



The 2017 NSW Influenza Season

A supplementary analysis of influenza-associated hospitalisations and deaths in 2017.

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1 Executive summary

1.1 Scope

This report presents an epidemiological review of the available hospitalisations and deaths data for NSW to assess the clinical severity of the 2017 influenza season. These data are not generally available during the influenza season and require post-hoc analyses.

Other findings from the influenza surveillance program conducted in NSW for the 2017 influenza season are available in the annual influenza season summary which is included in the [Influenza Monthly Epidemiological Report for December 2017](#).

1.2 Key findings in 2017

- 9330 people were hospitalised with a primary diagnosis of influenza, a 160% increase over the number in 2016. This included:
 - 593 hospital admissions for children aged 0-4 years
 - 1784 hospital admissions for people aged 85 years or over
 - 360 admissions to an intensive care unit (ICU)
 - 164 deaths.
- 6539 people were hospitalised with a secondary diagnosis of influenza, including in 164 admissions where it complicated pregnancies.
- 953 cases of laboratory-confirmed influenza infection were detected through sentinel hospital surveillance.¹ Of these:
 - 65% were influenza A; similar proportions of A(H1N1) and A(H3N2)
 - 34% were due to influenza B and 1% (3 cases) had dual infections
 - 254 admissions were for children aged under 15 years.
- 99 (39%) of the children with confirmed influenza infections detected through sentinel paediatric hospital surveillance had underlying medical conditions.
- 653 deaths were linked to influenza, including 562 which were confirmed by laboratory testing.
- 5 deaths in children aged 14 years or younger with laboratory-confirmed influenza, including 2 deaths in children aged 0-4 years.

These findings further characterise the increased burden of influenza illness in NSW during 2017, in the setting of steadily increasing influenza testing in the community and the introduction of rapid PCR testing for influenza in emergency departments in 2017.

These findings reinforce the conclusion drawn from other state and national analyses that the 2017 influenza season was one of the most severe on record, with an impact comparable to a wave of pandemic influenza.

2 Introduction

The objectives of the NSW influenza surveillance program are to:

- determine and monitor the stage, size and geographical spread of the influenza epidemic in the community each year
- detect outbreaks in high risk settings and implement appropriate control measures

¹ Sentinel hospital surveillance is via the Influenza Complications Alert Network (FluCAN) – see p.18

- better understand the epidemiology of the disease
- determine the severity of the disease to inform appropriate disease control measures and health services planning
- determine the influenza strains circulating in the community to inform vaccine development
- determine resistance patterns of influenza circulating in the community to inform antiviral recommendations
- facilitate further studies, where necessary, to investigate the epidemiology, clinical features, and vaccine effectiveness.

The influenza surveillance program collects epidemiological information from a range of sources throughout the year to achieve these objectives, and provides detailed epidemiological reports to the community and to health services. These reports are produced weekly in the lead up period to, and during the annual influenza season and then monthly during the inter-season period.

These epidemiological reports provide critical information that forecasts the start of the annual epidemic of influenza activity, allowing the community and the health system to finalise preparations for the influenza season. The program also monitors the magnitude of influenza activity throughout the winter and provides important information on circulating strains that helps inform estimates of vaccine effectiveness, antiviral resistance detection and vaccine development.

The influenza surveillance program clearly demonstrated that the 2017 influenza season was the most extensive for many years in terms of duration, and influenza-like illness presentations to emergency departments and general practitioners. Laboratory surveillance also confirmed the high prevalence of two influenza strains, influenza A(H3N2) and influenza B (Yamagata lineage), unlike most seasons where a single strain predominates.

Another key component to assessing the impact of an influenza season is the clinical severity of influenza infections from hospital admissions data and from death registrations. Coded hospitalisation data is not available during the influenza season because of the inevitable delays in coding and compiling hospital admission and discharge data from across the state. The completeness of death registrations data from the NSW Births Deaths and Marriages Registry also tends to improve with time.

This supplementary report focuses on coded hospital admissions data and death registrations data to better describe the exceptional 2017 influenza season.

3 NSW Combined Admitted Patient Dataset

3.1 Data Source: CAPED

The NSW Combined Admitted Patient Epidemiology Data (CAPED) provides near-complete coverage of admitted patient episodes of care of NSW residents. The term 'combined' reflects that it brings together:

- NSW public hospital data from the Health Information Exchange (HIE)
- NSW private hospital records

- interstate public hospitals (NSW residents only)

The CAPED snapshot 15 (extraction date 7 July 2018) was used to analyse full calendar year 2017 data for NSW public and private hospitals. Only acute episodes of care for NSW residents are included.

Figures are based on where a person resides, rather than where they are treated. No information on laboratory test results, including influenza test results, is available in the CAPED dataset.

Influenza-related hospital admissions were estimated selected on the basis of a primary or secondary diagnosis at separation in the following ICD-10-AM code ranges (diagnostic groups):

- J09.0 to J11.9 (*influenza* codes)
- J12.0 to J18.9 (*pneumonia* codes).

Pneumonia and influenza admissions data are often presented together as influenza can lead to pneumonia and, in most cases of hospitalisation and death from pneumonia, the responsible organism is not identified. Each year, 75-85 % of all hospitalisations for influenza and pneumonia are due to 'unspecified pneumonia'.

Separate analyses were conducted for: (1) where an *influenza* or a *pneumonia* code was the primary diagnosis, and; (2) where the primary diagnosis was not one of the *influenza* codes but there was at least one *influenza* code listed as a secondary diagnosis.

The following data parameters were used to analyse these hospital admissions:

- Demographics: age-group, gender, local health district (LHD) of residence
- Length of stay: days admitted (and hours in ICU if applicable)
- Outcome: transferred to nursing home, death.

Sub-analyses were performed for hospitalisations which included an ICU admission.

3.2 Acute hospital admissions with *influenza* and *pneumonia*

3.2.1 Admissions with *influenza* and *pneumonia* as a primary diagnosis

The number of admissions with a primary diagnosis of *influenza* (ICD J09-J11.9), *pneumonia* (ICD J12-J18.9), and combined, and admission rates per 100 000 NSW population for 2017 are shown in Table 1. These are presented by gender and age-group, and compared with 2016 figures.

Table 1 Number of admissions and admission rate per 100 000 population by gender and age group for NSW residents with a primary diagnosis of influenza or pneumonia, for the years 2017 and 2016.

