveillance sources:

- notifications of laboratory-confirmed influenza required by legislation in all states and territories, and notified to the NNDSS;
- subtype and strain data of circulating influenza viruses provided by the World Health Organization Collaborating Centre for Reference and Research on Influenza (WHOCC);[4]
- consultation rates for influenza-like illness (ILI) identified by sentinel general practitioners (GPs) – provided by the Australian Sentinel Practices Research Network (ASPREN) and the Victorian Sentinel Practice Influenza Network (VicSPIN);
- rates of ILI and absence from work from the online community survey FluTracking;
- hospitalised cases of influenza from 17 sentinel hospitals across Australia through the Influenza Complications Alert Network (FluCAN);
- mortality data from the New South Wales Government HealthStats webpage; the Australian Bureau of Statistics (ABS); and a mathematical modelling study estimating influenza-associated deaths.[5]

This report excludes data from sentinel laboratories and consultation rates from Emergency Departments (EDs) as they were not readily available. Rates were calculated using population data accessed from the ABS for the respective years.

Data sources

National Notifiable Diseases Surveillance System (NNDSS)

During the reporting period, laboratory-confirmed influenza was a notifiable disease under state and territory legislation in all Australian jurisdictions. Jurisdictional notifications were sent to NNDSS for national collation. In this report, data were analysed by the date of diagnosis, which is the earliest of the dates of symptom onset, specimen collection, or case notification. Age, sex, Aboriginal and/or Torres Strait Islander status, virus subtype, the jurisdiction of patient residence, hospitalisation, and outcomes, are included in NNDSS notifications.

Laboratory surveillance

WHO Collaborating Centre for Reference and Research on Influenza (WHOCC)

WHO Collaborating Centres for Reference and Research on Influenza are located in Melbourne (Australia), Beijing (China), Tokyo (Japan), London (the United Kingdom), and Atlanta (the United States of America); they form part of the World Health Organization Global Influenza Surveillance and Response System (WHO GISRS). The WHO Collaborating Centres are responsible for analysing influenza viruses collected through an international surveillance network involving 142 national influenza centres across 115 countries.[6] The Melbourne centre analyses viruses received from Australia and laboratories in the Asia-Pacific Region. Virus isolates are analysed antigenically; a geographically- and temporally-representative number of viruses, together with any strains demonstrating uncharacteristic reactions during antigenic characterisation, are further analysed by genetic sequencing of the viral HA and NA genes. Virological, serological, and epidemiological data form the basis from which WHO makes recommendations in February (for the Northern Hemisphere) and in September (for the Southern Hemisphere) on which strains should be included in the influenza vaccine for the following influenza season. The WHO vaccine recommendations are made in the context of strains that are antigenically 'like' laboratory reference strains that are named according to a standard nomenclature for influenza viruses. This nomenclature is based on the virus type, place of isolation, sequential number, year of isolation, and the subtype of the HA and NA genes (for influenza A). National and regional committees (such as the Australian Influenza Vaccine Committee) then translate the WHO recommendations into actual virus strains acceptable to regulatory authorities and vaccine manufacturers.

Sentinel general practitioner surveillance

Sentinel GP surveillance schemes for influenza monitor clinical consultations for ILI, defined as any presentation with fever, cough and fatigue; they also collect swabs from patients with ILI to inform virological surveillance of influenza. In Australia, there are two sentinel GP programs: ASPREN, a network of sentinel GPs, which collects ILI data from almost 250 providers across all states and territories, and the Victorian Infectious Diseases Reference Laboratory (VIDRL)-operated Victorian Sentinel Practice Influenza Network (VicSPIN), previously known as the General Practice Sentinel Surveillance Program (VIDRL GPSS), which operates solely in Victoria. ASPREN reports ILI rates throughout the year, while VicSPIN reports during the influenza season, from early May to late October. In addition, ASPREN provides annual vaccine effectiveness estimates to the Global Influenza Vaccine Effectiveness Movement and data to the WHOCC.

FluTracking

FluTracking is a project run by the University of Newcastle, the Hunter New England Area Health Service, and the Hunter Medical Research Institute. FluTracking is an online health surveillance system established to detect epidemics of influenza and to monitor the transmission and severity of ILI in the community. It involves volunteer participants from across

Australia completing a simple online weekly survey, which collects data on ILI symptoms, absence from work or normal duties, healthcare presentation, testing, and seasonal influenza vaccination.

Influenza Complications Alert Network (FluCAN)

The Influenza Complications Alert Network (FluCAN) is a national hospital-based sentinel surveillance system reporting data from 17 participating sites (there were 15 sites until 2013). FluCAN collects detailed clinical and laboratory information from all patients hospitalised at participating sites with a laboratory-confirmed diagnosis of influenza, to determine the burden of disease requiring hospitalisation associated with influenza, and to estimate the effectiveness of the influenza vaccine against hospitalisation with influenza. Data were extracted from the FluCAN annual reports published in the Medical Journal of Australia (2011 report) and Communicable Disease Intelligence (2012 to 2018 reports).[7–14]

Results

National notifications of laboratory-confirmed influenza cases

During the period 2011 to 2018, there were 669,370 laboratory-confirmed influenza cases notified to the NNDSS. The notification rates for laboratory-confirmed influenza increased from 2011, peaking in 2017, before declining in 2018 (Figure 1). The highest number of notifications was in 2017 (n = 251,290), followed by 2015 (n = 100,582). The lowest number of notifications in the period was in 2011 (n = 27,214) (Table 1). The 2017 notifications represent the highest levels of influenza notifications to the NNDSS since the 2009 pandemic year. Over the eight years reported, notifications peaked between July and September, usually returning to inter-seasonal levels by October/November each year (Figure 2). Over the reporting period, the peak number of notifications occurred in August 2017, with 99,428 notifications, which was almost 3.4 times as high as the 2016 peak of 29,428 notifications.

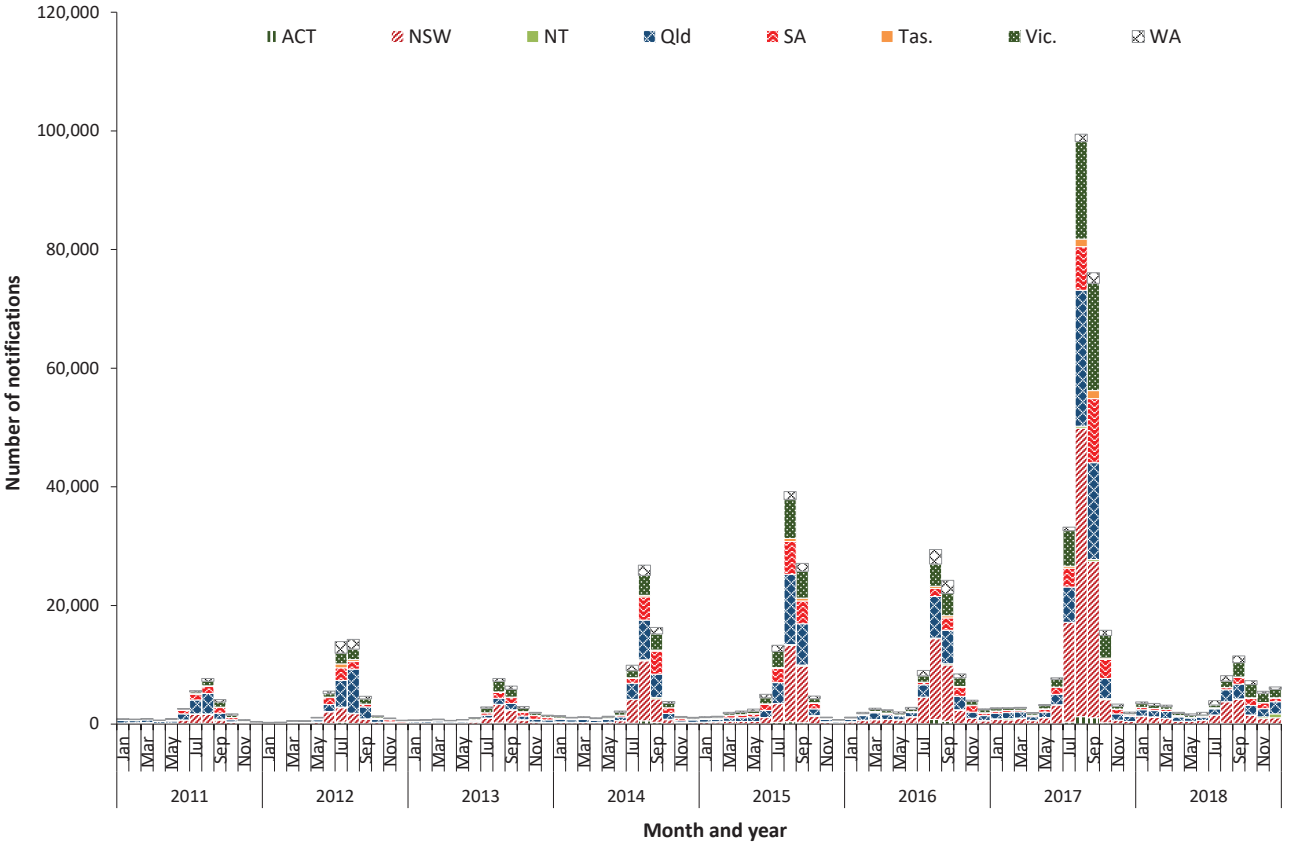
Geographic distribution

During the period from 2011 to 2018, thirty-four percent of laboratory-confirmed influenza notifications (n = 230,281/669,370) were in New South Wales, 26% (n = 174,286) in Queensland, 17% (n = 115,141) in Victoria, 13% (n = 84,804) in South Australia, 6% (n = 40,466) in Western Australia, and 1% each in the Northern Territory (n = 6,376), Tasmania (n = 8,881) and the Australian Capital Territory (n = 9,135) (Table 1). Of the states and territories, New South Wales reported the highest proportion of cases during each year of the reporting period, except in 2011 and 2012 when Queensland reported the highest proportion of cases.

Over the reporting period, all states and territories, except Western Australia, reported their highest rates of laboratory-confirmed influenza in 2017 (Table 1, Figure 3). Western Australia's notification rate for 2017 (n = 234 notifications per 100,000 population) was comparable with rates in 2012, 2014, 2015, and 2018, and was lower than in 2016 (n = 307 notifications per 100,000 population). For each year in the reporting period, the highest notification rates were reported from South Australia (2011–2015 and 2017), Queensland (2016), and the Northern Territory (2018) (Figure 3).

Activity at the peak of the influenza season was more prolonged during the 2012 and 2015–2018 seasons (Figure 2). The 2018 season extended until December in Queensland, Victoria, New South Wales, and the Northern Territory. Additionally, the Northern Territory had prolonged influenza seasons in 2013, 2015, 2016, and 2018 with seasons extending into the following year. Bimodal patterns were also observed in the Northern Territory during the 2011, 2013, 2014, and 2017 seasons (Figure 4).

Figure 1: Laboratory-confirmed influenza notifications in Australia, by state or territory, month and year of diagnosis, 2011 to 2018



Age and sex profile

Laboratory-confirmed influenza notification rates increased from 131 per 100,000 population in 2011, reaching a peak of 1,030 per 100,000 population in 2017 before declining to 244 per 100,000 population in 2018 for all age groups and persons. Except in 2016 and 2017, the highest notification rates each year were reported among males aged 14 years or younger. In 2016 and 2017, the highest rates were reported among females aged 65 years or older (Figure 5). Notifications in females predominated in all years, and overall represented 54.3% of notifications from 2011 to 2018 (Table 2).

During the eight-year period, influenza type A predominated in the 65 years or older age group, at 76.8% (n = 96,352). Influenza B predominated in 2015 (61% of notified cases), accounting for 71.6% of cases notified in the 14 years or younger age group, 59.9% in the 15–64 years age group, and 39.5% in the 65 years and over age group (Table 3).

Aboriginal and/or Torres Strait Islander status

During the reporting period Aboriginal and/or Torres Strait Islander status was recorded for 256,691 cases, with 15,846 of these cases (6.2%) identifying as Aboriginal and/or Torres Strait Islander. Throughout the eight-year period, laboratory-confirmed influenza notification rates were between 1.9 and 3.7 times higher among those identifying as Aboriginal and/or Torres Strait Islander than those identifying as non-Indigenous (Figure 6). Sixty-two percent of cases (n = 412,679) did not have Aboriginal and/or Torres Strait Islander status recorded.

