Influenza epidemiology in adults admitted to sentinel Australian hospitals in 2014: the Influenza Complications Alert Network (FluCAN)

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Abstract

The Influenza Complications Alert Network (FluCAN) is a sentinel hospital-based surveillance program that operates at sites in all states and territories in Australia. This report summarises the epidemiology of hospitalisations with laboratory-confirmed influenza during the 2014 influenza season. In this observational study, cases were defined as patients admitted to one of the sentinel hospitals with an acute respiratory illness with influenza confirmed by nucleic acid detection. During the period 3 April to 31 October 2014 (the 2014 influenza season), 1,692 adult patients (>16 years) were admitted with confirmed influenza to one of 15 of 17 FluCAN sentinel hospitals (excluding 2 paediatric hospitals). Of these, 47% were over 65 years of age, 10% were Indigenous Australians, 3.3% were pregnant and 85% had chronic co-morbidities. The majority of cases were due to influenza A. Influenza B was detected in 7% of patients. There were a large number of hospital admissions detected with confirmed influenza in this national observational surveillance system in 2014. These are estimated to represent a national annual burden of around 15,000 admissions and almost 100,000 bed-days nationally. *Commun Dis Intell* 2015;39(3):E355–E360.

Keywords: influenza; hospitalisation; morbidity

Introduction

Influenza is a common respiratory viral infection that affects up to 5%–10% of the population each year.[1] Although the proportion of cases requiring hospitalisation is low, because infection with influenza virus is relatively widespread, the incidence of hospitalisation from influenza is of public health significance.[2]

We established a national sentinel surveillance program for severe influenza in 2009 primarily to provide timely information to public health authorities nationally on hospitalisations with laboratory-confirmed influenza. In this report, we describe the epidemiology of hospitalisation in adults with laboratory-confirmed influenza. A report on severe paediatric influenza will be reported separately.

Methods

The Influenza Complications Alert Network (FluCAN) is a national hospital-based sentinel surveillance system.[3] For the 3 most recent influenza seasons including 2014, the participating sites have been The Alfred Hospital (Vic.), Royal Melbourne Hospital (Vic.), Canberra Hospital (ACT), Calvary Hospital (ACT), Monash Medical Centre (Vic.), University Hospital Geelong (Vic.), Royal Perth Hospital (WA), Royal Adelaide Hospital (SA), Royal Hobart Hospital (Tas.), Mater Hospital (Qld), Princess Alexandra Hospital (Qld), Cairns Base Hospital (Qld), Alice Springs Hospital (NT), Westmead Hospital (NSW), and John Hunter Hospital (NSW). In 2014, 2 additional paediatric speciality hospitals also participated but paediatric data will be reported separately. Case numbers vary from previous reports due to exclusion of paediatric cases.[4] Ethical approval has been obtained at all participating sites, at Monash University and the Australian National University.

An influenza case was defined as a patient admitted to hospital with influenza confirmed by nucleic acid testing. Surveillance is conducted from April to November (with follow up continuing to the end of November) each year. Admission or transfer to an intensive care unit (ICU) included patients managed in a high dependency unit. The onset date was defined as the date of admission except for patients where the date of the test was more than 7 days after admission, where the onset date was the date of the test. The presence of risk factors and comorbidities was ascertained from the patient's medical record. Restricted functional capacity was defined as those who were not fully active and not able to carry on all pre-disease performance without restriction.[5]

We examined factors associated with ICU admission and the length of hospital stay using

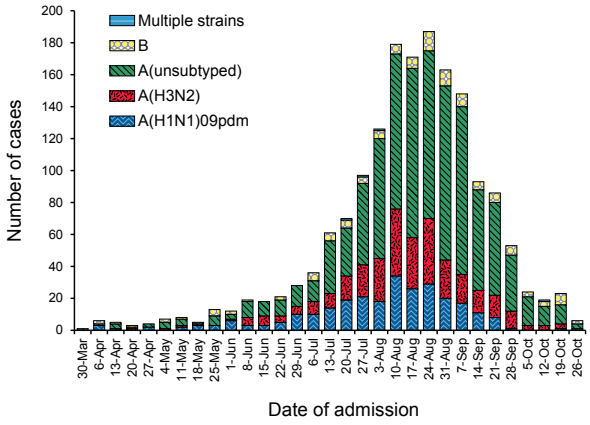
multivariable regression. Factors associated with ICU admission were determined using a logistic regression model, with factors retained in the multivariable model if $P<0.2$. Factors associated with the length of hospital stay were modelled using a linear regression, as the mean duration of stay was the parameter of interest. Standard errors were estimated using bootstrapping (1,000 replicates) to correct for non-normality of residuals due to the skewed distribution of length of stay.