Primary diagnosis		Influenza (J09-J11.9)				Pneumonia (J12-J18.9)				Influenza and pneumonia (J09 to J18.9)			
Year		2017		2016		2017		2016		2017		2016	
		Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population
Total		9330	118.8	3560	46.0	23762	302.6	24104	311.3	33092	421.3	27664	357.3
Gender	Female	4813	121.6	1831	46.9	11311	285.7	11251	288.1	16124	407.2	13082	335.0
	Male	4517	116.0	1729	45.1	12451	319.7	12853	334.9	16968	435.7	14582	380.0
Age group (years)	0-4	1193	233.2	593	118.1	2014	393.7	2179	433.9	3207	626.8	2772	552.0
	5-9	366	72.6	127	25.5	536	106.4	709	142.4	902	179.0	836	167.9
	10-14	161	34.6	45	9.9	204	43.9	223	49.0	365	78.5	268	58.9
	15-19	151	32.4	78	16.8	198	42.5	250	54.0	349	75.0	328	70.8
	20-24	161	31.2	87	16.6	242	46.9	308	58.9	403	78.1	395	75.5
	25-29	143	25.3	88	15.4	287	50.8	345	60.5	430	76.1	433	76.0
	30-34	212	36.7	95	16.6	406	70.3	419	73.4	618	107.1	514	90.1
	35-39	199	37.1	98	18.8	496	92.4	563	108.2	695	129.5	661	127.0
	40-44	223	42.7	100	19.3	538	103.1	630	121.9	761	145.8	730	141.2
	45-49	246	48.6	94	18.8	657	129.7	753	150.6	903	178.3	847	169.4
	50-54	284	57.3	125	25.4	863	174.1	948	192.5	1147	231.5	1073	217.9
	55-59	384	80.2	145	30.5	1095	228.6	1132	238.1	1479	308.8	1277	268.6
	60-64	486	111.6	188	44.3	1449	332.8	1445	340.3	1935	444.4	1633	384.6
65-69	570	145.1	223	57.6	1887	480.3	1789	462.4	2457	625.3	2012	520.1	
70-74	743	236.7	237	79.3	2250	716.8	2188	732.1	2993	953.5	2425	811.4	
75-79	914	393.2	305	138.0	2671	1149.0	2503	1132.1	3585	1542.2	2808	1270.1	
80-84	1110	683.3	381	244.1	2766	1702.7	2830	1813.1	3876	2386.0	3211	2057.2	
85+	1784	1031.0	551	328.9	5203	3006.8	4890	2919.1	6987	4037.7	5441	3248.1	

Demographics

In 2017, the 9330 NSW residents admitted with a primary diagnosis of *influenza* was 2.6 times higher (160% increase) than the previous year (3560 admissions). Admissions with a primary diagnosis of *influenza* or *pneumonia* were 20% higher than for 2016 (33 092 vs. 27 644 admissions), with the difference largely explained by the increases in *influenza* diagnoses. The total number of admissions and admission rates by gender were similar in both the *influenza* and the *pneumonia* diagnostic groups.

Influenza admission rates in 2017 increased by 2-3 times in all age-groups compared to the previous year, unlike rates for *pneumonia* which remained similar to rates in 2016. The highest *influenza* admission rates in 2017 were for children aged 0-4 years and people aged 65 years and over. People aged 85 years and over had the highest admission rate in 2017 at 1031.0 admissions per 100 000 population, a 3.1 times increase over the rate in 2016 (328.9 per 100 000 population).

The ratio of *influenza* admissions to all hospital admissions also increased in 2017 to 0.6% of all hospital admissions, up from 0.2% in 2016. Admissions in 2017 with a primary diagnosis of *influenza* or *pneumonia* were 2.0% of all hospital admissions, up from 1.6% in 2016.

In 2017, *influenza* admission rates varied across NSW but all were well above the corresponding rates in 2016 (Figure 1, Table 2). *Influenza* admission rates were highest in Hunter New England LHD (149.8 per 100 000 population) and lowest in Far West LHD (66.8 per 100 000 population).

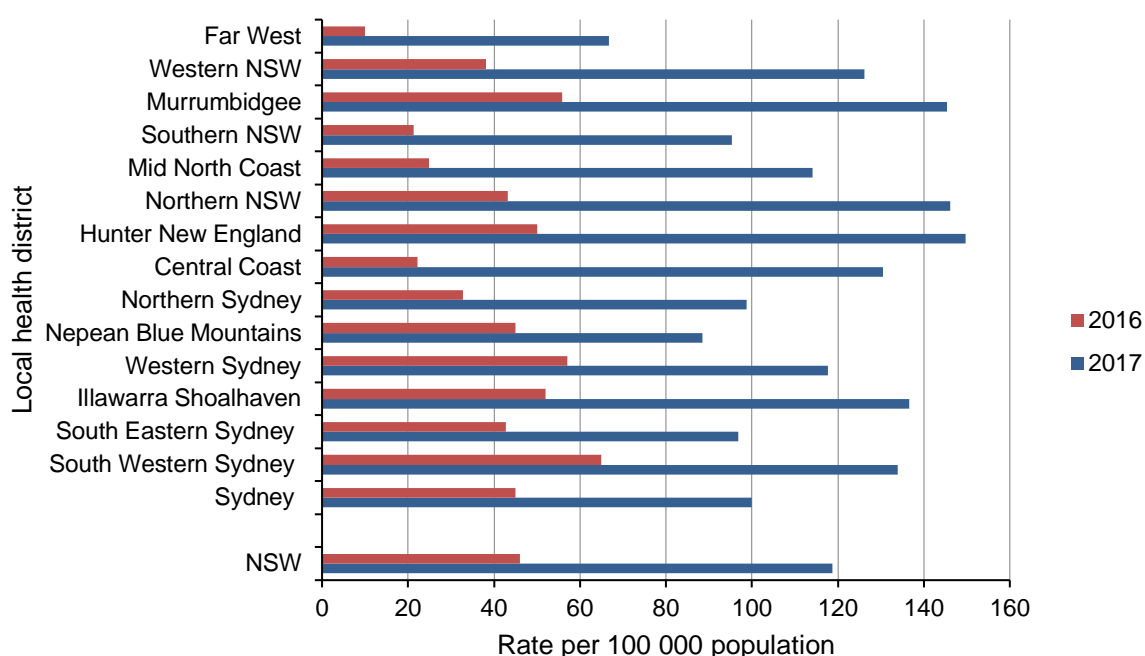


Figure 1 Admission rate per 100,000 population for NSW residents with a primary diagnosis of *influenza* by local health district, 2016 and 2017.

Table 2 Number of admissions and admission rate per 100 000 population by local health district of residence for NSW residents with a primary diagnosis of *influenza* or *pneumonia*, for the years 2017 and 2016.

Primary diagnosis	Influenza (J09-J11.9)				Pneumonia (J12-J18.9)				Influenza and pneumonia (J09 to J18.9)			
	2017		2016		2017		2016		2017		2016	
Year	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population
Sydney	671	99.9	298	45.0	1574	234.4	1683	254.4	2245	334.3	1981	299.5
South Western Sydney	1328	133.8	633	65.0	2699	272.0	2705	277.8	4027	405.9	3338	342.8
South Eastern Sydney	902	96.9	393	42.7	2288	245.8	2119	230.4	3190	342.7	2512	273.1
Illawarra Shoalhaven	561	136.6	212	52.1	1442	351.0	1376	337.8	2003	487.6	1588	389.9
Western Sydney	1162	117.6	549	57.1	2273	230.1	2163	224.9	3435	347.7	2712	282.0
Nepean Blue Mountains	333	88.5	167	45.1	981	260.6	948	255.8	1314	349.0	1115	300.8
Northern Sydney	919	98.8	302	32.8	2349	252.6	2363	257.0	3268	351.4	2665	289.8
Central Coast	446	130.4	75	22.2	1225	358.3	1412	418.4	1671	488.7	1487	440.6
Hunter New England	1389	149.8	459	50.0	3166	341.4	3291	358.7	4555	491.2	3750	408.8
Northern NSW	441	146.2	129	43.3	1230	407.7	1149	385.2	1671	553.8	1278	428.5
Mid North Coast	251	114.2	54	24.8	993	451.6	976	448.6	1244	565.8	1030	473.4
Southern NSW	200	95.4	44	21.3	831	396.3	931	450.3	1031	491.7	975	471.6
Murrumbidgee	352	145.4	135	55.9	1105	456.4	1228	508.8	1457	601.7	1363	564.7
Western NSW	355	126.1	107	38.2	1481	526.1	1657	591.5	1836	652.2	1764	629.7
Far West	20	66.8	3	10.0	125	417.4	103	344.9	145	484.2	106	354.9
NSW	9330	118.8	3560	46.0	23762	302.6	24104	311.3	33092	421.3	27664	357.3

Length of stay

In 2017, the average length of stay (ALOS) for NSW residents admitted with a primary diagnosis of *influenza* was 4.4 days with a range of 1-254 days. The ALOS was similar to that in 2016 but a wider range (4.4 days, range 1-126 days). While an admission of just one day was the most common length of stay in both years, the proportion dropped in 2017 by over 7 per cent (18.1% from 25.8% in 2016) (Figure 2).