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Table 1: Notifications and rates[a] of laboratory-confirmed influenza in Australia by state or territory,[b] 2011 to 2018

		2011	2012	2013	2014	2015	2016	2017	2018
ACT	Notifications	270	667	552	1,262	1,206	1,604	3,098	476
	% of all notifications	1.0	1.5	2.0	1.9	1.2	1.8	1.2	0.8
	Rate	73.4	177.1	144.0	324.6	304.7	397.9	751.9	113.1
NSW	Notifications	5,786	7,986	8,394	20,889	30,271	35,585	103,858	17,512
	% of all notifications	21.3	17.9	29.7	30.9	30.1	39.2	41.3	29.7
	Rate	80.2	109.3	113.4	278.2	397.5	460.2	1,320.0	219.2
NT	Notifications	597	443	480	810	676	701	1,474	1,195
	% of all notifications	2.2	1.0	1.7	1.2	0.7	0.8	0.6	2.0
	Rate	258.1	187.8	198.6	333.5	276.3	285.3	595.5	483.0
Qld	Notifications	10,383	16,834	5,507	17,895	28,061	23,294	56,614	15,698
	% of all notifications	38.2	37.8	19.5	26.4	27.9	25.6	22.5	26.7
	Rate	231.9	368.5	118.4	379.2	587.3	480.8	1,148.9	313.2
SA	Notifications	4,742	6,287	4,827	11,041	15,651	7,869	28,490	5,897
	% of all notifications	17.4	14.1	17.1	16.3	15.6	8.7	11.3	10.0
	Rate	289.2	379.5	288.8	654.5	920.3	459.4	1,652.6	339.6
Tas.	Notifications	363	1,093	297	675	1,437	1,055	3,509	452
	% of all notifications	1.3	2.5	1.0	1.0	1.4	1.2	1.4	0.8
	Rate	71.0	213.6	58.0	131.4	279.0	203.9	671.7	85.6
Vic.	Notifications	3,210	5,995	5,848	9,860	17,287	12,941	48,227	11,773
	% of all notifications	11.8	13.5	20.7	14.6	17.2	14.2	19.2	20.0
	Rate	58.0	106.1	101.3	167.3	287.0	209.6	762.9	182.2
WA	Notifications	1,863	5,235	2,399	5,253	5,993	7,837	6,020	5,866
	% of all notifications	6.8	11.8	8.5	7.8	6.0	8.6	2.4	10.0
	Rate	79.2	215.8	96.5	208.7	235.9	306.6	233.9	226.1
Australia	Notifications	27,214	44,540	28,304	67,685	100,582	90,886	251,290	58,869
	Rate	121.8	195.9	122.4	288.3	422.3	375.7	1,021.4	235.5

a Notification rate per 100,000 population.
b ACT: Australian Capital Territory; New South Wales: New South Wales; NT: Northern Territory; Qld: Queensland; SA: South Australia; Tas.: Tasmania; Vic.: Victoria; WA: Western Australia

Figure 2: Laboratory-confirmed influenza notifications in Australia by month, 2011 to 2018

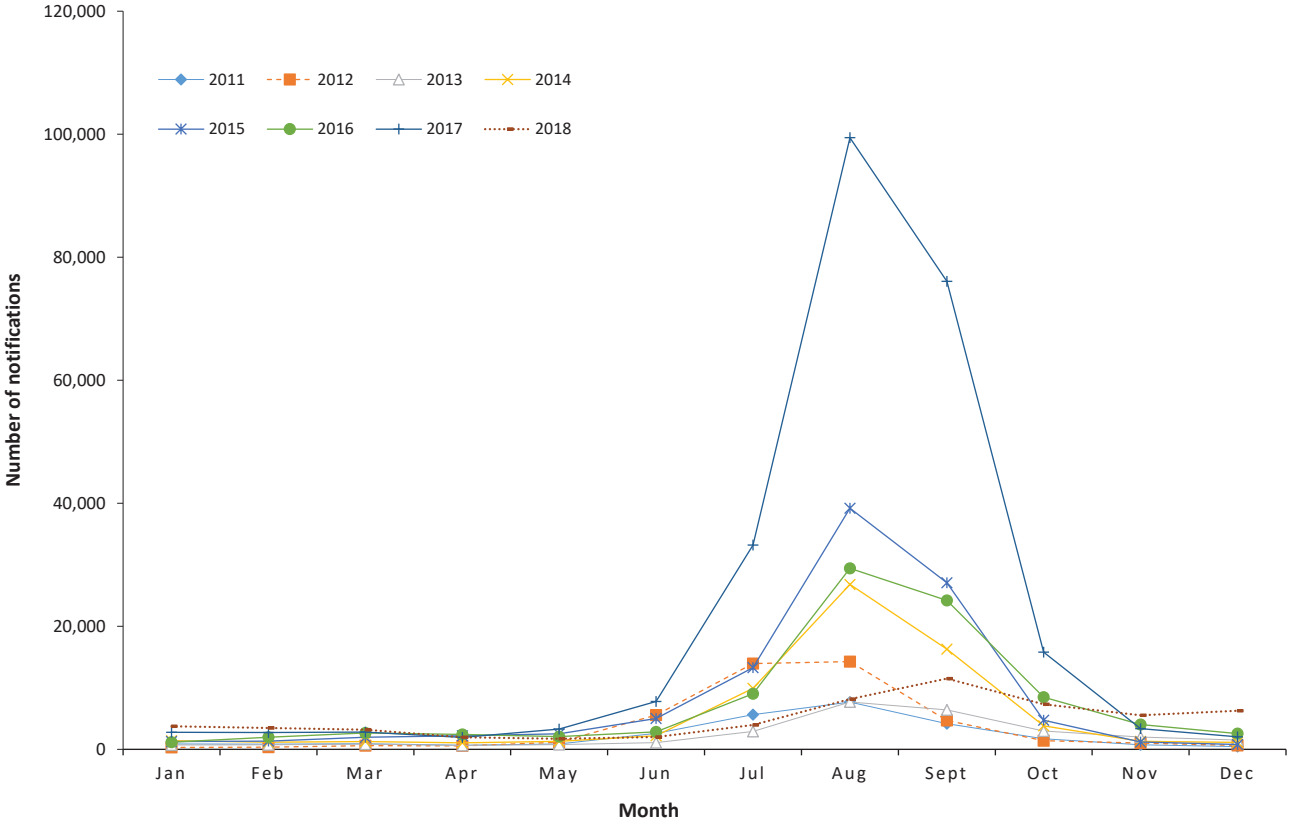


Figure 3: Rate of notification of laboratory-confirmed influenza in Australia by jurisdiction, 2011 to 2018

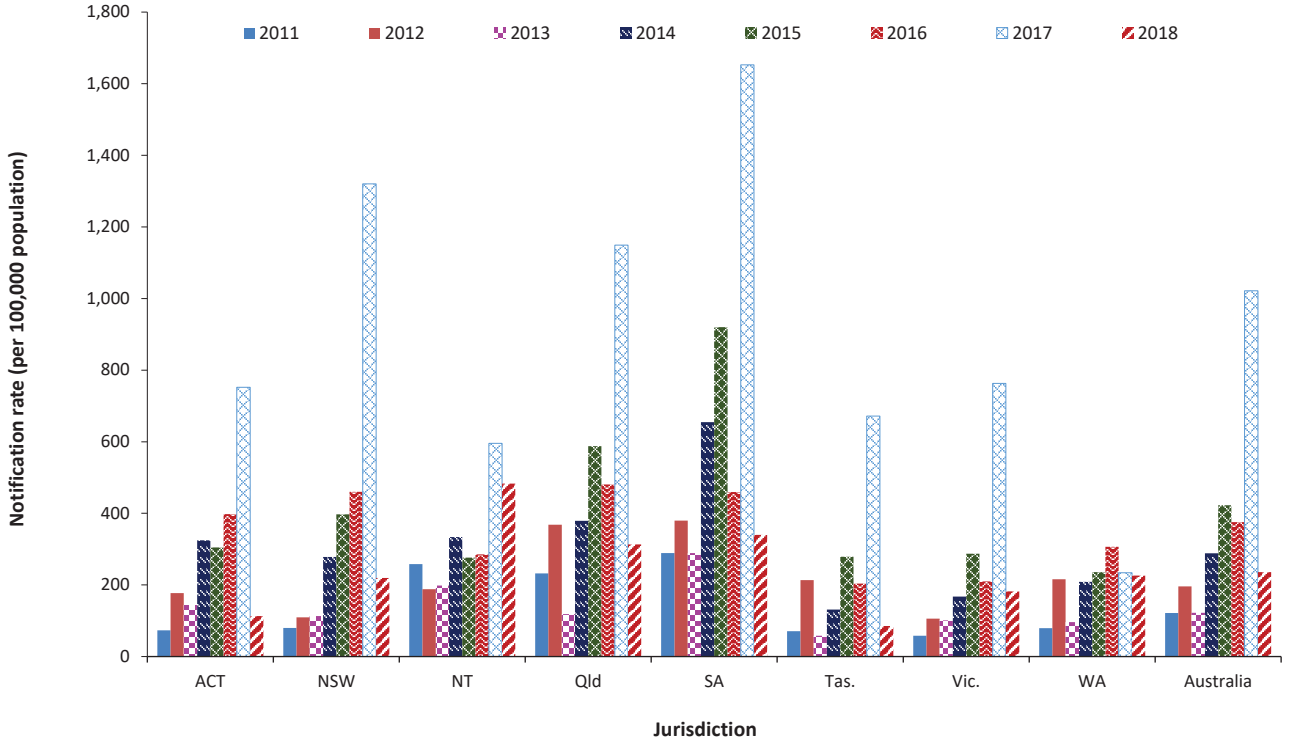


Figure 4: Notifications of laboratory-confirmed influenza in Australia by year and state or territory, 2011 to 2018

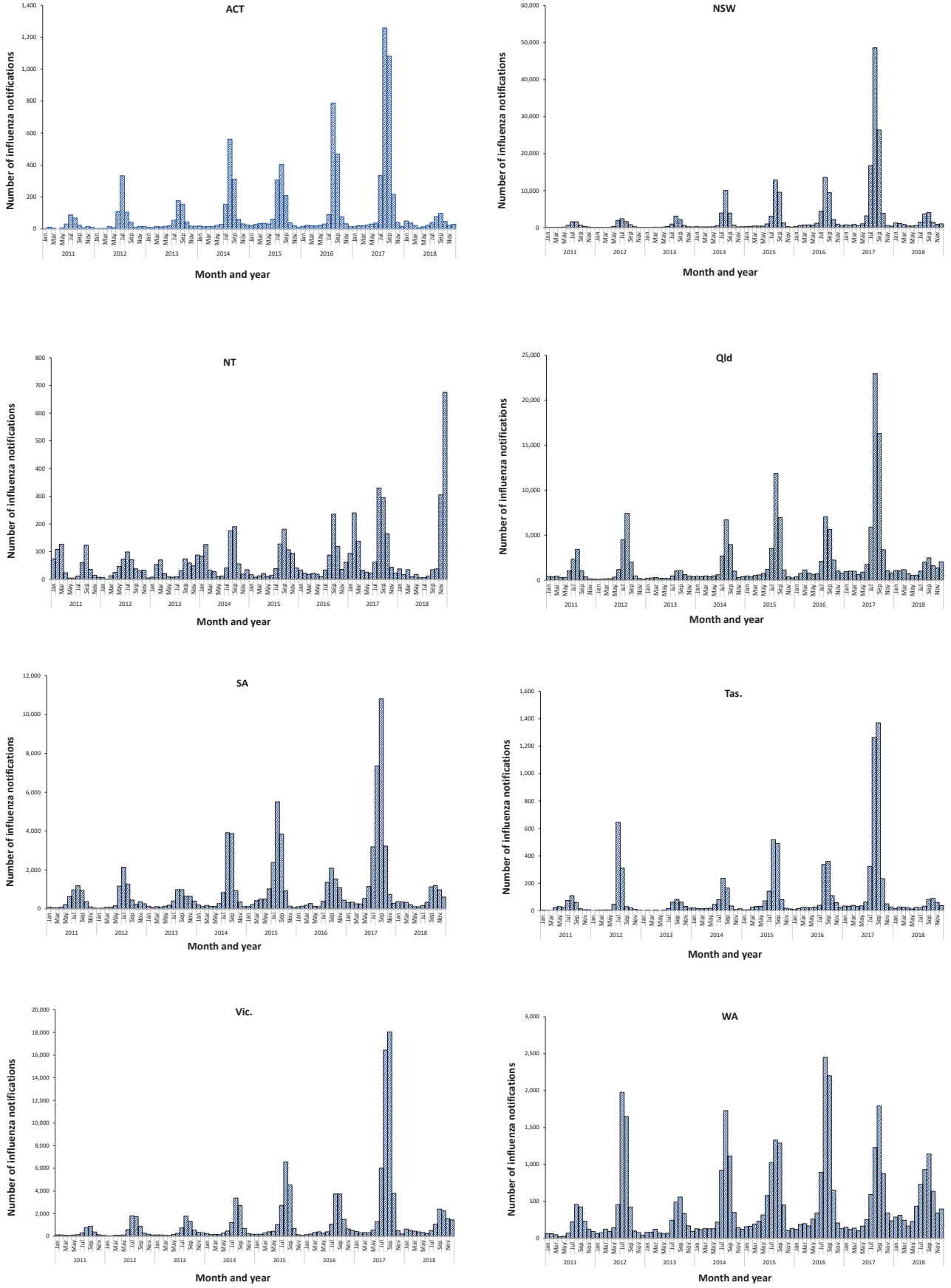


Figure 5: Notification rates of laboratory-confirmed influenza in Australia by sex and age group, 2011 to 2018

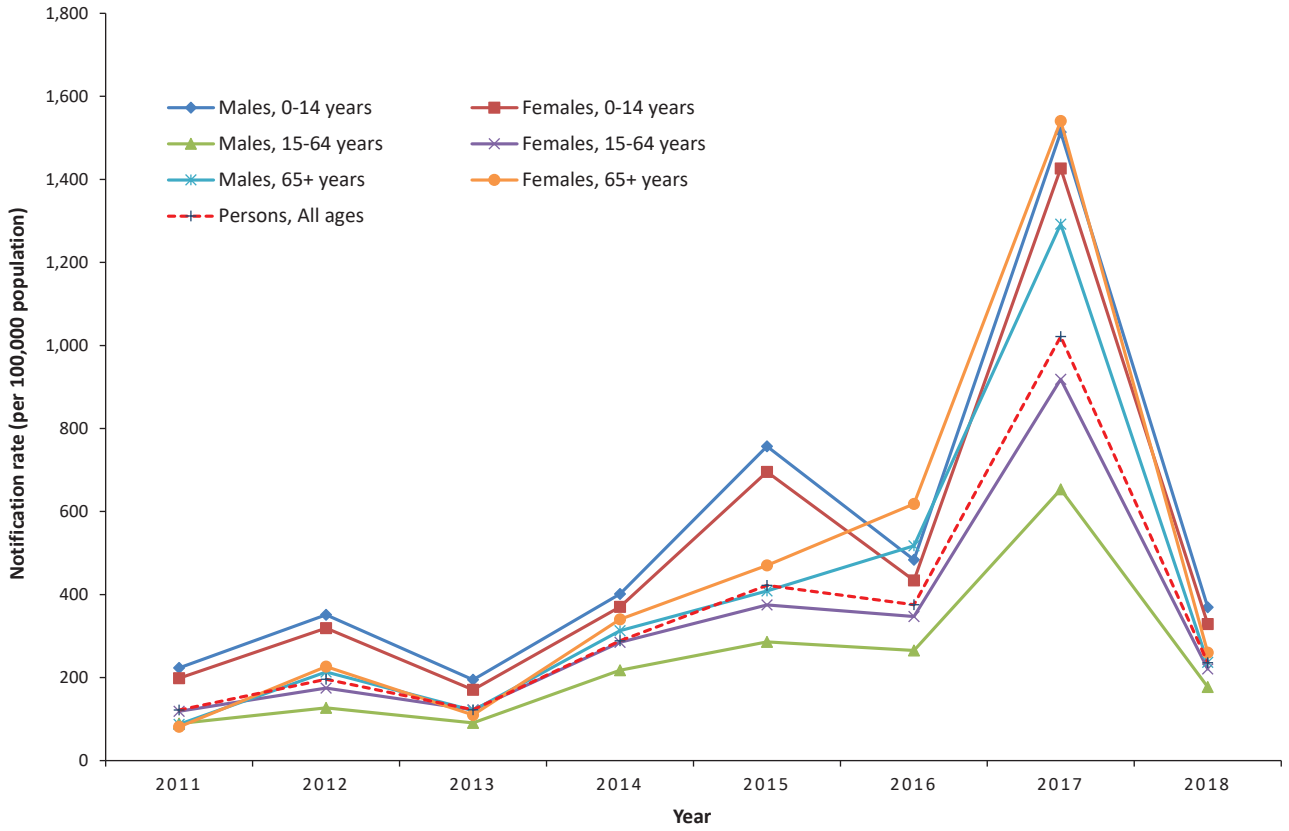


Table 2: Notifications and rates of laboratory-confirmed influenza in Australia by year and sex,[a] 2011 to 2018

Year		2011	2012	2013	2014	2015	2016	2017	2018
Notifications n (%)	Male	12,825 (47)	20,620 (46)	13,264 (47)	31,124 (46)	46,743 (47)	41,287 (45)	11,1564 (45)	27,723 (47)
	Female	14,360 (53)	23,891 (54)	15,028 (53)	36,529 (54)	53,772 (53)	49,546 (55)	137,902 (55)	31,096 (53)
Notification rate[b]	Male	115.4	182.3	115.3	266.7	395.2	344	914.2	223.6
	Female	128.0	209.2	129.3	309.4	448.5	406.5	1,112.3	246.9

a Excludes notifications with sex not reported (n = 2,091).

b Notification rate per 100,000 population.