Results

During the period 5 April to 31 October 2014 (the 2014 influenza season), 1,692 patients were admitted with laboratory-confirmed influenza to one of 15 FluCAN non-paediatric sentinel hospitals. The peak rate of admission was highest in early September, and varied by jurisdiction between mid-August and mid-September (Figure). The majority of cases were due to influenza A, but 115 (6.8%) were due to influenza B. The proportion due to influenza B varied by site from 1 of 55 cases (2%) at the University Hospital Geelong, to 32 of 180 cases (18%) at Westmead Hospital.

Of these 1,692 patients, 793 (47%) were more than 65 years of age, 169 (10%) were Indigenous Australians, 56 (3.3%) were pregnant and 1,433 (85%) had chronic co-morbidities (Table 1 and Table 2). Of the 1,283 patients (76%) where influenza vaccination status was ascertained, 636 (50%) had been vaccinated. The most commonly reported co-morbidities were respiratory disease, cardiac disease, immunosuppression and diabetes. Of the total, 684 (40%) patients reported a restriction in functional status and 111 (6.6%) were resident in an aged care facility.

Figure: Date of admission in patients hospitalised with confirmed influenza, 5 April to 31 October 2014



By week beginning on listed date; representing date of admission (or date of influenza diagnosis if acquired less than 7 days in hospital).

Table 1: Demographic characteristics of hospitalised adult patients with confirmed influenza

Characteristic	Influenza type								Total*	
	A/H1N1/09pdm		A/H3N2		A/unsubtyped		B			
Total	271		309		993		115		1,692	
Age group	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
16-49 years	126	46.5	67	21.7	276	27.8	37	32.2	507	30.0
5-65 years	79	29.2	53	17.2	234	23.6	26	22.6	392	23.2
65-79 years	51	18.8	107	34.6	250	25.2	24	20.9	434	25.7
80+ years	15	5.5	82	26.5	233	23.5	28	24.3	359	21.2
Male	136	50.2	149	48.2	436	43.9	52	45.2	776	45.9
Indigenous	11	4.1	4	1.3	146	14.7	8	7.0	169	10.0
State or territory										
ACT	39	14.4	100	32.4	9	0.9	10	8.7	158	9.3
NSW	32	11.8	124	40.1	137	13.8	39	33.9	335	19.8
NT	0	0.0	0	0.0	131	13.2	9	7.8	140	8.3
Qld	19	7.0	17	5.5	172	17.3	13	11.3	221	13.1
SA	1	0.4	0	0.0	301	30.3	15	13.0	317	18.7
Tas.	30	11.1	0	0.0	22	2.2	3	2.6	55	3.3
Vic.	107	39.5	46	14.9	221	22.3	16	13.9	391	23.1
WA	43	15.9	22	7.1	0	0.0	10	8.7	75	4.4

* 4 patients with disease with multiple subtypes included in total.

Table 2: Risk factors, severity and outcomes in hospitalised adult patients with confirmed influenza

	Not admitted to intensive care unit		Admitted to intensive care unit		Total	
Total	1,481		211		1,692	
	n	%	n	%	n	%
Pregnancy	52	3.5	4	1.9	56	3.3
Nursing home resident	109	7.4	2	0.9	111	6.6
Restricted functional status	610	41.2	74	35.1	684	40.4
Medical comorbidities	1,252	84.5	181	85.8	1433	84.7
Chronic cardiac disease	511	34.5	61	28.9	572	33.8
Chronic renal disease	224	15.1	27	12.8	251	14.8
Chronic renal disease	589	39.8	111	52.6	700	41.4
Diabetes	383	25.9	45	21.3	428	25.3
Chronic liver disease	67	4.5	16	7.6	83	4.9
Immunosuppressed	279	18.8	31	14.7	310	18.3
Chronic neurological disease	260	17.6	20	9.5	280	16.5
Influenza vaccination	580/1,132	51.2	56/151	37.1	636/1,283	49.6
Influenza subtype						
A/H1N1/09pdm	216	14.6	55	26.1	271	16.0
A/H3N2	274	18.5	35	16.6	309	18.3
A/unsubtyped	885	59.8	108	51.2	993	58.7
B	102	6.9	13	6.2	115	6.8
Multiple strains	4	0.3	0	0.0	4	0.2
In hospital mortality	23/1,330	1.7	21/186	11.3	44/1,516	2.9

Presentation and treatment

For 1,546 patients with laboratory-confirmed influenza where the duration of symptoms was known, the median duration of symptoms prior to admission was 3 days (interquartile range (IQR): 2, 5 days). Of patients with influenza, 950 (56%) received oseltamivir; of these, 299 were known to have received oseltamivir within 48 hours of symptom onset. The duration of hospital stay was similar in patients that did not receive antivirals (median 4 days, IQR 2, 7 days), received antivirals within 48 hours of symptom onset (4 days, IQR 2, 7 days) or who received antivirals more than 48 hours after symptom onset (5 days, IQR 3, 8 days).