The ALOS for admissions with a primary diagnosis of *pneumonia* was similar at 5.2 days in 2017 with a range of 1-225 days. This was similar to the ALOS for *pneumonia* admissions in 2016 (5.1 days, range 1-197 days).

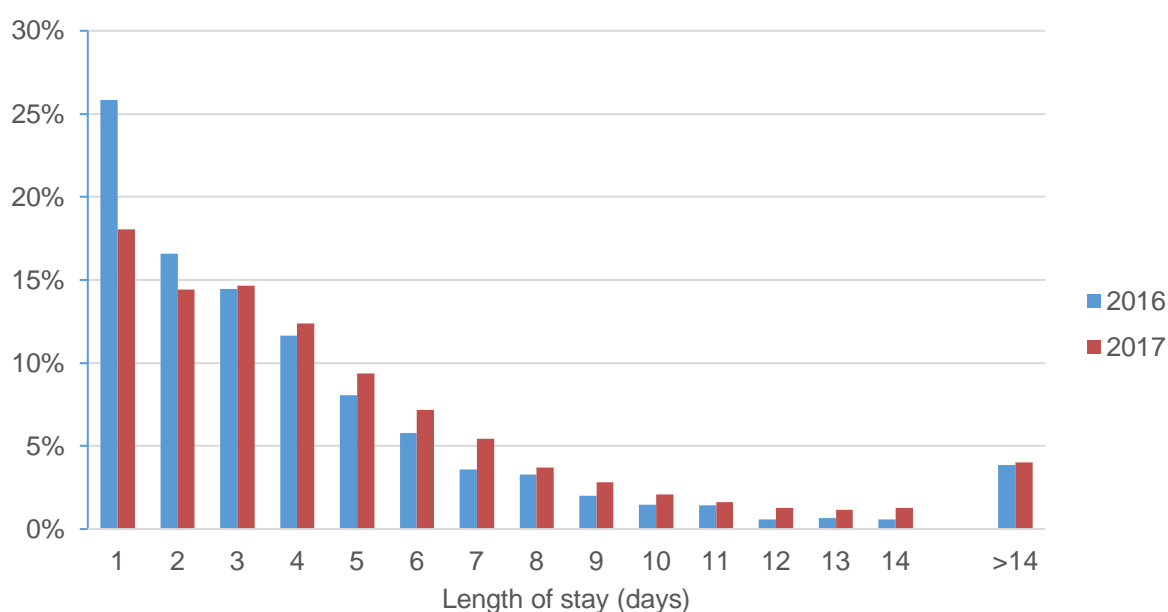


Figure 2 Percentage of admissions for NSW residents with a primary diagnosis of influenza by length of stay (days) for the years 2017 and 2016.

Outcomes

In 2017, there were 164 deaths recorded for NSW residents admitted with a primary diagnosis of *influenza* or 1.8 per cent of all *influenza* admissions (Table 3). This represents 115 additional deaths over that in 2016 (49 deaths), or a 2.4 times increase. In the *influenza* and *pneumonia* combined category there was a total of 1092 deaths in 2017, 173 more deaths than in 2016 or an 18.8% increase.

Most *influenza* deaths recorded in hospitalised people in 2017 were in those aged 65 years or over, with just over half (84 deaths) in people aged 85 years or older, at a rate of 48.5 deaths per 100,000 population (Table 4). There were no deaths recorded in hospitalised children 0-4 years but there were two deaths recorded in older hospitalised children (aged 14 and 17 years) and 17 deaths in adults aged under 65 years of age.

The rate of *influenza* deaths in males was slightly higher than females but the gender difference was more marked in deaths for the *pneumonia* admissions group.

A total of 232 admissions with an *influenza* diagnosis resulted in a *Transfer to a nursing home* mode of separation (Table 3). This was a 1.6 times increase over the number of nursing home transfers in 2016 (88 hospital separations).

Table 3 Mode of separation for NSW residents admitted with a primary diagnosis of influenza or pneumonia, for the years 2017 and 2016.

Primary diagnosis	Influenza (J09-J11.9)				Pneumonia (J12-J18.9)				Influenza and pneumonia (J09 to J18.9)			
	2017		2016		2017		2016		2017		2016	
	Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Discharge on Leave	2	0.0%	1	0.0%	2	0.0%	1	0.0%	4	0.0%	2	0.0%
Discharge by Hospital	7908	84.8%	3086	86.7%	18535	78.0%	18769	77.9%	26443	79.9%	21855	79.0%
Discharge Own Risk	90	1.0%	29	0.8%	278	1.2%	261	1.1%	368	1.1%	290	1.0%
Transfer to Nursing Home	232	2.5%	88	2.5%	647	2.7%	580	2.4%	879	2.7%	668	2.4%
Transfer to Public Psychiatric Hospital	4	0.0%	1	0.0%	8	0.0%	7	0.0%	12	0.0%	8	0.0%
Transfer to other Hospital	511	5.5%	167	4.7%	2234	9.4%	2451	10.2%	2745	8.3%	2618	9.5%
Death with Autopsy	5	0.1%	1	0.0%	22	0.1%	32	0.1%	27	0.1%	33	0.1%
Death without Autopsy	159	1.7%	48	1.3%	906	3.8%	838	3.5%	1065	3.2%	886	3.2%
Transfer to Other Accommodation	14	0.2%	2	0.1%	41	0.2%	56	0.2%	55	0.2%	58	0.2%
Type Change Separation	390	4.2%	130	3.7%	1062	4.5%	1065	4.4%	1452	4.4%	1195	4.3%
Discharge on Leave	13	0.1%	6	0.2%	18	0.1%	33	0.1%	31	0.1%	39	0.1%
Transfer to Palliative Care Unit / Hospice	2	0.0%	1	0.0%	9	0.0%	11	0.0%	11	0.0%	12	0.0%
Total separations	9330		3560		23762		24104		33092		27664	

Table 4 Number of deaths and death rate per 100 000 population by gender and age group for NSW residents with a primary diagnosis of influenza or pneumonia, for the years 2017 and 2016.