Virus type and subtype

Analysis of NNDSS influenza typing data showed influenza A(unsubtyped) was the predominant type during the period from 2011 to 2018 (Table 4). Of notifications with influenza type recorded during the reporting period, 67.7% overall were type A (55.7% unsubtyped, 6.9% H3N2, and 5.0% H1N1), 32.1% were type B, 0.2% accounted for mixed influenza type A and B, and type C infections, and < 0.1% of cases (n = 354) were untyped. Over the reporting period there was variation in the distribution of influenza types. For example, in 2015 influenza type B predominated, accounting for 61% of notifications, while in all other years during the reporting period, influenza type A predominated. The highest A(H1N1) proportion was reported in 2011 (26.1%) followed by 2013 (14.3%) and 2014 (10.1%), while A(H3N2) was highest in 2012 (16.9%) followed by 2016 (10.8%) (Figure 7).

Table 3: Influenza notifications in Australia by year, age group and type/subtype[a]

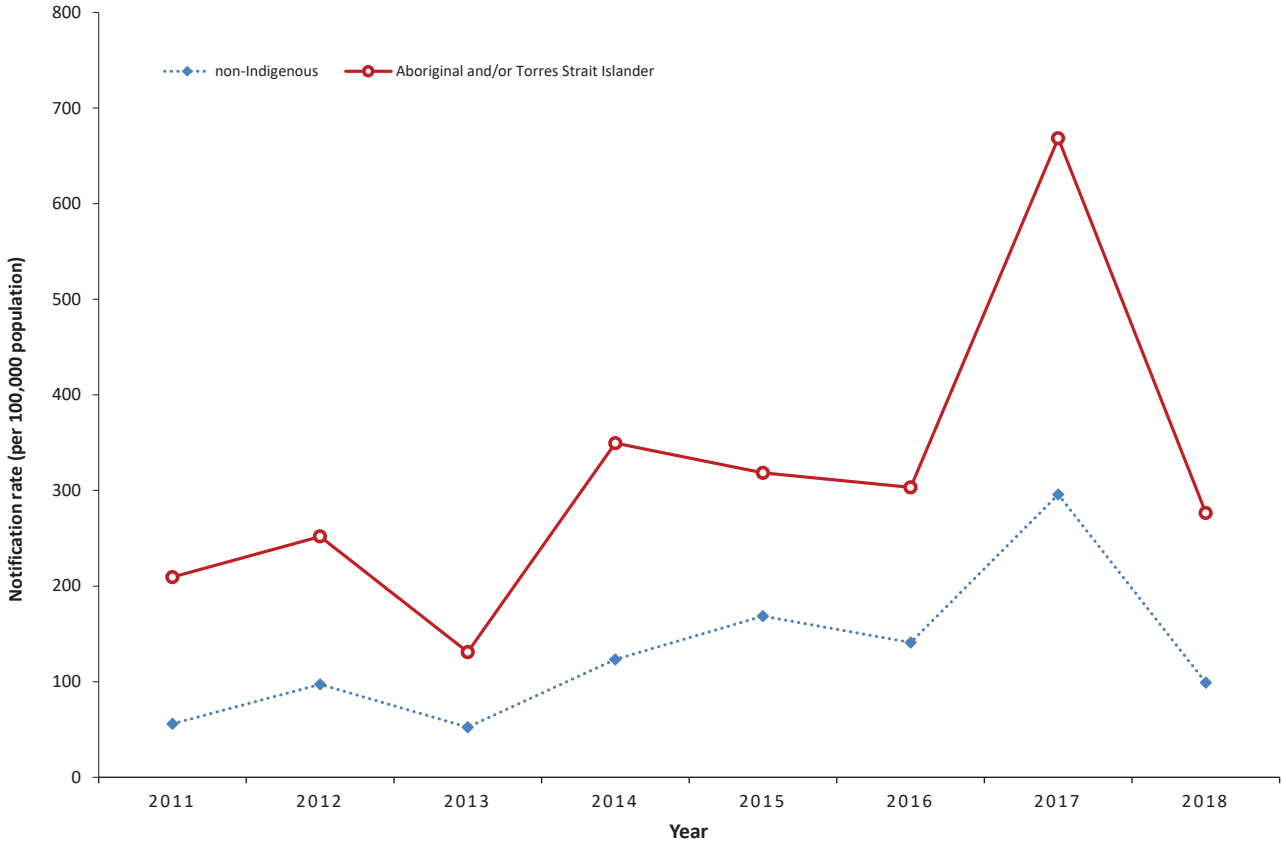
Year	Age group (years)	Influenza type/subtype[a]						Notification rate[a] (per 100,000 population)
		A/H1N1	A/H3N2	A (unsubtyped)	B	A and B	C	
2011	< 15	2,437	666	2,542	3,287	5	1	211.1
	15–64	4,485	1,044	6,553	3,458	29	1	103.7
	≥ 65	189	275	1,551	544	29	0	83.8
2012	< 15	89	2,284	7,452	4,611	3	3	335.5
	15–64	200	3,738	13,947	5,074	28	5	151.1
	≥ 65	24	1,513	4,654	860	36	1	220.5
2013	< 15	1,120	350	2,177	4,353	13	0	183.0
	15–64	2,614	872	7,848	5,070	37	0	106.6
	≥ 65	314	441	2,072	986	22	0	115.2
2014	< 15	2,067	1,358	11,518	2,182	12	9	386.2
	15–64	4,216	2,956	27,247	4,759	46	3	251.6
	≥ 65	616	1,550	7,968	1,107	36	1	327.6
2015	< 15	915	1,478	6,827	23,446	71	0	727.6
	15–64	1,262	3,262	16,289	31,217	96	0	330.7
	≥ 65	156	1,768	7,544	6,200	39	1	441.9
2016	< 15	1,883	1,852	14,311	2,950	25	3	459.8
	15–64	3,060	4,712	35,595	5,395	58	1	306.2
	≥ 65	448	3,216	15,909	1,392	18	0	571.4
2017	< 15	1,381	1,927	34,880	30,558	268	0	1,487.7
	15–64	1,795	4,825	71,299	49,816	285	0	791.6
	≥ 65	302	4,070	34,205	15,459	135	2	1,429.0
2018	< 15	1,428	307	11,886	2,816	7	0	349.7
	15–64	2,273	1,078	22,380	6,806	39	0	198.9
	≥ 65	500	734	6,333	2,133	29	0	248.6

a Excludes 354 untyped notifications and 103 notifications where age was not reported.

Hospitalisations

A total of 176,486 (26.4%) cases across the reporting period had data on whether or not they were hospitalised recorded in the NNDSS. Of the 176,486 cases with hospitalisation data, 13,338 cases (7.6%) were reported to have been hospitalised. The proportion of cases who were hospitalised peaked in 2013 (64.8%) and was lowest during the 2017 season (3.1%) (Figure 8). Hospital admissions were likely under-reported to the NNDSS during the period from 2011 to 2018 and should therefore be interpreted with caution. For example, during the period from 2011 to 2018, a total of 12,900 laboratory-confirmed influenza patients were hospitalised in just the 17 hospitals under the FluCAN network. Furthermore, there were no hospital admissions reported from Victoria in the NNDSS throughout the period 2011 to 2018.

Figure 6: Notification rates of laboratory confirmed influenza in Australia by Aboriginal and/or Torres Strait Islander status, 2011 to 2018[a]



a Aboriginal and/or Torres Strait Islander status was missing for 412,679 cases.

In the NNDSS hospitalisation data, patients in the 65 years or older age group had the highest hospitalisation rates, except in 2011 when those 14 years or younger had the highest rates of hospitalisation (Figure 9).

Virology

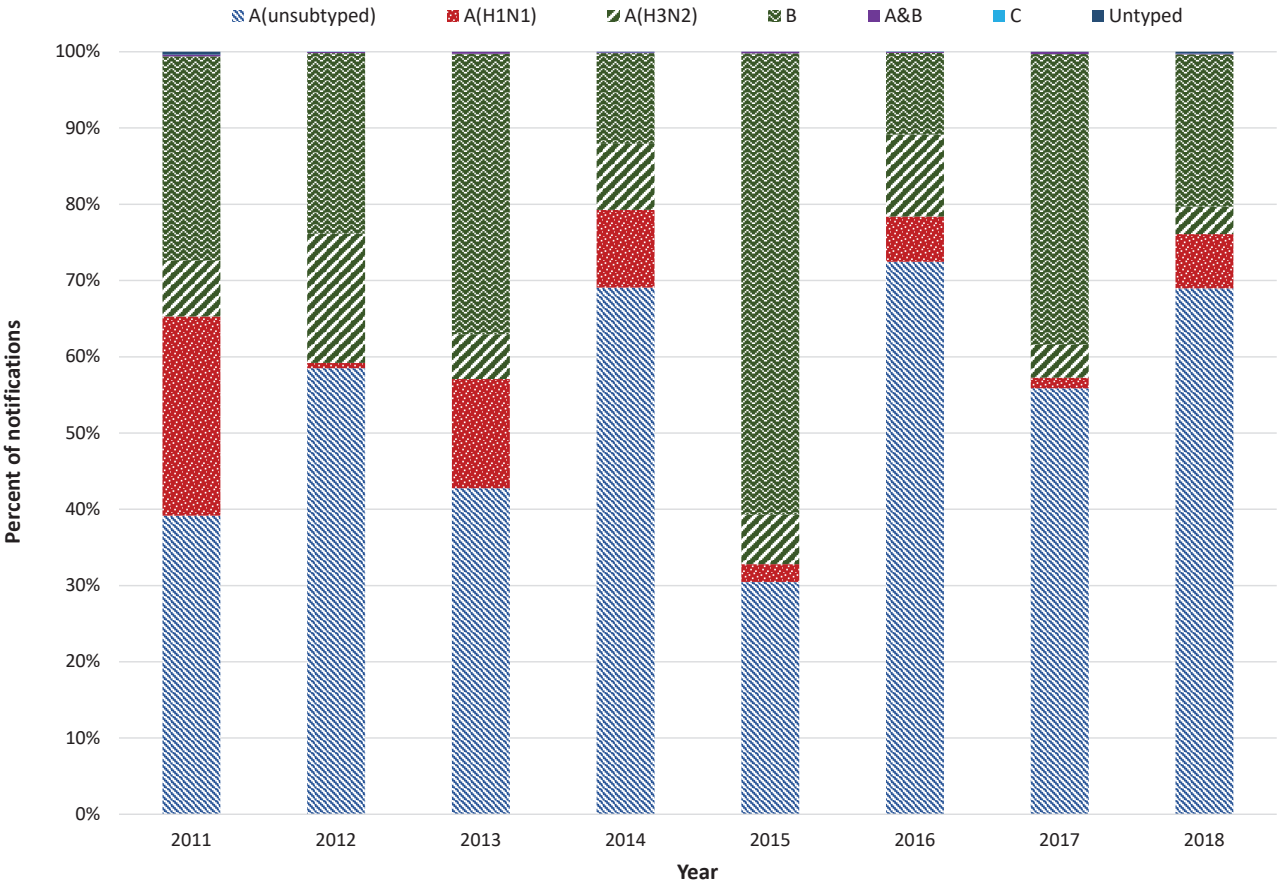
Samples received and tested

The highest numbers of samples received by the Australian WHO Collaborating Centre (WHOCC) were in 2017 (n = 4,459) followed by 2015 (n = 4,436), with the lowest number of samples in 2018 (n = 2,357).

Influenza type A isolates were the predominant isolates tested by the Australian WHOCC during each year of the reporting period, except for 2015 when almost 70% of the isolates were type B (Figure 10 and Figure 11). These proportions are consistent with data reported through the NNDSS and FluCAN.

During the reporting period, two antigenically and genetically distinct lineages of influenza B virus were circulating: the B/Victoria/2/87 lineage (represented by the southern hemisphere 2016 vaccine strain B/Brisbane/60/2008) and the B/Yamagata/16/88 lineage (represented by the southern hemisphere 2015 vaccine strain B/Phuket/3073/2013). Influenza B only accounted for about a third of notifications (32%) from 2011 to 2018. The B/Yamagata lineage was the predominant B virus except in 2011, 2012, and 2015 when B/Victoria predominated (Figure 11). Of influenza B viruses characterised by the Australian WHOCC site during the eight-year period, 54.3% were from the Yamagata lineage,

Figure 7: Proportion of influenza notifications in Australia by year and subtype, 2011–2018



although the proportion was higher (66.6%) when analysing the most recent four years (2015 to 2018) (Table 5).

During the reporting period, many B/Victoria/2/87 lineage viruses were well inhibited by antisera raised against B/Brisbane/60/2008-like viruses. However, an increasing proportion of viruses were antigenically different from B/Brisbane/60/2008-like viruses, and were more closely related to B/Colorado/06/2017-like viruses.[19] This led to a change to a B/Colorado/06/2017-like virus as the B/Victoria component for the southern hemisphere 2019 vaccine.[15]

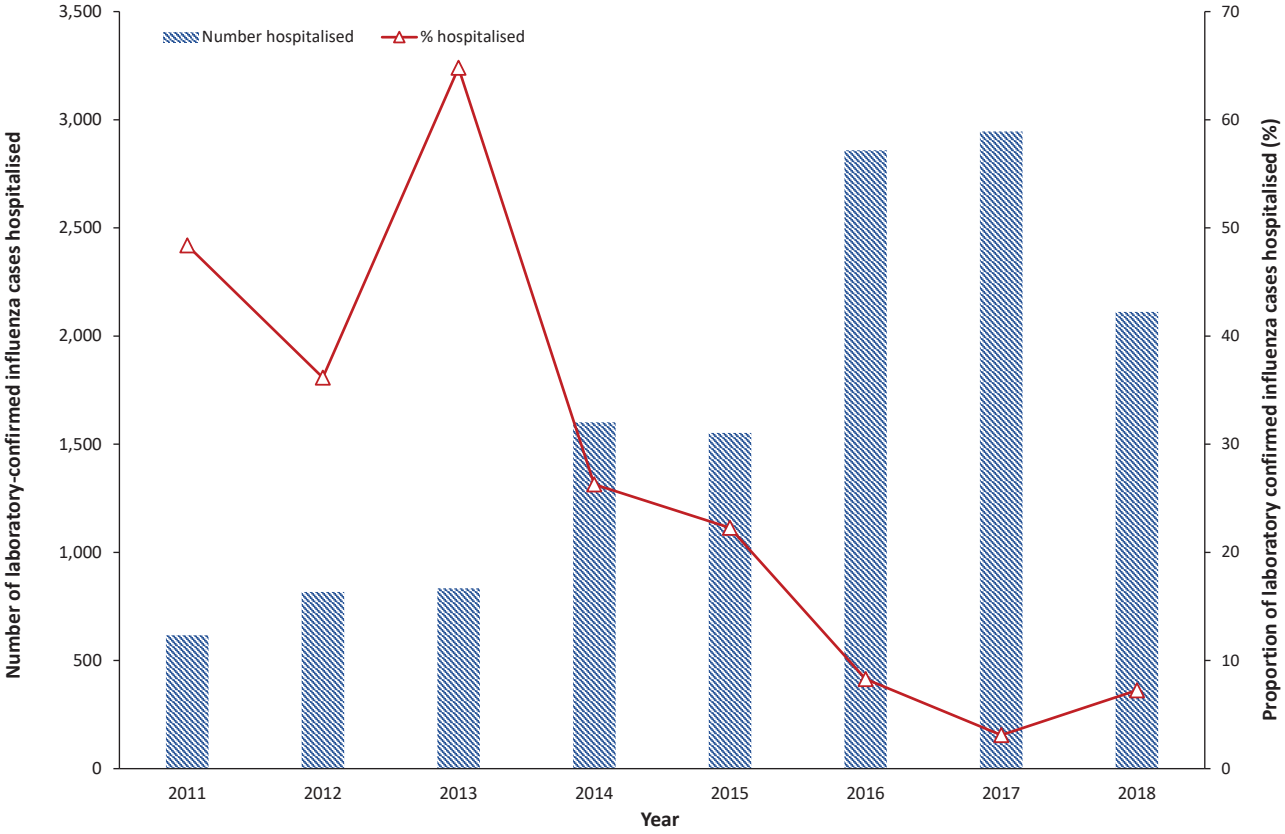
Of influenza A viruses circulating during the reporting period, the A(H1N1) viruses were mostly antigenically similar to the vaccine strain A/California/7/2009 (H1N1), except in 2017 and 2018 when they were mostly similar to A/Michigan/45/2015. The A(H3N2) strains varied over the years but included the vaccine strains A/Perth/16/2009, A/Switzerland/9715293/2013, A/Hong Kong/4801/2014, and A/Singapore/INFIMH/2016.

In 2018, the Australian WHOCC site detected, for the first time, swine A(H3N2)v (v for variant) virus from a human patient in South Australia. Phylogenetic analysis of the virus showed a combination of genes derived from seasonal A(H3N2) viruses and A(H1N1)pdm09 viruses. The detection of this virus from a human patient highlights the importance of robust surveillance of zoonotic influenzas that can infect humans and potentially represent a pandemic threat if human-to-human transmission subsequently occurs.

Table 4: Influenza in Australia by year and subtype, 2011-2018

Influenza type/ subtype	2011 n (%)	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)
A(unsubtyped)	10,654 (39)	26,061 (59)	12,104 (43)	46,745 (69)	30,664 (30)	65,843 (72)	140,388 (56)	40,599 (69)
A(H1N1)	7,112 (26)	313 (1)	4,048 (14)	6,901 (10)	2,333 (2)	5,391 (6)	3,478 (1)	4,201 (7)
A(H3N2)	1,985 (7)	7,538 (17)	1,663 (6)	5,864 (9)	6,508 (6)	9,780 (11)	10,823 (4)	2,119 (4)
B	7,299 (27)	10,551 (24)	10,412 (37)	8,049 (12)	60,868 (61)	9,737 (11)	95,833 (38)	11,755 (20)
A&B	63 (< 1)	67 (< 1)	72 (< 1)	94 (< 1)	206 (< 1)	101 (< 1)	688 (< 1)	75 (< 1)
C	2 (< 1)	9 (< 1)	0 (0)	13 (< 1)	1 (< 1)	4 (< 1)	0 (0)	2 (< 1)
Untyped	99 (< 1)	1 (< 1)	5 (< 1)	19 (< 1)	2 (< 1)	30 (< 1)	80 (< 1)	118 (< 1)
Total	**27,214 (100)**	**44,540 (100)**	**28,304 (100)**	**67,685 (100)**	**100,582 (100)**	**90,886 (100)**	**251,290 (100)**	**58,869 (100)**

Figure 8: Number and per cent of influenza cases in Australia that were hospitalised, 2011 to 2018



The Australian WHOCC tested a total of 14,900 isolates for resistance to oseltamivir. Fifty-one isolates (0.3%) were resistant to oseltamivir, all of which were type A isolates (49 of A(H1N1) pdm09, and two of A(H3N2)).

Influenza-like illness – national online community survey (FluTracking)

Participants

The highest proportion of participants during the eight-year period were in the 50–64 years age group (proportion range: 31–36%), followed by the 35–49 years age group (23–30%), while the lowest proportion of participants was in the 65 years or older age group (except in 2017 and 2018 when the lowest proportion of participants was in the 15 years or younger age group). Participation declined during the reporting period in those aged between 16 and 64 years, and increased for those aged 15 years or younger and 65 years or older (Figure 12).

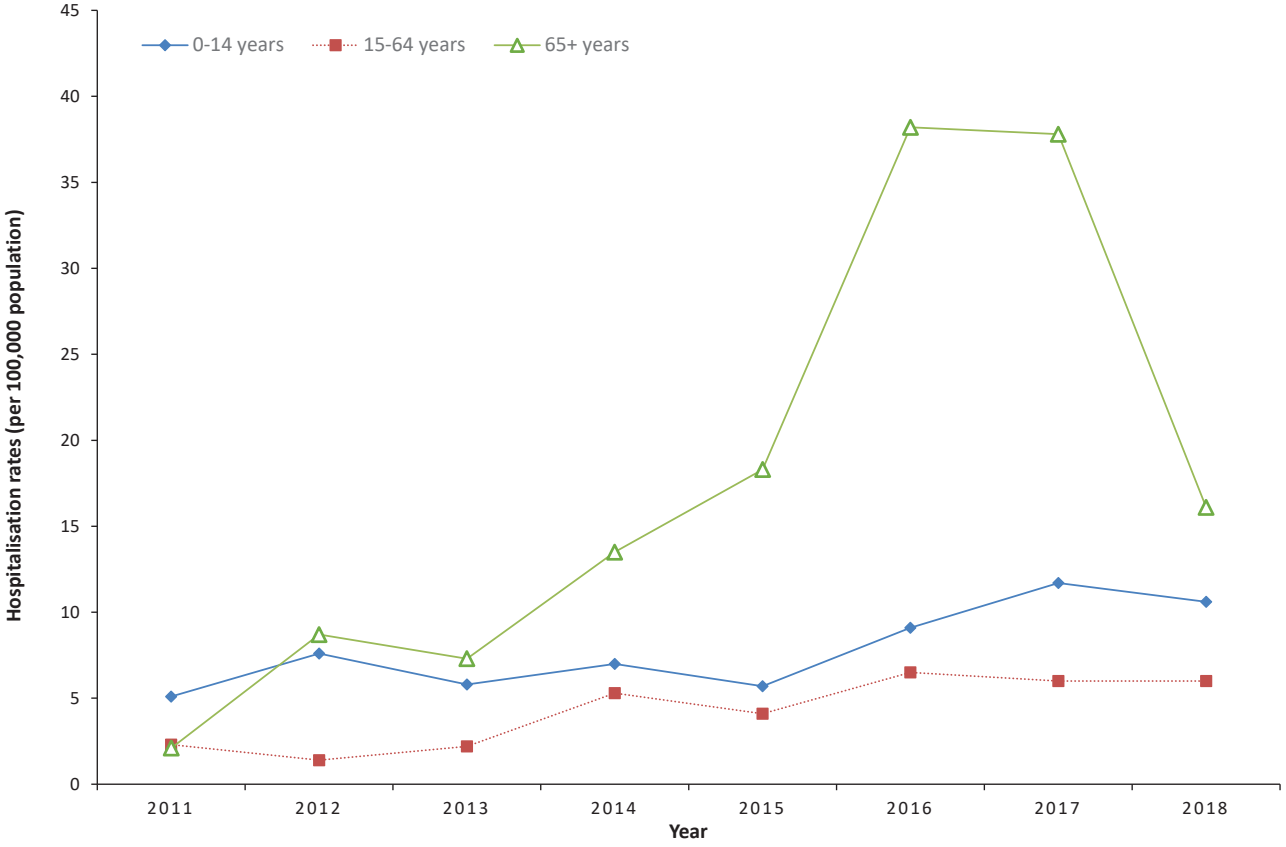
During the eight-year reporting period, 117,046 of the participants (61.2%) were female, and the number of participants who identified as Aboriginal and/or Torres Strait Islander ranged from 102 (1.2%) in 2011 to 492 (1.7%) in 2018.

The number of participants completing at least one survey increased each year over the eight-year reporting period from 13,101 in 2011 to 45,532 in 2018, representing a 3.5 times increase. The rate of FluTracking participation also increased more than threefold, from 58.3 per 100,000 population in 2011, to 182.2 per 100,000 population in 2018 (Figure 13).

Percentage with ILI symptoms (cough and fever) and absence from work

Almost two percent (1.9%) of participants who completed a survey in the national peak week of ILI for 2018 reported fever and cough, compared to 3.1%, 2.7%, and 3.4% in 2015, 2016, and 2017 respectively. The eight-year average peak was reported in week 32 (2.0%) (Figure 14).

Figure 9: Influenza hospitalisation rates in Australia by age group, 2011 to 2018



Of the participants who completed the survey in the national peak week of ILI over the reporting period, the proportion reporting both ILI and absence from work was lowest in 2018 (1.4%) and highest in 2017 (2.7%). The 2018 influenza season also had fewer participants reporting ILI and associated absenteeism from work overall than in previous seasons over the eight years (Figure 14).

Influenza-like illness consultations from sentinel general practitioner surveillance systems

The peak influenza-like illness (ILI) rate reported through the sentinel GPs (ASPREN and VicSPIN) were highest in 2017 (22.6 per 1,000 consultations) and 2015 (18.9), and lowest in 2018 (6.5) and 2013 (10.1). ILI rates typically peaked in weeks 33 to 34, except for 2012 and 2018 when the peak notification rates were in weeks 29 and 37 respectively (Figure 15). Similarly, GP consultations and notifications reported by VicSPIN peaked during the same range of weeks over the eight-year reporting period (Figure 16).