Primary diagnosis		Influenza (J09-J11.9)				Pneumonia (J12-J18.9)				Influenza and pneumonia (J09 to J18.9)			
		2017		2016		2017		2016		2017		2016	
Year		Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population
Total		164	4.2	49	1.3	928	23.8	870	22.7	1092	28.0	919	23.9
Gender	Female	80	1.0	25	0.3	419	5.3	387	5.0	499	6.4	412	5.3
	Male	84	2.1	24	0.6	509	12.9	483	12.4	593	15.0	507	13.0
Age group (years)	0-4	0	0.0	0	0.0	2	0.4	4	0.8	2	0.4	4	0.8
	5-9	0	0.0	0	0.0	2	0.4	0	0.0	2	0.4	0	0.0
	10-14	1	0.2	0	0.0	0	0.0	1	0.2	1	0.2	1	0.2
	15-19	1	0.2	1	0.2	2	0.4	1	0.2	3	0.6	2	0.4
	20-24	1	0.2	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
	25-29	0	0.0	1	0.2	2	0.4	0	0.0	2	0.4	1	0.2
	30-34	0	0.0	0	0.0	3	0.5	0	0.0	3	0.5	0	0.0
	35-39	0	0.0	0	0.0	3	0.6	3	0.6	3	0.6	3	0.6
	40-44	1	0.2	0	0.0	5	1.0	6	1.2	6	1.1	6	1.2
	45-49	4	0.8	0	0.0	8	1.6	9	1.8	12	2.4	9	1.8
	50-54	1	0.2	0	0.0	15	3.0	14	2.8	16	3.2	14	2.8
	55-59	5	1.0	2	0.4	13	2.7	20	4.2	18	3.8	22	4.6
	60-64	5	1.1	4	0.9	31	7.1	31	7.3	36	8.3	35	8.2
	65-69	9	2.3	4	1.0	53	13.5	55	14.2	62	15.8	59	15.3
	70-74	9	2.9	1	0.3	73	23.3	71	23.8	82	26.1	72	24.1
	75-79	18	7.7	4	1.8	106	45.6	87	39.4	124	53.3	91	41.2
80-84	25	15.4	12	7.7	164	101.0	160	102.5	189	116.3	172	110.2	
85+	84	48.5	20	11.9	446	257.7	408	243.6	530	306.3	428	255.5	

3.2.2 Admissions with *influenza* as a secondary diagnosis only

Influenza infection increases the risk of a range of other respiratory and non-respiratory illnesses, including exacerbations of chronic medical conditions such as chronic obstructive pulmonary disease, ischaemic heart disease and diabetes. In quantifying the contribution of influenza to hospital admissions it is important to also consider acute admissions with other primary diagnoses where influenza was a contributing factor.

ICD-10 codes are also used to classify secondary diagnoses for hospital admissions. In 2017 there were 6539 hospital admissions where there was at least one influenza diagnosis (J09 – J11.9) listed as a secondary diagnosis but not as the primary diagnosis. The ten most frequent primary diagnoses with influenza as a secondary diagnosis are listed in Table 5.

Chronic obstructive pulmonary disease with acute lower respiratory infection was the most common primary diagnosis (17.5%), followed by asthma and congestive heart failure. *Diseases of the respiratory system complicating pregnancy, childbirth and the puerperium* was also a common primary diagnosis where influenza was also noted (164 admissions, 2.5%).

Table 5 Number of admissions with an influenza code as a secondary diagnosis only: ten most frequent primary diagnoses, 2017.

Diagnostic category	ICD-10 code	Number	Per cent total
Chronic obstructive pulmonary disease with acute lower respiratory infection	J44.0	1144	17.5%
Asthma, unspecified	J45.9	336	5.1%
Congestive heart failure	I50.0	265	4.1%
Septicaemia, unspecified; Sepsis, unspecified	A41.9	241	3.7%
Diseases of the respiratory system in or complicating pregnancy, childbirth and the puerperium	O99.5	164	2.5%
Unspecified acute lower respiratory infection	J22	124	1.9%
Acute subendocardial myocardial infarction	I21.4	122	1.9%
Atrial fibrillation and atrial flutter, unspecified	I48.9	102	1.6%
Agranulocytosis	D70	97	1.5%
Urinary tract infection, site not specified	N39.0	96	1.5%

3.3 ICU admissions with influenza and pneumonia

The number of people hospitalised with a diagnosis of *influenza* or *pneumonia* and who were admitted to an intensive care unit (ICU) is a subset of all admissions with these diagnoses.

3.3.1 ICU admissions with influenza or pneumonia as a primary diagnosis

The number of admissions with a primary diagnosis of *influenza* (ICD J09-J11.9) or *pneumonia* (ICD J12-J18.9) and who were admitted to an ICU during their admission ('ICU admissions') for the years 2017 and 2016, and admission rates per 100 000 NSW population are shown in Table 6.

In 2017, there were 360 ICU admissions with a primary diagnosis of *influenza*, a 160% increase over the previous year (138 admissions). Admissions with a primary diagnosis of *influenza* or *pneumonia* were 29.1% higher than for 2016 (1656 vs. 1283 admissions), with the difference heavily influenced by the increases in *influenza* diagnoses.

The ratio of *influenza* ICU admissions to all ICU admissions also increased in 2017. The number of ICU admissions in 2017 with a primary diagnosis of *influenza* was 1.0% of all ICU admissions, up from 0.4% in 2016. Admissions in 2017 with a primary diagnosis of *influenza* or *pneumonia* were 4.7% of all ICU admissions, up from 4.0% in 2016.

Demographics

ICU admission rates by population for *influenza* by age-group in 2017 generally increased over those of the previous year, particularly in the youngest and oldest age-groups, with more modest increases in rates for *pneumonia*. The highest *influenza* admission rates in 2017 were for children aged 0-4 years (33 admissions, 6.5 per 100 000 population) and people aged 65 years and over.

The age-group with the highest ICU admission rate in 2017 was people aged 85 years and over at 29.5 admissions per 100 000 population, a 3.2 times increase over the rate for this age-group in 2016 (9.6 per 100 000 population).

In 2017, the total number of ICU admissions and admission rates for females and males were similar in both the *influenza* and the *pneumonia* diagnostic groups.

Table 6 Number of ICU admissions and admission rate per 100 000 population by gender and age group for NSW residents with a primary diagnosis of influenza or pneumonia, for the years 2017 and 2016

Primary diagnosis		Influenza (J09-J11.9)				Pneumonia (J12-J18.9)				Influenza and pneumonia (J09 to J18.9)			
Year		2017		2016		2017		2016		2017		2016	
		Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population	Number	Rate per 100 000 population
Total		360	4.6	138	1.8	1296	16.5	1145	14.8	1656	21.1	1283	16.6
Gender	Female	184	4.7	65	1.7	706	18.1	645	16.8	890	22.9	710	18.5
	Male	176	4.4	73	1.9	590	14.9	500	12.8	766	19.3	573	14.7
Age group (years)	0-4	33	6.5	8	1.6	68	13.3	40	8.0	101	19.7	48	9.6
	5-9	7	1.4	1	0.2	16	3.2	23	4.6	23	4.6	24	4.8
	10-14	4	0.9	1	0.2	19	4.1	7	1.5	23	4.9	8	1.8
	15-19	4	0.9	2	0.4	9	1.9	13	2.8	13	2.8	15	3.2
	20-24	6	1.2	3	0.6	13	2.5	16	3.1	19	3.7	19	3.6
	25-29	5	0.9	3	0.5	19	3.4	14	2.5	24	4.2	17	3.0
	30-34	7	1.2	4	0.7	26	4.5	25	4.4	33	5.7	29	5.1
	35-39	7	1.3	7	1.3	43	8.0	35	6.7	50	9.3	42	8.1
	40-44	13	2.5	7	1.4	39	7.5	52	10.1	52	10.0	59	11.4
	45-49	18	3.6	4	0.8	52	10.3	43	8.6	70	13.8	47	9.4
	50-54	15	3.0	6	1.2	77	15.5	67	13.6	92	18.6	73	14.8
	55-59	23	4.8	11	2.3	92	19.2	86	18.1	115	24.0	97	20.4
	60-64	28	6.4	13	3.1	96	22.0	89	21.0	124	28.5	102	24.0
	65-69	27	6.9	14	3.6	133	33.9	93	24.0	160	40.7	107	27.7
	70-74	28	8.9	6	2.0	143	45.6	124	41.5	171	54.5	130	43.5
	75-79	51	21.9	18	8.1	159	68.4	136	61.5	210	90.3	154	69.7
80-84	33	20.3	14	9.0	149	91.7	148	94.8	182	112.0	162	103.8	
85+	51	29.5	16	9.6	143	82.6	134	80.0	194	112.1	150	89.5	

Length of stay (in ICU)

The average number of hours in ICU for people admitted with a primary diagnosis of *influenza* (ICD J09-J11.9) or *pneumonia* (ICD J12-J18.9) for the years 2017 and 2016 are shown in Table 7. In Figure 3, the length of stay in ICU is shown in days.