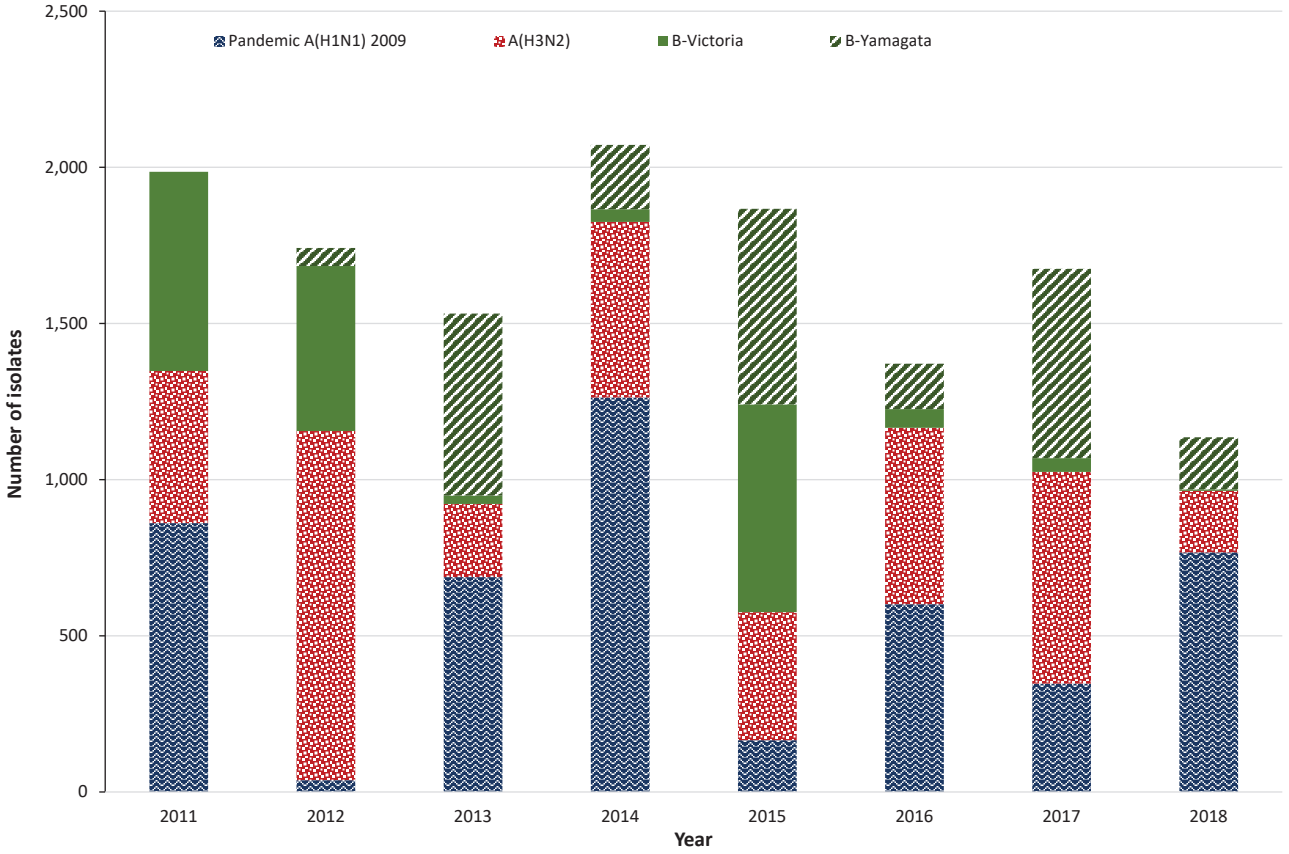
Morbidity

FluCAN

Hospitalisations

A total of 12,900 admissions were reported during the period 2011–2018 across all 17 FluCAN hospital sites. Influenza confirmed admissions increased by almost a factor of fifteen, from 296 in 2011 to 4,259 in 2017, before declining to 769 in 2018 (Table 6). The hospitalisation rates also followed a similar trend, with a peak in 2017 of 17.3 admissions per 100,000 population. In most jurisdictions, the peak numbers of hospitalised cases were reported from mid-August to mid-October, except in 2011 when the highest number of hospitalisations was in July. The proportion of influenza-confirmed admissions to an intensive care unit (ICU) were highest in

Figure 10: Number of isolates tested at the Australian WHOCC site by type/subtype, 2011 to 2018[a,b]



a 2015 data only up to 21 December 2015.

b 2018 data only up to 17 December 2018.

2013 (16%) and lowest in 2015 (7%) (Table 6). Hospitalisation data in the FluCAN 2011 report were not disaggregated by state or territory and were therefore not included in the analysis. During the period from 2012 to 2018, Victoria reported the highest number of laboratory-confirmed influenza admissions with the exception of 2016 and 2018 (Figure 17).

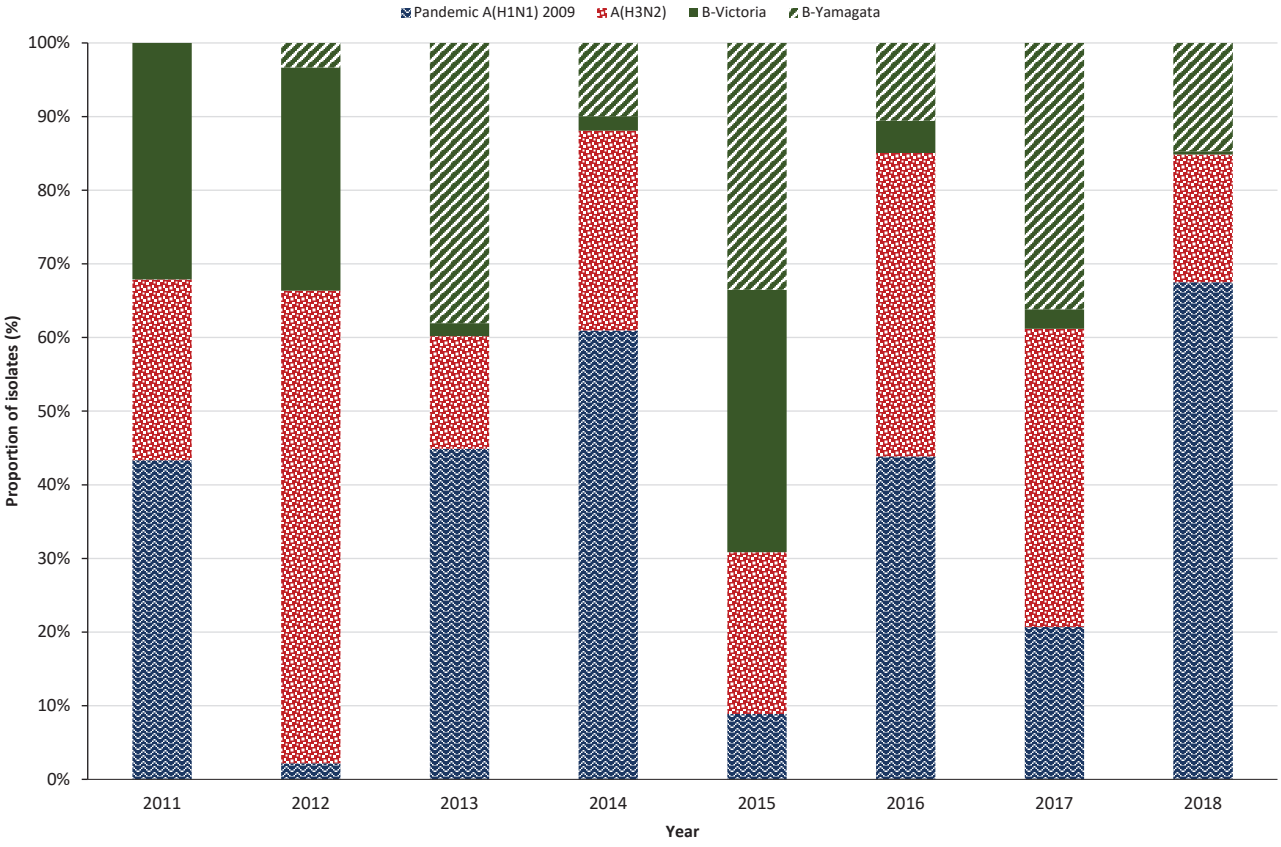
Demographic characteristics

Overall, during the period from 2011 to 2018, those aged 65 years or older accounted for 5,984 (46%) of the 12,900 patients who were admitted with confirmed influenza to FluCAN sentinel hospitals. The proportion of those aged 65 years or older was lowest in 2018 (30%) and highest in 2017 (52%). During 2015 to 2018, sixteen percent of admitted patients (1,473) were aged 15 years or younger. In total, 860 patients hospitalised with confirmed influenza (7%) identified as Aboriginal and/or Torres Strait Islander (Figure 18). The lowest proportion of people identifying as Aboriginal and/or Torres Strait Islander was reported in 2011 (4%) and the highest in 2014 (10%). The majority of patients hospitalised with laboratory-confirmed influenza (51%; 6,552/12,900) were females, with 315 patients (2%) reported to be pregnant during the time they were admitted to hospital.

Comorbidities

Of the 12,900 people admitted in sentinel hospitals with influenza during the period 2011 to 2018, there were 9,940 (77.1%) who had chronic comorbidities. The comorbidities included (but were not limited to) chronic respiratory illness, diabetes, chronic liver disease, immunosuppression, malignancy, chronic cardiac disease, and obesity.

Figure 11: Proportion of isolates tested at the Australian WHOCC site by type/subtype, 2011 to 2018[a,b]



a 2015 data only up to 21 December 2015.

b 2018 data only up to 17 December 2018.

Table 5: Summary of influenza isolates analysed by haemagglutination inhibition (HI) assay from samples collected from 2011 to 2018 by the Australian WHOCC site, VIDRL

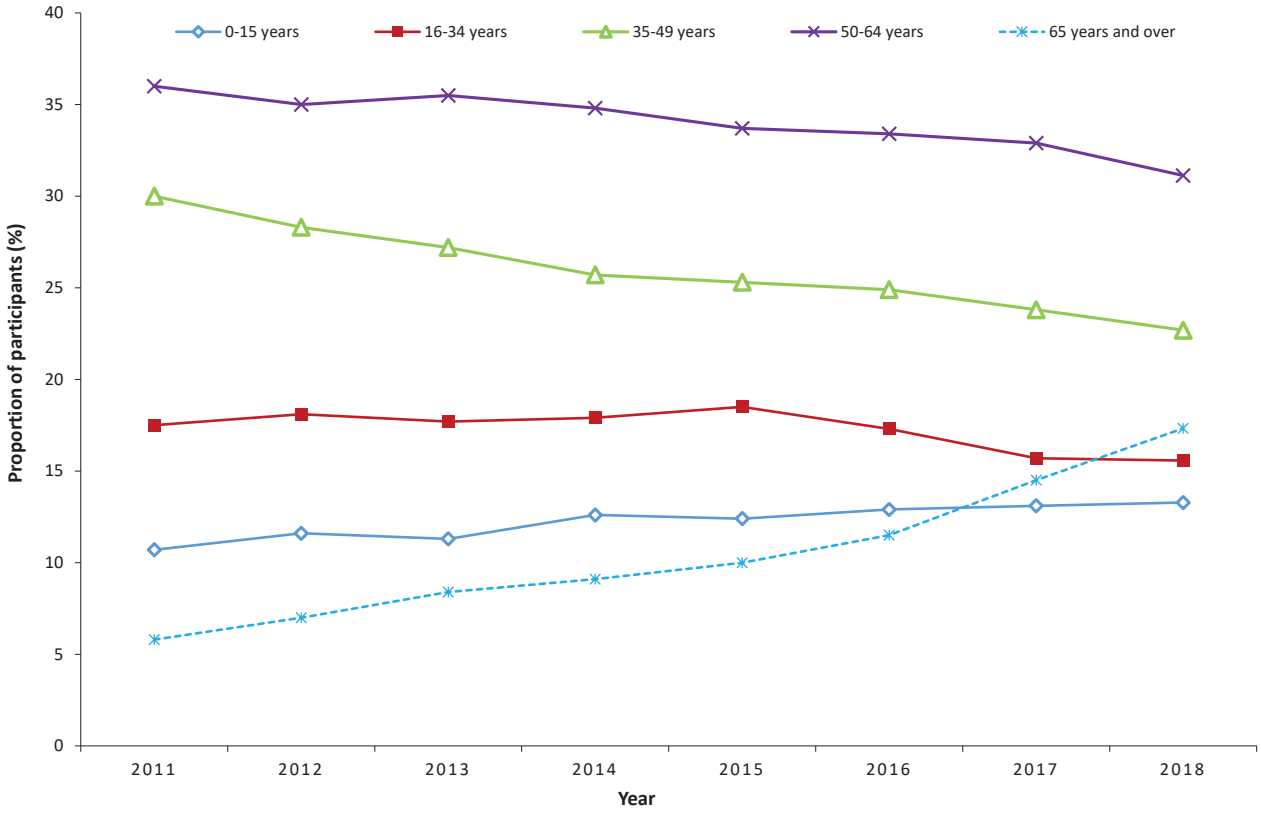
Influenza type/subtype	2011	2012	2013	2014	2015[a]	2016	2017	2018[b]	2011 to 2018
Pandemic A(H1N1) 2009	861	38	688	1,263	166	601	347	767	4,731 (35%)
A(H3N2)	487	1,118	234	562	410	565	678	197	4,251 (32%)
B-Victoria	638	528	27	41	665	60	44	5	2,008 (15%)
B-Yamagata	NI[c]	58	583	206	626	145	606	167	2,391 (18%)

a 2015 data only up to 21 December.

b 2018 data only up to 17 December.

c NI: not indicated.

Figure 12: Proportion of FluTracking participants by age group and year, 2011 to 2018[a]



a Source: FluTracking.

Influenza type and subtypes

The majority of laboratory-confirmed influenza admissions to sentinel hospitals from 2012 to 2018 were due to influenza type A, except in 2015 when type B predominated (Figure 19).

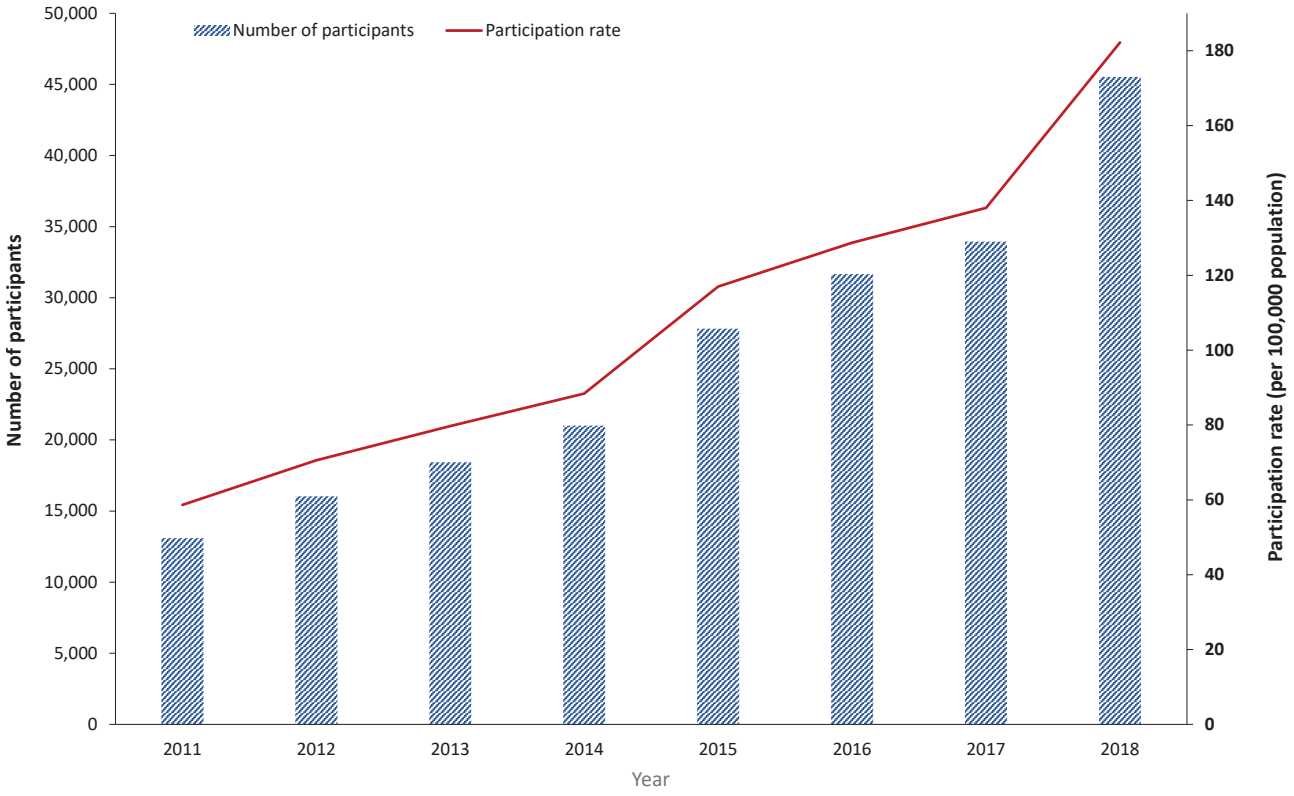
Length of stay

During the reporting period, the longest mean length of hospital stay was reported in 2014 (6.6 days) and the shortest in 2011 (4.0 days). In 2014, increased length of stay was associated with admission to ICU (patients with more severe illness, medical comorbidities, and functional impairment), while a shorter length of stay was associated with factors such as pregnancy and Aboriginal and/or Torres Strait Islander status.[10] During 2017, patients with delayed initiation of treatment with oseltamivir (by more than two days following onset of symptoms) had a longer hospital stay, after adjusting for other factors associated with length of stay including age group, chronic comorbidities, and ICU admission.[13]