The average admission time in ICU for influenza admissions in 2017 was 131.6 hours (5.5 days), slightly shorter than in 2016 but with a wider range. A total of 22 patients (6.1%) had ICU admissions of 21 days or longer. Average ICU admission times were about a day shorter for *pneumonia* admissions in both years.

Table 7 Average admission time (hours) in ICU for NSW residents with a primary diagnosis of influenza or pneumonia, for the years 2017 and 2016.

Primary diagnosis	Influenza (J09-J11.9)		Pneumonia (J12-J18.9)	
	2017	2016	2017	2016
Total ICU admissions	360	138	1296	1145
Average length of stay in ICU (hours)	131.6	133.7	108.1	114.0
Minimum (hours)	1	1	1	1
Maximum (hours)	1413	880	3179	2529

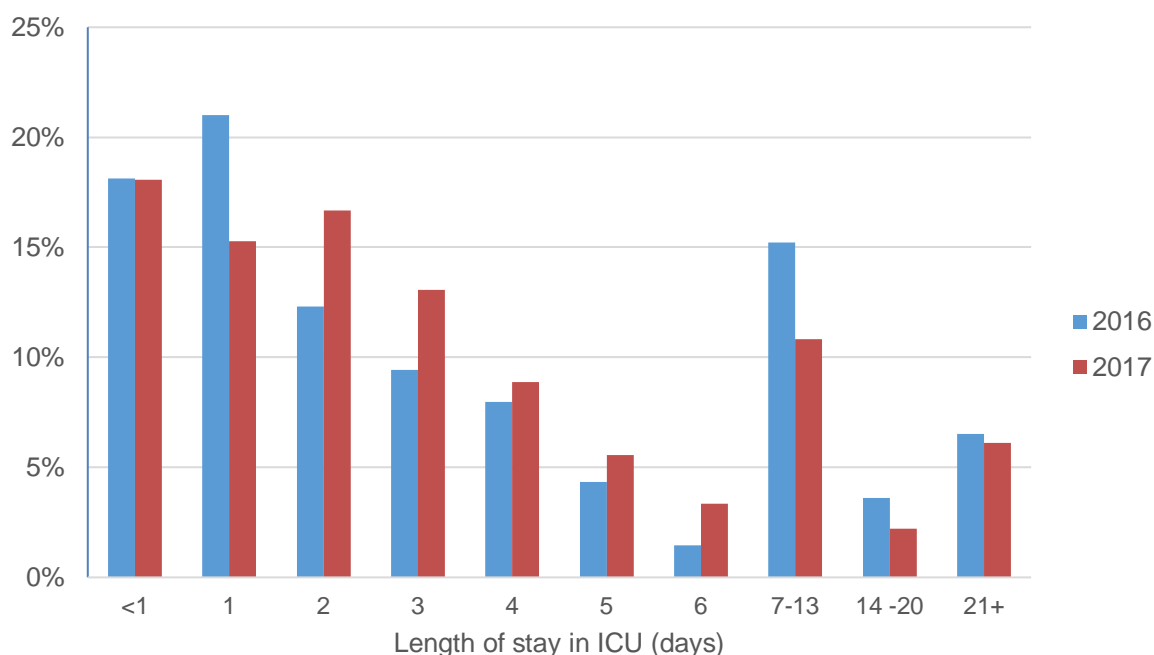


Figure 3 Percentage of ICU admissions for NSW residents with a primary diagnosis of influenza by length of stay (days) for the years 2017 and 2016.

Outcomes

Information on mode of separation for ICU admissions was examined for eventual mode of separation. The primary outcome of interest was death although the location where the death occurred was not necessarily the ICU.

In 2017 there were 43 deaths in people admitted with a primary diagnosis of *influenza* who were also admitted to ICU, or 11.9% of all ICU admissions in this category. The number of deaths in 2017 was a notable increase on the total in 2016 (14 deaths).

A total of 31 deaths (72.1%) occurred in people aged 65 years or older.

3.3.2 ICU admissions with influenza as a secondary diagnosis only

In 2017 there were 735 hospitalisations which included an ICU admission where there was at least one *influenza* diagnosis (J09 – J18.9) listed as a secondary diagnosis but not as the primary diagnosis. This included 103 additional deaths.

In 2016 there were just 248 hospitalisations in this category, including 35 deaths.

In 2017, the ten most frequent primary diagnoses where the hospitalisation included an ICU admission and influenza was included as a secondary diagnosis are listed in Table 8.

Chronic obstructive pulmonary disease with acute lower respiratory infection was the most common primary diagnosis, followed by septicaemia and a range of cardiac, respiratory and renal conditions and diabetes.

Table 8 Hospitalisations with an ICU admission and influenza as a secondary diagnosis only: ten most frequent primary diagnoses, 2017.

Diagnostic category	ICD-10 code	Number	Per cent total
Chronic obstructive pulmonary disease with acute lower respiratory infection	J44.0	132	18.0%
Septicaemia, unspecified; Sepsis, unspecified	A41.9	55	7.5%
Congestive heart failure	I50.0	25	3.4%
Asthma, unspecified	J45.9	21	2.9%
Respiratory failure unspecified, type II	J96.91	20	2.7%
Acute respiratory failure, type II	J96.01	16	2.2%
Acute subendocardial myocardial infarction	I21.4	14	1.9%
Insulin-dependent diabetes mellitus with ketoacidosis, stated as uncontrolled or without coma	E10.11	14	1.9%
Acute renal failure, unspecified; Acute kidney failure, unspecified	N17.9	11	1.5%
Acute respiratory failure, type I	J96.00	10	1.4%

4 Sentinel hospital influenza surveillance

4.1 Influenza Complications Alert Network (FluCAN)

In 2009, [a rapid alert system for severe respiratory illness: the FluCAN Surveillance System](#) was created with the involvement and support of the Thoracic Society of Australia and New Zealand and funding from the [NH&MRC](#).

The aim of FluCAN was to establish and maintain a real-time sentinel hospital surveillance system for acute respiratory disease requiring hospitalisation, which could provide a reliable and timely source of information that could be used to inform public health policy. Since 2010, FluCAN surveillance has been supported by the Commonwealth Department of Health, with data management provided by Monash University, Melbourne.