Estimated national admissions

Based on the ratio of cases to hospital beds, FluCAN estimated that, during 2011–2018, admissions due to influenza nationally were at their lowest in 2011 (n = 3,200), and highest in 2017 (n = 31,000) (Table 6). These estimated hospital admissions are likely underestimates as not all patients hospitalised with influenza are laboratory confirmed, and patients may present with post-influenza sequelae, such as secondary bacterial pneumonia, and non-respiratory complications such as myocardial infarction. The relative number of cases between jurisdictions does not reflect true influenza activity, due to differences in the number and size of sentinel hospitals in each jurisdiction.[7]

Figure 13: Number and rate of participants who completed at least one survey, 2011 to 2018[a]



a Source: FluTracking.

Treatment

For the years with data available for patients who received oseltamivir treatment, of the 7,791 patients who were eligible for treatment, 4,418 (57%) received oseltamivir, and 1,334/7,791 (17%) received the treatment within the recommended two days of symptom onset.

Case fatalities in sentinel hospitals

During the reporting period, the case fatality rate for patients hospitalised with influenza across the 17 sentinel hospitals declined from 3.5% in 2012 to 2.1% in 2015, then increased to a peak of 4.2% in 2017 before again declining in 2018 to 0.4% (Table 6). Higher instances of mortality were reported in patients aged 65 years or older, ranging from 50% in 2013 to 83% in 2017, and in patients with medical comorbidities (over 90%).

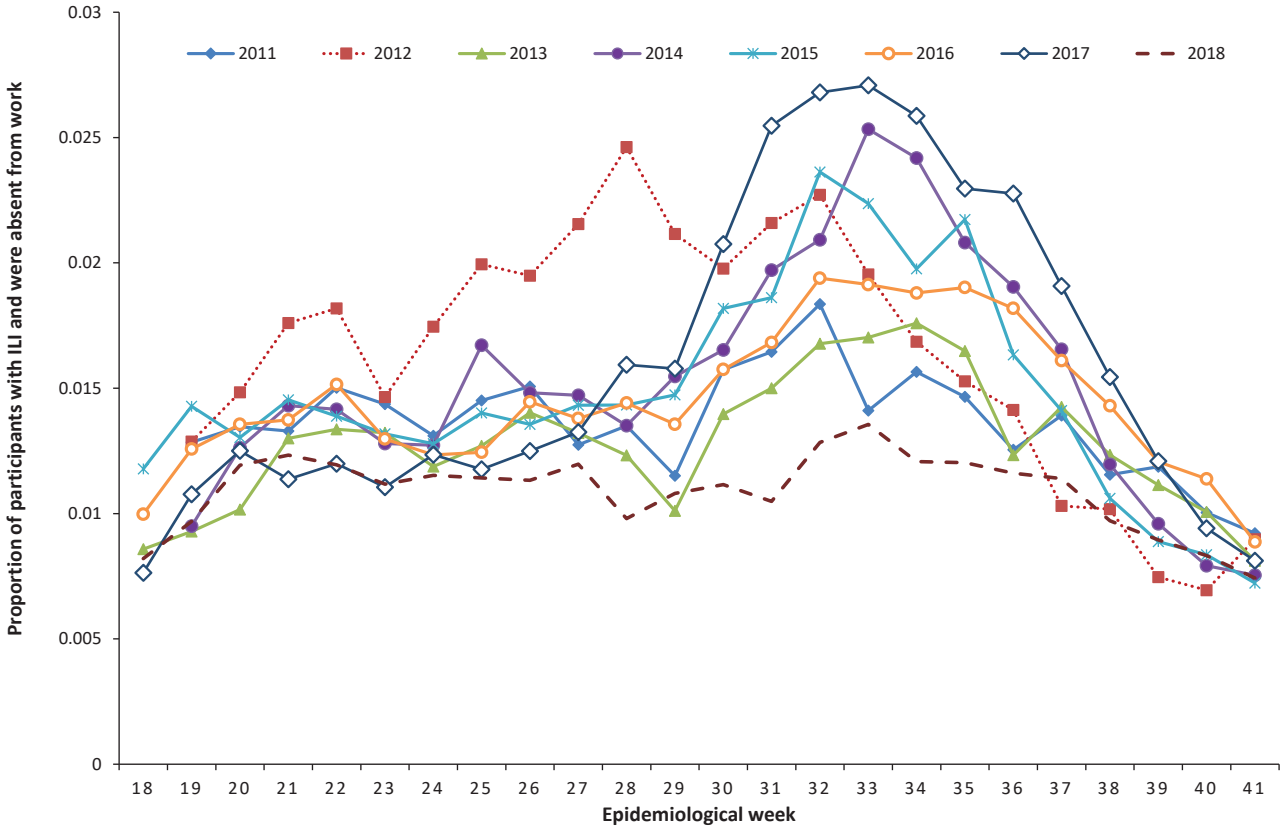
Mortality

Mortality from a primary influenza infection is rare, and most of the deaths attributed to influenza occur from complications including pneumonia, obstructive airways disease and sudden cardiac failure. These occur predominantly in identified risk groups such as those 65 years or older and those under six months of age, or those with chronic medical conditions.

Influenza mortality data reported to the NNDSS

A total of 2,294 deaths from laboratory-confirmed influenza were reported to the NNDSS from 2011 to 2018. The number of deaths increased steadily from 68 in 2011 to 274 in 2016, rose sharply to 1,183 in 2017, then declined to 149 in 2018. The proportion of cases reported to have died due to laboratory-confirmed influenza ranged between 0.22% in 2015 and 0.47% in 2017 during the reporting period (Figure 20).

Figure 14: Proportion of FluTracking participants reporting ILI and absence from work in Australia, by week, 2011 to 2018[a]



a Source: FluTracking.

Deaths due to influenza and pneumonia – New South Wales

Mortality rates from influenza and pneumonia, reported by the New South Wales Registry of Births, Deaths and Marriages during 2011–2018, showed that rates of deaths from influenza and pneumonia were much higher in the 65 years or older age group than the overall rates across all age groups. Males who were 65 years or older had the highest rates, followed by females in the same age group (Figure 21).[16]

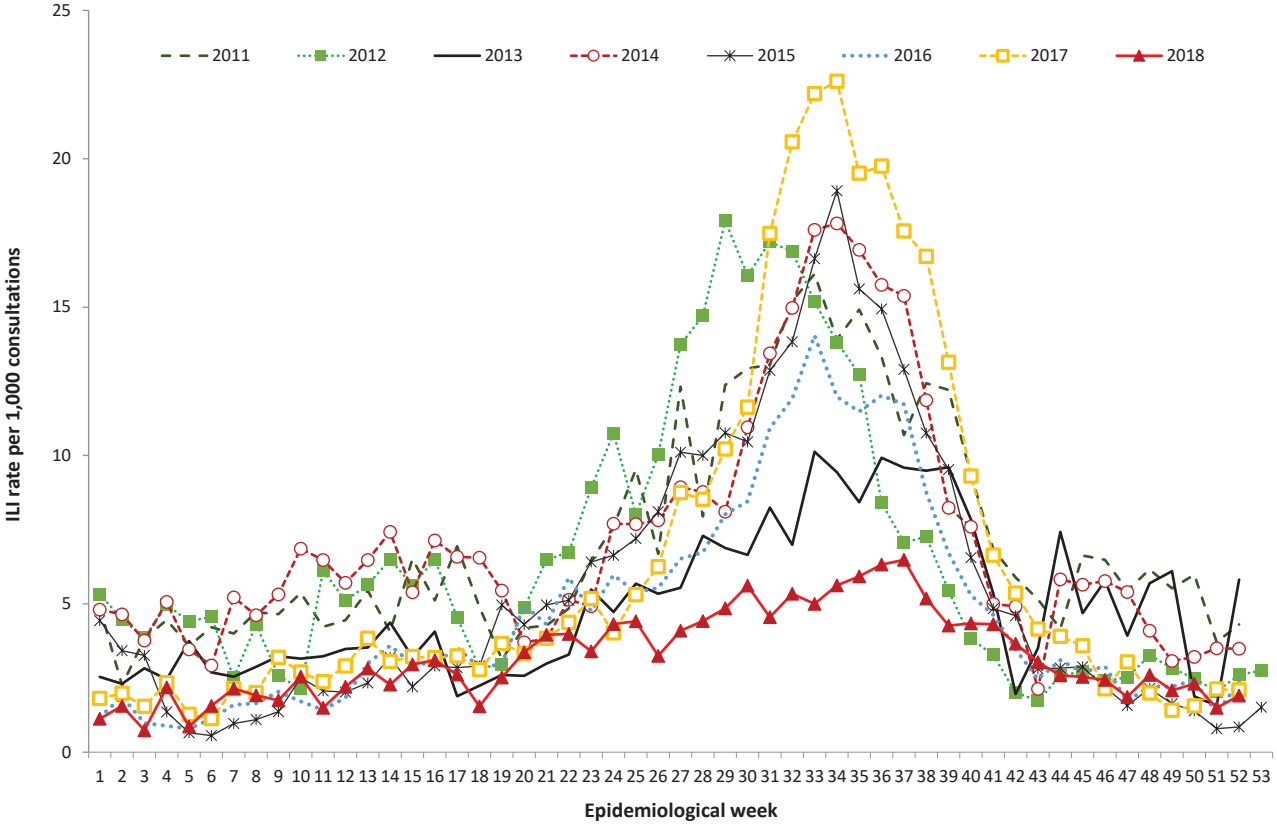
Australia Bureau of Statistics (ABS) death data

During 2017, there were 1,255 deaths due to influenza reported by the ABS, representing a standardised death rate of 3.9 per 100,000 population for this year. The deaths in 2017 were 2.7 times higher than in 2016 (n = 464). Of the reported deaths due to influenza in 2017, there were 563 patients who also had pneumonia as a contributing cause.[17] When grouped, influenza and pneumonia contributed to 4,369 deaths in 2017 and were the ninth leading cause of death for the year, up from the eleventh leading cause of death in 2016 (n = 3,334 deaths), with the majority of the increase (85%) driven by influenza virus. Being female, aged over 75 years, having commodities, and living in the eastern states of Australia were factors associated with higher mortality from influenza and pneumonia.[17] During 2018, influenza and pneumonia were the twelfth leading cause of death (n = 3,102 deaths).

Influenza-associated mortality estimates

A recent mathematical modelling study by Muscatello et al.[5] estimated influenza-associated deaths during 2010–2019 using death data from the Australian Institute of Health and Welfare and the Australian Bureau of Statistics. The study employed statistical time series analysis

Figure 15: Sentinel general practitioner ILI consultation rates by year and week, 2011 to 2018[a]



a Sources: ASPREN and VicSPIN.

to estimate excess deaths (the number of deaths above the number that would normally be expected for a specified time period) for three cause of death categories that were grouped according to the International Classification of Diseases, Revision 10 (ICD-10): pneumonia and influenza (P&I) (ICD-10 J09-J18), respiratory (ICD10 Chapter J: Diseases of the respiratory system), and all-cause (all deaths).

Relevant to the reporting period, the study found that Australia experienced high influenza-associated mortality in 2017. For the all-cause death category, the average annual total influenza-associated excess deaths during 2010–2019 were estimated to be around 2,800, or 12 deaths per 100,000 population. Using this same category, in 2017, the estimated number and rate were around 6,400 or 26 per 100,000 population. Using the respiratory death category, the average annual estimate was 950 (4 per 100,000 population), and in 2017 was 3,000 (12 per 100,000 population). The average annual estimates for the P&I deaths category was 500 (2 per 100,000 population), and in 2017 was 1,911 (8 per 100,000 population). Around four out of five excess deaths, regardless of category, were in persons aged ≥ 75 years; fewer than one in ten excess deaths were in persons aged < 65 years. Around 2% of all-age, all-cause deaths on average were estimated to be associated with influenza, and this doubled in 2017.[5]

Discussion

Based on the available data, the trends in influenza notifications increased from 2011, peaked in 2017 and declined in 2018. The number of influenza notifications in 2017 was the highest number reported since the 2009 pandemic year. While jurisdictions with larger populations (New South Wales, Victoria, and Queensland) recorded higher case numbers, smaller jurisdictions, such as South Australia and the Northern Territory, recorded the highest notification rates in all years except for 2016.