In NSW, FluCAN includes three sentinel monitoring sites for influenza hospitalisations: The Children's Hospital at Westmead (CHW), John Hunter Hospital and Westmead Hospital. FluCAN only includes cases confirmed by PCR (i.e. nucleic acid testing).

From 3 April to 31 October 2017, FluCAN reported 953 hospital admissions with confirmed influenza from the three NSW sites, higher than the 509 hospital admissions reported for 2016 (Figure 4), with the following characteristics:

- 822 (86%) cases were admitted to either a general ward or a respiratory ward and 131 (14%) were admitted to an intensive care unit.
- 622 (65%) cases were influenza A positive: of these, 13 were typed as influenza A(H1N1) and 11 were influenza A(H3N2)
- 328 (34%) cases were influenza B positive and 3 cases tested positive for both influenza A and B.
- 96 of the 131 cases (73%) admitted to ICU were positive for influenza A.
- 254 (27%) cases were aged under 15 years, 162 (17%) people were aged 18 to 49 years and 537 (56%) were in people aged 50 years and older
- 26 (3%) cases were in pregnant women: 1 influenza A(H1N1), 18 influenza A(untyped) and 5 influenza B.

The Children's Hospital at Westmead (CHW) contributes to the influenza surveillance activities of both FluCAN and the Paediatric Active Enhanced Disease Surveillance (PAEDS) system. PAEDS is a hospital-based active surveillance system for selected serious childhood conditions, particularly vaccine preventable diseases and potential adverse events following immunisation.

In addition to the 251 influenza cases admitted at CHW in children aged less than 15 years confirmed by PCR (and therefore included in FluCAN), there were another 125 hospitalised admitted influenza cases diagnosed by a positive antigen test, giving a total of 376 cases for this reporting period (3 April to 31 October 2017). CHW have noted that this is approximately twice the number of admitted influenza cases than in the same period in 2016.

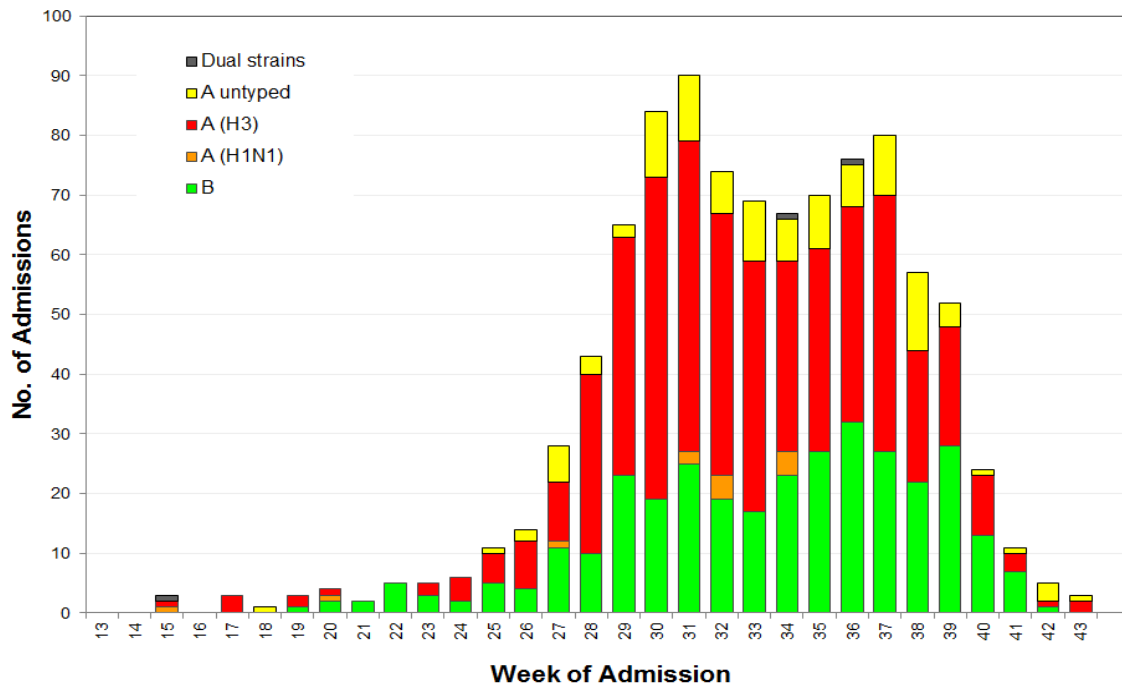


Figure 4 FluCAN – Number of confirmed influenza admissions to NSW sentinel hospitals, 3 April – 31 October 2017.

Notes: Includes cases confirmed by PCR only. The influenza A untyped category indicates no strain sub-typing has been performed. The Influenza A(H3) category includes some influenza A results so categorised on the basis that influenza A(H1N1) was excluded.

4.2 Paediatric surveillance of influenza with severe complications

The Australian Paediatric Surveillance Unit (APSU), based at The Children’s Hospital at Westmead, is a national research resource established in 1993 to facilitate active surveillance of uncommon childhood diseases, rare serious complications of common diseases or rare adverse effects of treatment (please refer to the [case definition](#) for severe complications).

APSU contributors are clinicians working in paediatrics and child health who provide weekly reports on 17 different conditions under surveillance. All positive reports of cases generate a brief questionnaire requesting de-identified information about the child’s demographics, details of diagnosis, management and short-term outcome from the clinician. For more details on APSU methods see the APSU website: www.apsu.org.au.

Since 2009, surveillance for severe complications from influenza has been conducted by the APSU from July to September. For the reporting period in 2017 there were 56 cases in children aged under 15 years in NSW which met the case definition for influenza with severe complications. This contrasts with just 15 cases reported for 2016. Of the 56 cases reported to the APSU the following characteristics were reported:

- 31 cases had influenza A strains infections and 25 were due to influenza B
- there were equal numbers of males and females
- the median age of cases was 5.5 years (range 9 days to 14.6 years), with four cases (7%) under six months of age.
- of the 52 cases aged 6 months or older (and therefore old enough to be vaccinated for influenza), three cases were vaccinated for influenza. However, the influenza vaccination status of 29 (56%) cases was not known.
- 22 (39%) of the cases had an underlying chronic medical condition.
- 34 (61%) of the cases required intensive care admission during their hospitalisation and there was one death recorded.
- 33 (50%) cases required ongoing treatment post discharge from hospital
- the median length of stay in hospital was 11 days (range 1-56 days).

Medical complications were recorded for all 56 cases including pneumonia (22 cases), bacterial co-infections, mechanical ventilation, encephalitis (five cases). One child required cardio-pulmonary resuscitation.

5 Influenza-associated deaths

There are a variety of information sources for estimating the number of influenza-associated deaths in 2017. Because these data are collected under the NSW deaths register and a variety of different surveillance systems it is likely that there is a degree of double-counting of deaths.

Influenza contributes to many other conditions which can result in death but may not always be recognised or recorded as a contributing factor in the death registration.

5.1 Deaths with influenza or pneumonia reported on the death certificate

Deaths are identified from the NSW Registry of Births, Deaths and Marriages where a keyword search is applied, across any text field of the Medical Certificate Cause of Death (MCCD), to identify death registrations that mention influenza or pneumonia. The MCCD text includes conditions directly leading to the death, antecedent causes and other significant conditions contributing to the death. Deaths were grouped by year and age-group and rates were calculated using NSW population estimates. While pneumonia has many causes it is routinely included in this search strategy as it is a well-known indicator for monitoring seasonal influenza activity and mortality. There was no information about influenza testing for records with either influenza or pneumonia cause of death. Deaths in 2017 that were subject to coronial investigations may not be included in the register until finalised.