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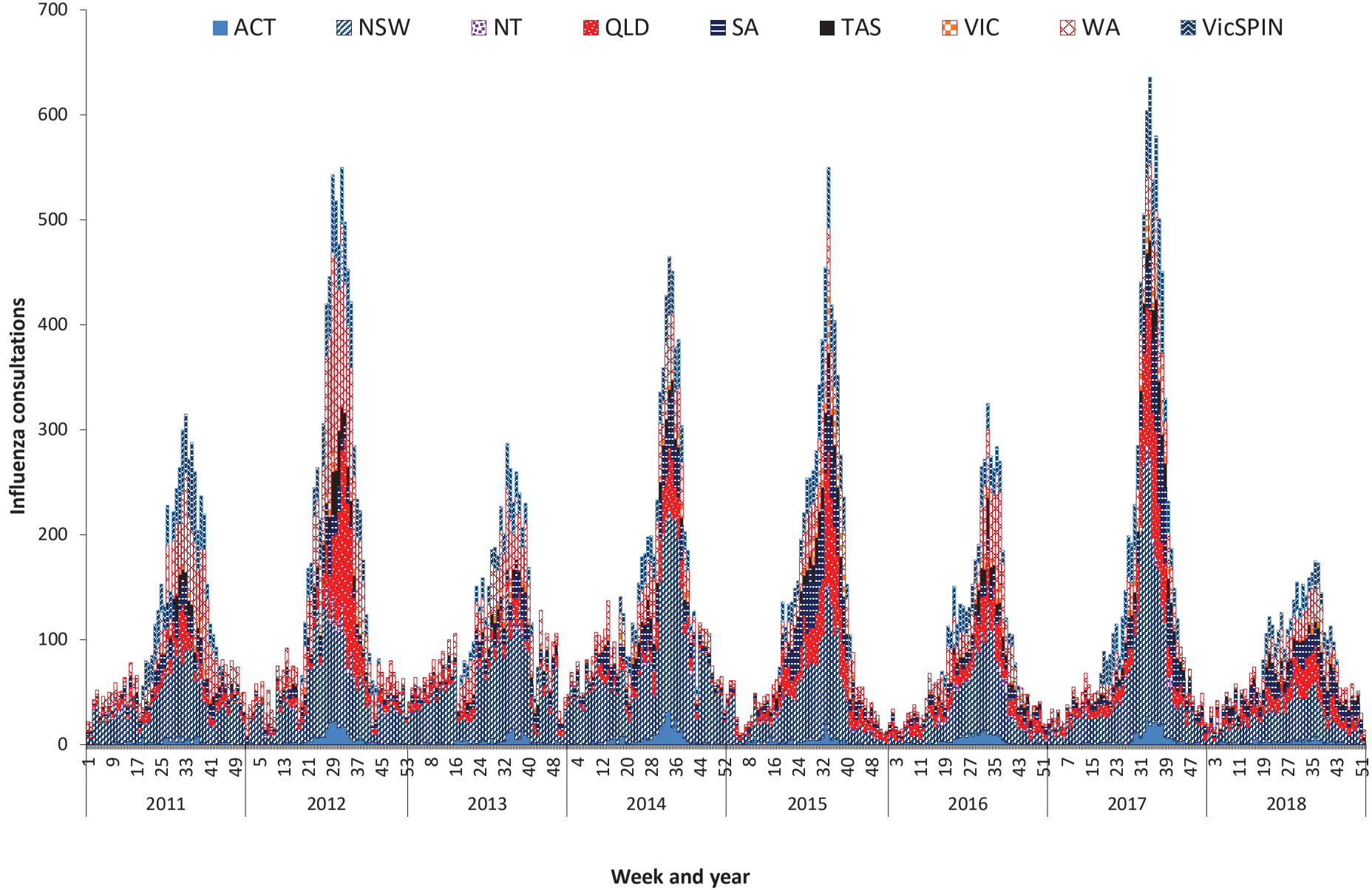
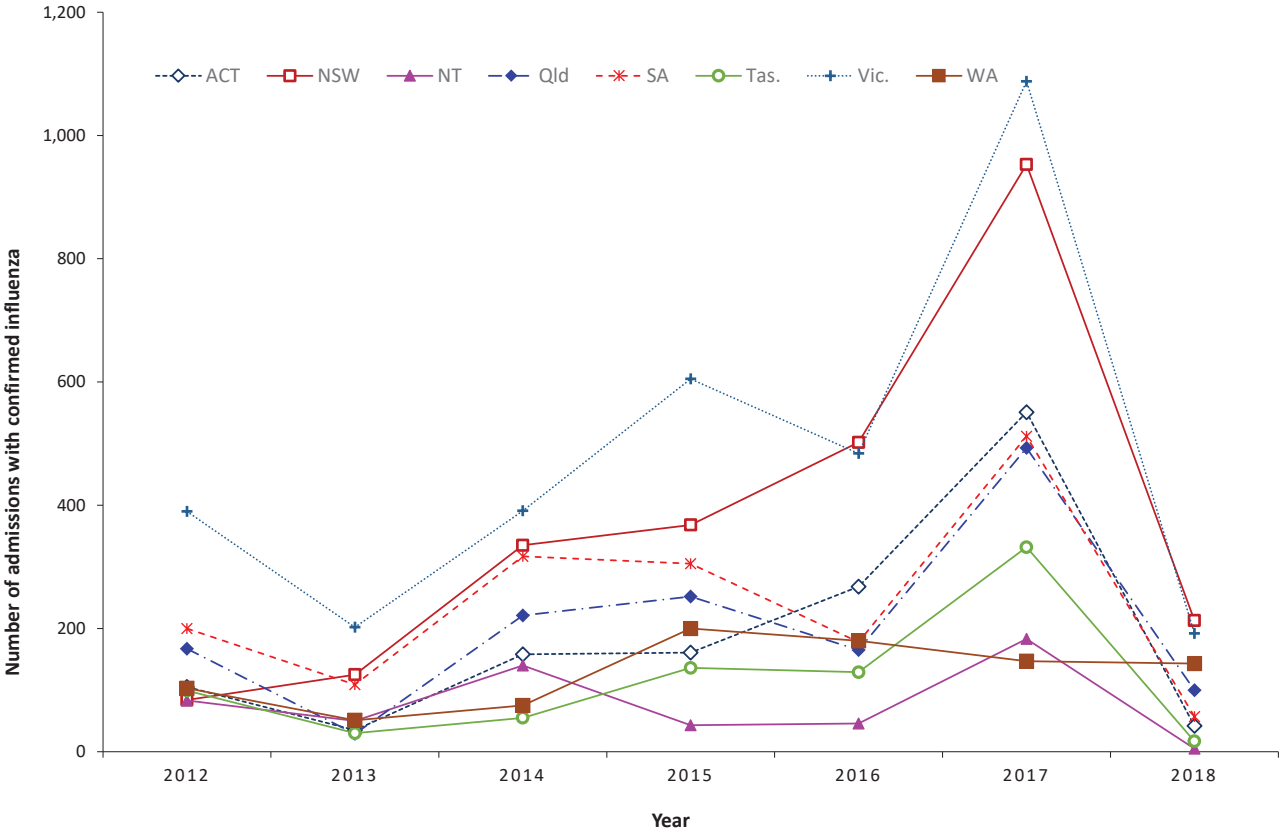
Figure 16: Sentinel general practitioner ILI consultations (ASPREN), by state or territory and VicSPIN, 2011 to 2018[a]



a Sources: ASPREN and VicSPIN.

Figure 17: Number of hospital admissions with confirmed influenza in sentinel hospitals in Australia, by state or territory and year, 2012 to 2018[a]



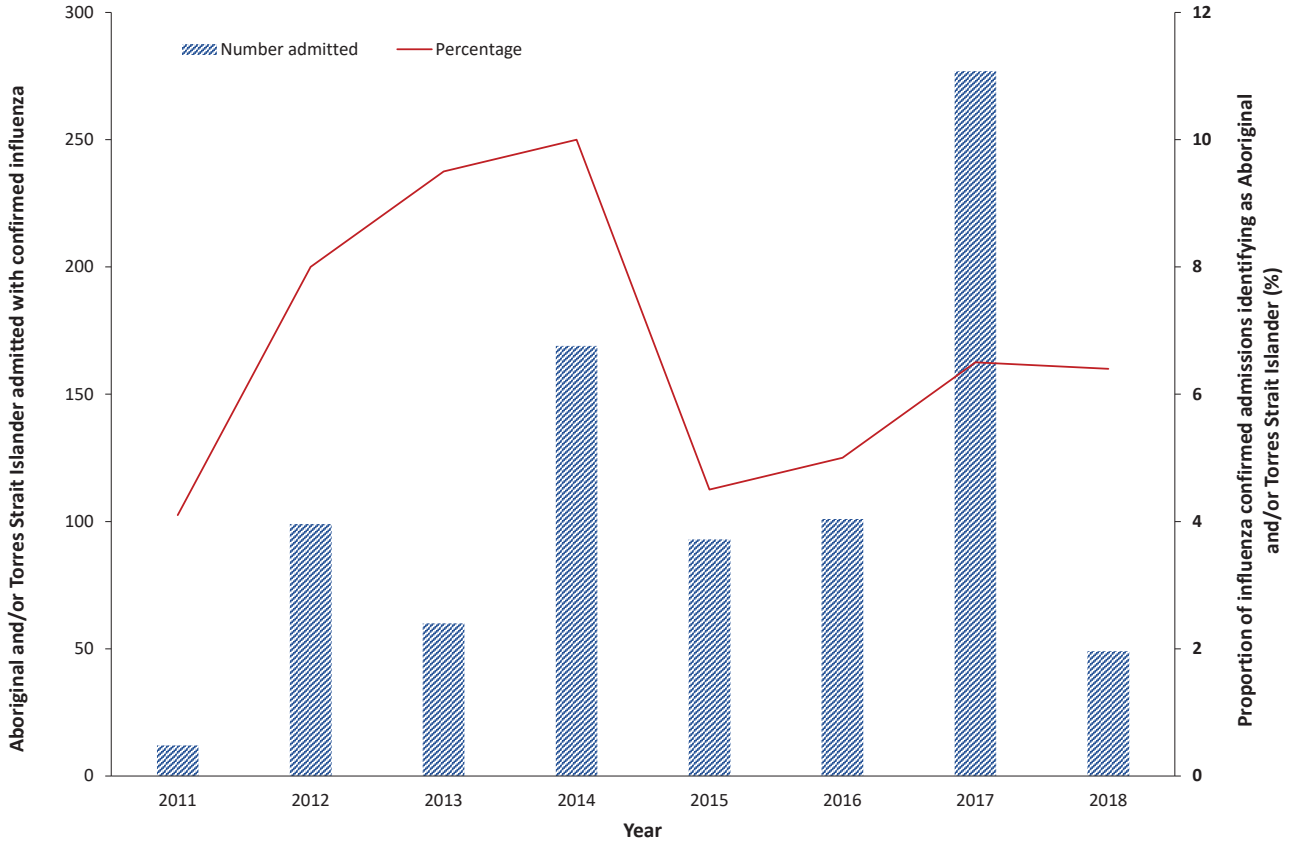
a Source: FluCAN. 2011 data not included.

Children under 15 years of age and adults aged 65 years or over had the highest notification rates. Influenza cases with medical comorbidities experienced higher mortality rates, as did males aged over 65 years, followed by females in the same age group. Influenza type A predominated over the eight years, except in 2015 when type B was the predominant type. This trend was also consistent with the Australian WHOCC data of influenza isolates tested. From 2011 to 2018, circulating A(H1N1) and A(H3N2) viruses were mostly antigenically similar to the corresponding vaccine strain. Influenza B only accounted for about a third of notifications (32%) from 2011 to 2018. During the reporting period, approximately 54% of influenza B viruses characterised by the Australian WHOCC site were from the Victoria lineage, and most were similar to the B/Brisbane/60/2008 vaccine strain. During the 2018 season, the Australian WHOCC site detected, for the first time, swine A(H3N2) v virus from a human patient in Australia, highlighting the need to maintain vigilance for zoonotic infections.

Data from the various influenza surveillance systems indicated that influenza activity in 2012, 2014, 2015, and 2017 was above average levels. Trends in ILI were mostly consistent with laboratory-confirmed influenza data reported to the NNDSS, with activity peaking between August and September (except in 2012, when activity peaked in July).

Consistent with notifications, the number of cases hospitalised with influenza increased in 2017, with a high number of hospital admissions reported among those aged 65 years or older; among children younger than 15 years of age; and among those with comorbidities. The Australian guidelines recommend the use of oseltamivir for patients with influenza requiring hospitalisation or who are at risk of complications, such as the elderly and immunocompromised.[18] For the years for which data on treatment was reported by FluCAN (2012–2014, 2017, and 2018), just over half of influenza hospital admissions (57%) received treatment, although only 17% of those eligible received

Figure 18: Number and proportion of patients identifying as Aboriginal and/or Torres Strait Islander admitted to sentinel hospitals with laboratory-confirmed influenza in Australia, 2011 to 2018



treatment within two days following onset of symptoms. These findings suggest the need to optimise treatment. Some patients present to health facilities after the 48-hour threshold for optimum treatment; thus, mechanisms facilitating early treatment or pre-hospital administration of the treatment are needed.

Prolonged influenza seasons were experienced in 2012 and in 2015 to 2018. Prolonged influenza seasons would potentially require re-vaccination, as the optimal effectiveness of the vaccines is within 3–4 months of vaccination.[19] Mortality in all years was highest in cases 65 years or older and those with medical comorbidities.

Overall, all data sources were consistent in indicating trends in influenza activity and support the characterisation of the 2011 to 2018 influenza seasons as moderate, with the exception of 2017 when increased activity was experienced.

Limitations

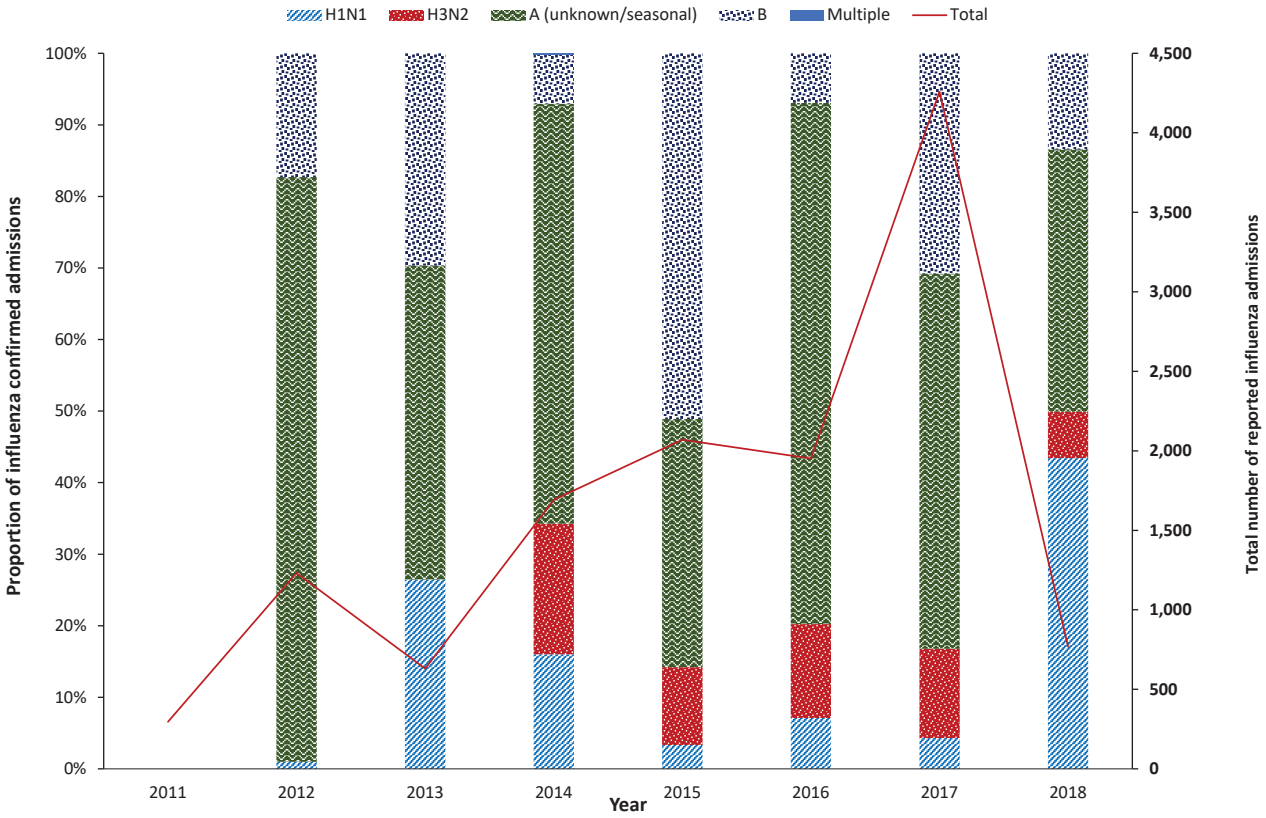
Although influenza surveillance in Australia is robust and draws from several sources, not all influenza surveillance data during the reporting period were available for this report, such as data for consultations at Emergency Departments and sentinel laboratories. The report relied on secondary data extracted from annual reports such as FluCAN and the Australian WHOCC. As a result, the report focused on describing the trends over the 8 year period.

Table 6: Characteristics of patients with laboratory-confirmed influenza admitted to FluCAN sentinel hospital sites in Australia, 2011 to 2018[a,b]

Year	2011[c,d]	2012[c]	2013[c]	2014[c]	2015[c]	2016[c]	2017[c]	2018[c]
Hospitalised	296 (1.3)[e]	1,231 (5.4)[e]	631 (2.7)[e]	1,692 (7.2)[e]	2,070 (8.7)[e]	1,952 (8.1)[e]	4,259 (17.3)[e]	769 (3.1)[e]
Influenza type/subtype								
H1N1	NI	12 (1.0)	167 (26.5)	271 (16.0)	69 (3.3)	139 (7.1)	183 (4.3)	334 (43.4)
H3N2	NI	0	0	309 (18.3)	225 (10.9)	256 (13.1)	532 (12.5)	50 (6.5)
A (unknown/ seasonal)	NI	1,006 (81.7)	277 (43.9)	993 (58.7)	718 (34.7)	1,422 (73.4)	2,234 (52.5)	282 (36.7)
B	NI	213 (17.3)	187 (29.6)	115 (6.8)	1,058 (51.1)	135 (6.9)	1,310 (30.8)	103 (13.4)
Multiple	NI	0	0	4 (0.2)	0	0	0	0
Age group (years)[b]								
< 18 (2011–2013); < 16 (2014–2018)	NI	148 (12.0)	32 (5.1)	0	320 (15.5)	351 (18.0)	587 (13.8)	215 (28.0)
18–39 (2011–2013); 16–49 (2014–2018)	90 (30.4)	229 (18.6)	139 (22.0)	507 (30.0)	475 (22.9)	397 (20.3)	773 (18.1)	204 (26.5)
40–64 (2011–2013); 50–64 (2014–2018)	104 (35.1)	281 (22.8)	260 (41.2)	392 (23.2)	319 (15.4)	300 (15.4)	671 (15.8)	122 (15.9)
65–79	59 (19.9)	307 (24.9)	131 (20.8)	434 (25.7)	489 (23.6)	458 (23.5)	1,162 (27.3)	134 (17.4)
80+	43 (14.5)	266 (21.6)	69 (10.9)	359 (21.2)	467 (22.6)	446 (22.8)	1,066 (25.0)	94 (12.2)
Female	162 (54.7)	617 (50.1)	317 (50.2)	916 (54.1)	1,045 (50.5)	991 (50.8)	2,103 (49.4)	401 (52.1)
Pregnant	14 (4.4)	39 (3.2)	27 (4.3)	56 (3.3)	43 (2.1)	50 (2.6)	69 (1.6)	17 (2.2)
Indigenous status								
Aboriginal and/or Torres Strait Islander	12 (4.1)	99 (8.0)	60 (9.5)	169 (10.0)	93 (4.5)	101 (5.2)	277 (6.5)	49 (6.4)
Jurisdiction								
ACT	NI	105 (8.5)	35 (5.5)	158 (9.3)	161 (7.8)	268 (13.7)	551 (12.9)	42 (5.5)
NSW	NI	84 (6.8)	125 (19.8)	335 (19.8)	368 (17.8)	502 (25.7)	953 (22.4)	213 (27.7)
NT	NI	83 (6.7)	50 (7.9)	140 (8.3)	43 (2.1)	46 (2.4)	183 (4.3)	5 (0.7)
Qld	NI	167 (3.6)	29 (4.6)	221 (13.1)	252 (12.2)	165 (8.5)	493 (11.6)	100 (13.0)
SA	NI	200 (16.2)	109 (17.6)	317 (18.7)	305 (14.7)	178 (9.1)	512 (12.0)	57 (7.4)
Tas.	NI	99 (8.0)	30 (4.8)	55 (3.3)	136 (6.6)	129 (6.6)	332 (7.8)	17 (2.2)
Vic.	NI	390 (31.7)	202 (32.0)	391 (23.1)	605 (29.2)	484 (24.8)	1,088 (25.5)	192 (25.0)
WA	NI	103 (8.4)	51 (8.1)	75 (4.4)	200 (9.7)	180 (9.2)	147 (3.5)	143 (18.6)
ICU admissions	NI	123 (10.0)	102 (16.2)	201 (11.9)	154 (7.4)	214 (11.0)	493 (11.6)	77 (10.0)
Comorbidities	225 (76.0)	944 (76.7)	488 (77.3)	1,433 (84.7)	1,543 (74.5)	1,492 (76.4)	3,310 (77.7)	505 (65.7)
Died in hospital	NI	40 (3.5)	20 (3.2)	44 (2.9)	43 (2.1)	65 (3.3)	155 (4.2)	3 (0.4)
Mean length of hospital stay (days)	4.0	NI	NI	6.6	5.0	5.6	6.2	4.3
Estimated hospitalisations (national)	3,200	10,000	5,400	15,000	17,000	14,000	31,000	5,700

a Source: FluCAN.
b The reported age categories were revised from 2014.
c Unless otherwise indicated, values in parentheses are percentages.
d NI: not included.
e Value in parentheses is rate per 100,000 population per year.

Figure 19: Influenza confirmed hospital admissions to sentinel hospitals in Australia by subtype and year, 2011 to 2018[a]



a Subtype data was not available for 2011.

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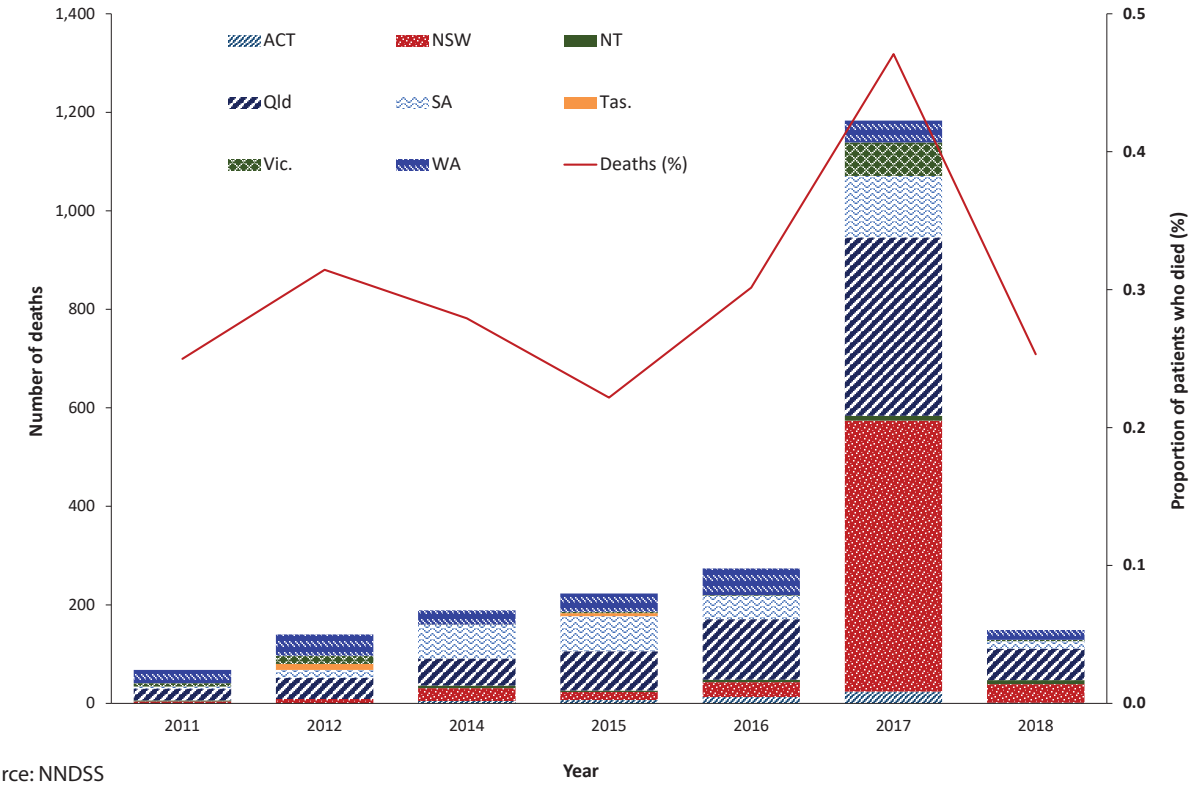
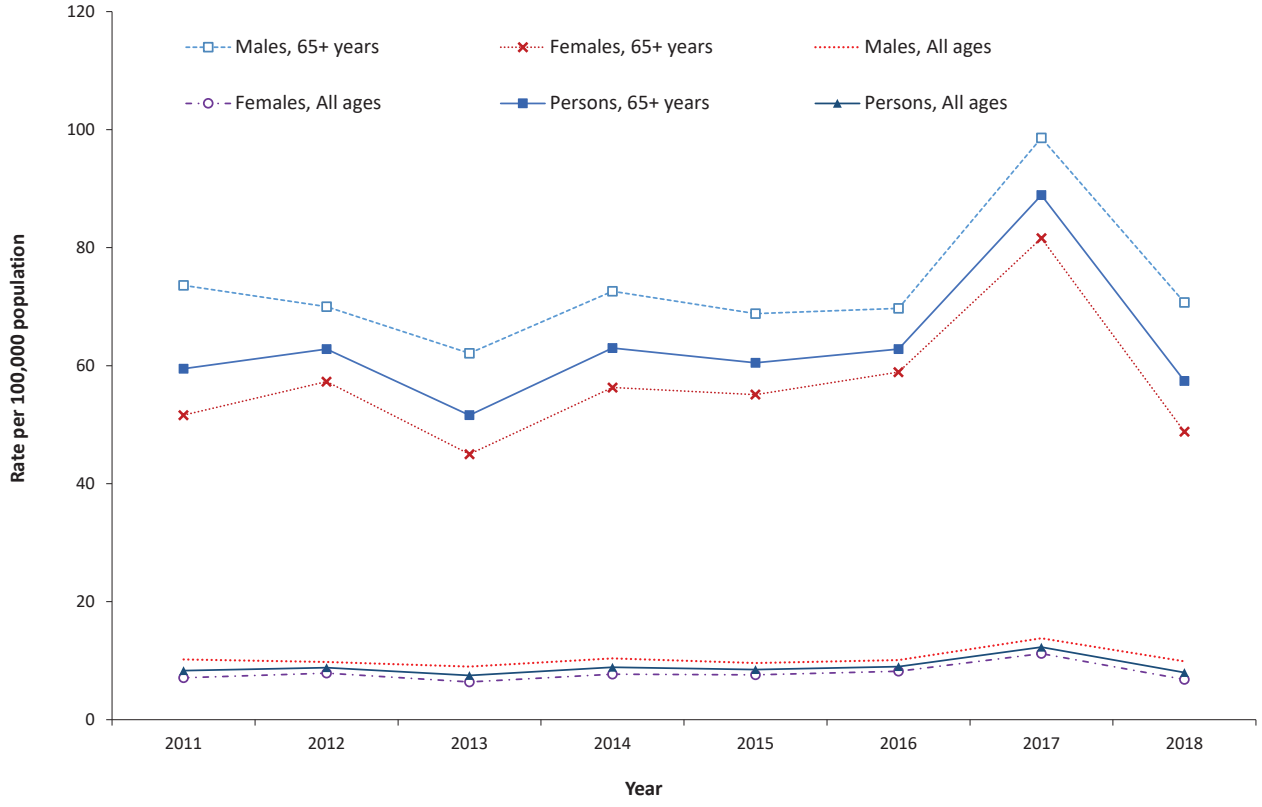
Figure 20: Number and proportion of laboratory-confirmed influenza deaths in Australia by state or territory, 2011 to 2018



Source: NNDSS

Figure 21: Influenza and pneumonia deaths in New South Wales, by sex, all persons, and 65 years and above, 2011 to 2018[a]



a Source: New South Wales Government, HealthStats NSW, Influenza and pneumonia deaths.[16]

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