5.1.1 Influenza-related deaths

Influenza-related deaths were identified using a keyword search for influenza and possible misspellings.

In 2017, among all 53 111 death certificates there were 621 records which included influenza as a cause of death (Table 9). This is 2.8 times the number in 2016 (220 deaths) and well above the totals in all recent years including the pandemic year of 2009.

In 2017, 93.9% of influenza-related deaths (583/621) were in people aged 65 years and over. There were two deaths in people aged 5 to 14 years, and two deaths in people aged 15 to 24 years; all four deaths of these deaths matched to laboratory-confirmed influenza notifications.

The rate of influenza-related deaths in 2017 was 7.9 per 100 000 population well above the rate of 2.8 per 100 000 population in 2016 and rates in previous years back to 2009 (Table 9).

5.1.2 Influenza and pneumonia deaths

An additional 4932 death certificates had pneumonia as a contributing cause of death, which was 9.6% of all deaths in 2017.

Death rates for both influenza and pneumonia as a proportion of the NSW population exceeded the forecast epidemic threshold in the week ending 4 August 2017, and remained elevated until the week ending 6 October 2018 (Figure 5).

Overall, influenza and pneumonia death rates were markedly elevated in 2017 compared with previous years back to 2012 (Figure 5), both in terms of higher peak activity (at least 1% higher than peaks in recent years) and longer duration above the epidemic threshold (10 weeks).

Table 9 Comparison of deaths for all causes and influenza-related deaths, 2009 to 2017 and predominant influenza strain(s).

	Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
All-cause deaths	Number	47369	47548	49880	50764	49934	51891	52460	52785	53111
	Percent ≥65 years	81.0%	81.0%	82.0%	82.0%	82.0%	82.0%	83.0%	83.0%	84.0%
	Rate per 100 000 population	672	666	691	695	674	691	689	681	674
Influenza-related deaths	Number	49	10	24	35	36	118	84	220	621
	Percent ≥65 years	49.0%	70.0%	63.0%	94.0%	56.0%	85.0%	88.0%	94.0%	94.0%
	Rate per 100 000 population	0.7	0.1	0.3	0.5	0.5	1.6	1.1	2.8	7.9
	Rate per 1,000 All-cause deaths	1.0	0.0	0.0	1.0	1.0	2.0	2.0	4.0	12.0
Predominant Influenza strain(s)		A(H1)	A(H1)	A(H1)/B	A(H3)	A(H1)/B	A(H3)	B/A(H3)	A(H3)	A(H3)/A(H1)/B

Source: Death Registration Unit Record File, NSW Ministry of Health SaPHARi.

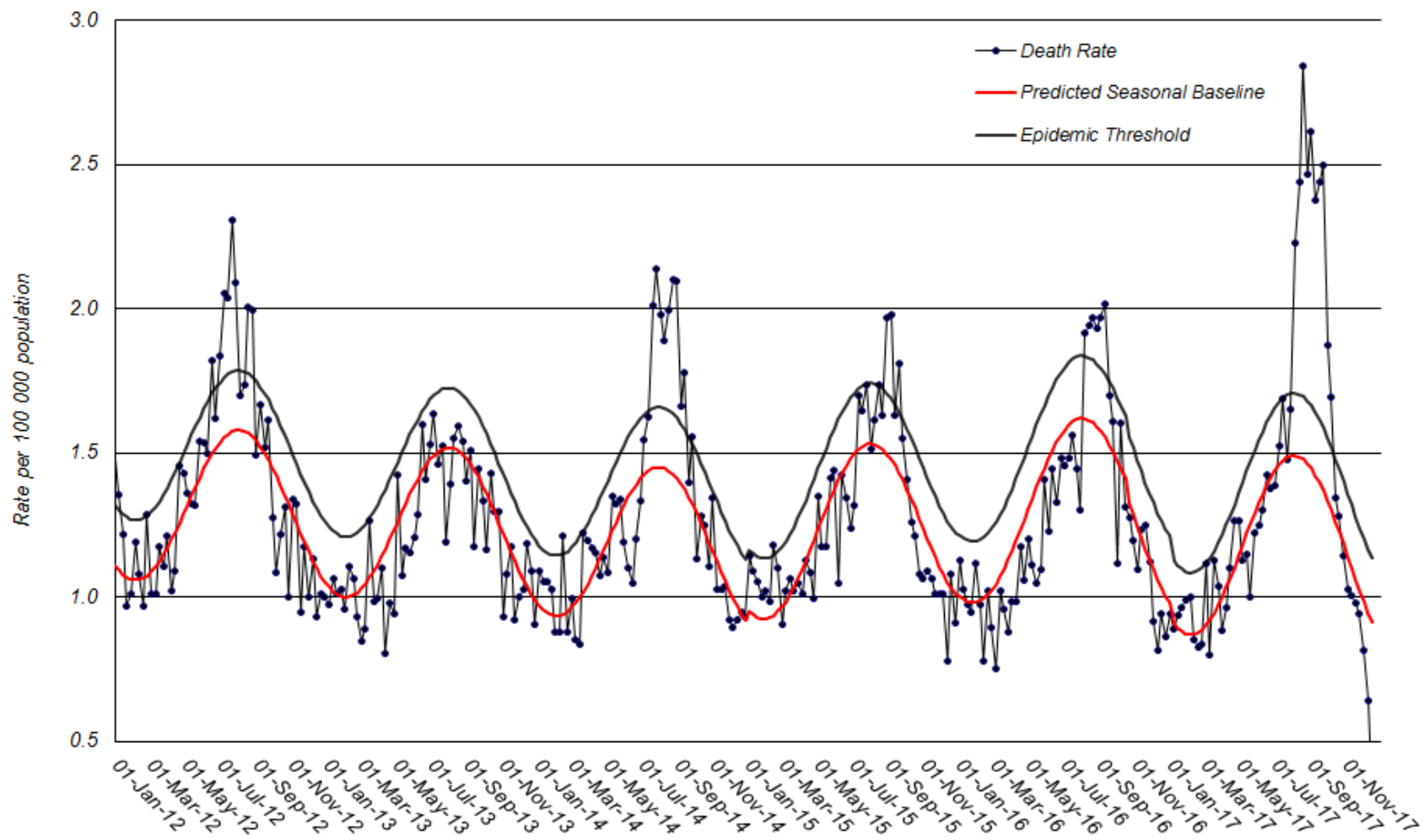


Figure 5 NSW Registry of Births, Deaths and Marriages Rate of deaths classified as influenza and pneumonia per 100 000 NSW population, 2012 - 2017.

Notes on interpreting RBDM death data

The predicted seasonal baseline estimates the predicted rate of influenza or pneumonia deaths in the absence of influenza epidemics. If deaths exceed the epidemic threshold, then it may be an indication that influenza is beginning to circulate widely.

The number of deaths mentioning “Pneumonia or influenza” is reported as a rate per 100,000 NSW population. Using the NSW population provides a more stable and reliable denominator than deaths from all causes. This is because pneumonia and influenza are known to contribute to increases in deaths from non-respiratory illnesses, such as deaths due to ischaemic heart disease.

As the number of these deaths will increase with rises in influenza activity, the actual effect of influenza on mortality rates will be obscured if all-cause mortality is used as the denominator. This limitation is avoided by using the NSW population, which is relatively constant throughout the year, as the denominator. Not all deaths will have had laboratory confirmation for influenza.

Deaths referred to a coroner during the reporting period may not be available for analysis. Deaths in younger people may be more likely to require a coronial inquest. Therefore influenza-related deaths in younger people may be under-represented in these data.

5.2 Influenza deaths in the notifiable conditions information system (NCIMS)

Due to the number of influenza notifications each year, individual notifications are only followed up as an exception, such as notifications linked to institutional outbreaks. This means that there is usually very limited information on outcomes, including deaths and hospitalizations.

This review included a confidential data linkage between the influenza-related deaths recorded in the RBDM dataset for 2017 with the confirmed influenza case notifications in the NCIMS dataset for the same year.

Overall, there were 562 influenza notifications in 2017 with the outcome recorded as death, and where influenza was listed as the cause of death (549 cases) or where the cause of death was unknown (13 cases). Influenza was recorded as not being the cause of death in one other influenza notification with a fatal outcome, and this case was excluded from the analysis.

Data linkage allowed for 530 (85.3%) of the 621 influenza-related RBDM death records to be matched with influenza notifications. Of the remaining 91 unmatched influenza-related RBDM death records, 31 cases were in residents of aged care facilities known to have had laboratory-confirmed influenza outbreaks reported in 2017.

The remaining 32 influenza cases notified to NSW Health where a fatal outcome had been recorded did not have a matching influenza-related RBDM death certificate. This included 14 influenza notifications in NCIMS received as part of investigations by the NSW Coroner's office, and for which there was not yet a RBDM death certificate. Of these 14 deaths, two were in children in the 0-4 year age-group and one death was in a child in the 10-14 age-group.

5.3 Acute hospital admission (CAPED) influenza deaths

As noted in section 3.2.1 above, in 2017 there were 164 deaths recorded in CAPED for NSW residents admitted with a primary diagnosis of *influenza*. In the broader *Influenza and pneumonia* combined category there was a total of 1092 deaths recorded in the CAPED dataset in 2017.

These records were not able to be compared with other sources of deaths data and it is not known how many had tested positive for influenza. It is likely that many of these deaths are also included in the RBDM influenza-related deaths data described in section 5.1.1 above and some may also have had positive influenza tests recorded in the NCIMS dataset.

5.4 Summary of deaths surveillance

In 2017:

- There were 621 influenza-associated deaths recorded in the NSW RBDM deaths register, including 530 laboratory-confirmed cases recorded in NCIMS.
- There were 32 other laboratory-confirmed influenza-related deaths in NCIMS. This included 14 deaths related to coronial investigations, including three deaths in children aged under 10 years.
- There were 164 deaths recorded for NSW residents hospitalised with a primary diagnosis of *influenza*, and these made up part of the 1092 deaths recorded in patients with a primary diagnosis of *Influenza and pneumonia*.
- There were at least five deaths recorded in children with influenza infections aged 14 years and younger but it is yet to be determined if influenza was a cause of death in three of these cases.

6 Limitations

This review is subject to a number of limitations.

Firstly, the introduction in 2017 of new rapid PCR testing into many NSW public hospital emergency departments and some primary care settings is likely to have increased influenza case detection compared to previous years, and possibly resulted in more identified influenza hospitalisations. However, only 8 per cent of influenza testing in NSW in 2017 was by rapid PCR testing and the magnitude of its effect on influenza hospitalisation data is unclear. One study in four metropolitan public hospitals emergency departments in Sydney actually found a significantly

lower proportion of patients were admitted after a positive rapid PCR test for influenza in 2017 than for patients tested by standard PCR.²

Secondly, some hospitalised people given an *influenza* discharge diagnosis may not have been true influenza cases as confirmation by laboratory testing is not required. Conversely, it seems likely that many true cases of influenza were not recognised or at least not classified as such.

Thirdly, there was no influenza strain information available from the CAPED hospital admissions dataset to fully assess if particular strains were more likely to lead to hospital admission overall or for particular age-groups. Limited influenza strain information was available through two sentinel hospital influenza surveillance systems which suggested that hospital admissions were linked to influenza A or to influenza B strains in similar proportions to influenza notifications overall, i.e. 58% influenza A, 42% influenza B.

7 Discussion

Consistent with other surveillance indicators, this review of hospital admissions, ICU activity and deaths data shows that the burden of influenza infections in 2017 was much higher than previous years.

The burden of influenza linked to laboratory-confirmed cases in any given year is likely to be only a small proportion of the actual influenza burden. The likelihood of identifying true influenza cases depends upon the availability and accuracy of testing platforms, and how they are utilised by clinicians. The ascertainment of influenza-related hospital admissions improves with increased laboratory testing for influenza and with improved recording of influenza diagnoses in discharge codes.

Influenza test numbers have been steadily increasing each year, both in primary care and the hospital sector, making it difficult to interpret trends over time based on influenza notifications alone. While the widespread introduction of rapid PCR testing in 2017, particularly in emergency departments, is likely to have increased the ascertainment of influenza, it only accounted for a small proportion of testing in NSW 2017 overall.

Influenza testing by standard PCR for patients with more serious illness admitted to intensive care units has become routine in recent years and so is unlikely to have been affected by the introduction of rapid PCR testing. The observations of increases in influenza-related morbidity and mortality among intensive care patients in 2017 documented in this report are therefore unlikely to have been substantially biased by changed testing practices.

While this review compares the increases in influenza hospital morbidity and influenza mortality from the previous year, it should be noted that the influenza

² Wabe N, Li L, Lindeman R, et al. The impact of rapid molecular diagnostic testing for respiratory viruses on outcomes for emergency department patients. *Med J Aust* 2019; 210 (7): 316-320. doi: 10.5694/mja2.50049.

activity in 2016 was also higher than most other recent years. A more suitable comparator for measuring the burden of influenza activity in 2017 might be the 2009 influenza pandemic year.

In assessing the burden of an illness like influenza on hospitalisations, it is important to consider primary and secondary diagnoses, as influenza infections may exacerbate many underlying medical conditions and pregnancy. An analysis of hospital admissions that is limited to influenza as a primary diagnosis is likely to significantly underestimate the overall impact of influenza in the hospital sector.

The review of admissions where influenza was a secondary diagnosis identified that influenza complicating pregnancy was an important contributor of hospitalisations in 2017, with 166 hospital admissions recorded. Hospitalisations for other important conditions known to be exacerbated by influenza, such as chronic obstructive pulmonary disease, asthma and congestive heart failure were also frequently commonly associated with influenza secondary diagnoses.

In 2017, there was a 2.6 times (160%) increase in ICU admissions with a primary diagnosis of influenza compared to the previous year. While this was consistent with the increase seen in all hospital admissions with a primary diagnosis of influenza, it represents a significant increased burden on the state's ICU bed capacity during the busy winter months.

The matching of RBDM death records with influenza notifications data enabled the identification of additional fatal laboratory-confirmed influenza cases. There were at least 653 deaths in people with confirmed influenza infections or attributed to influenza. Deaths in people aged 65 years and older accounted for 94% of the total, and there was also a small but concerning number of deaths in children.

Data linkage with influenza notification data may also increase the ascertainment of true influenza-related hospital admissions, as was shown in the influenza death data analyses, and it is recommended that this be conducted for the 2017 CAPED dataset with a view to including this in the routine annual influenza season surveillance reports.

8 Acknowledgements

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