Admissions to intensive care

Of all cases, 179 patients (10.6%) were initially admitted to ICU and a further 32 (2%) were subsequently transferred to ICU after initial admission to a general ward. In a multivariate model, elderly patients and nursing home residents were associated with a lower risk of ICU admission in patients admitted to hospital with laboratory-confirmed influenza Table 3). In this model, medical comorbidities were associated with a higher risk of ICU admission and pregnancy was associated with a low risk of ICU admission, but these differences were not statistically significant. There were no significant differences in the risk of admission by influenza type.

Outcome

The mean length of hospital stay for all patients was 6.6 days. Admission to ICU was associated with an increase in mean hospital length of stay of 8.3 days compared with those not admitted to ICU; other factors associated with a prolonged length of stay included medical comorbidities and restricted pre-morbid functional capacity. Factors associated with a shorter length of stay included pregnancy and Indigenous ethnicity (Table 4).

Of the 1,516 patients where hospital mortality status was documented, 44 (2.9%) patients died, which included 21 patients in ICU. Of all in-hospital deaths, 32 (73%) were patients more than 65 years of age, 43 (98%) had medical comorbidities and 2 (1.9%) were Indigenous Australians. Significant medical comorbidities in patients who died following admission with laboratory-confirmed influenza were recorded as chronic cardiac disease (n=19), chronic respiratory disease (n=23), immunosuppression (n=11), diabetes (n=14) and renal disease (n=9).

Table 3: Factors associated with admission to intensive care in patients hospitalised with confirmed influenza

Variable	Crude odds ratio (95% CI)	*P* value	Adjusted odds ratio (95% CI)	*P* value
Age >65 years	0.43 (0.31, 0.58)	<0.001	0.43 (0.31, 0.59)	<0.001
Medical comorbidities	1.10 (0.73, 1.66)	0.639	1.43 (0.94, 2.17)	0.099
Pregnancy	0.53 (0.19, 1.48)	0.227	0.37 (0.13, 1.05)	0.062
Indigenous Australian	1.12 (0.70, 1.78)	0.637	NI	
Restricted functional status	0.77 (0.57, 1.04)	0.091		
Nursing home resident	0.12 (0.03, 0.49)	0.003	0.16 (0.04, 0.68)	0.013
Influenza type				
Influenza A	1 (referent)			
Influenza B	0.89 (0.49, 1.61)	0.688	NI	

NI Not included in final model.

Table 4: Factors associated with length of hospital stay from presentation or diagnosis with influenza

Variable	Crude coefficient (95% CI)	*P* value	Adjusted coefficient (95% CI)	*P* value
Age >65 years	1.07 (0.19, 1.96)	0.017	0.79 (-0.03, 1.60)	0.059
Medical comorbidities	2.10 (1.28, 2.91)	<0.001	1.20 (0.37, 2.03)	0.004
Indigenous Australian	-1.92 (-2.81, -1.03)	<0.001	-1.44 (-2.19, -0.70)	<0.001
Pregnancy	-3.10 (-4.28, -1.91)	<0.001	-1.69 (-2.56, -0.82)	<0.001
Influenza B (vs Influenza A)	-0.13 (-1.52, 1.26)	0.854	NI	
RACF resident	1.33 (-0.15, 2.80)	0.079		
Restricted functional capacity	2.06 (1.32, 2.80)	<0.001	1.59 (0.95, 2.24)	<0.001
Intensive care admission	8.12 (6.40, 9.84)	<0.001	8.31 (6.53, 10.08)	<0.001

* Bootstrapped linear regression: baseline length of stay 3.7 days (representing mean length of stay in a non-elderly, non-Indigenous patient with no comorbidities or functional restriction, not admitted to intensive care unit).

NI Not included in final model.

RACF Residential aged care facility.

Discussion

Hospital-based sentinel surveillance provides timely and detailed information on the severity of illness, and complements community- and primary care-based surveillance systems that provide information on the extent of spread. Surveillance programs similar to FluCAN are operating in many countries.[6–10] The FluCAN system in Australia includes sites in all jurisdictions with representation from metropolitan and regional hospitals, specialist paediatric hospitals and those in tropical and subtropical regions. By collecting data on patients with acute respiratory illness who test negative for influenza, vaccine coverage (particularly in vulnerable patients) and vaccine effectiveness against severe influenza can be estimated from the same study.[11, 12]

In 2014, we recorded almost 1,700 admissions to the 15 hospitals that participated in this surveillance network, representing the highest number of admissions since surveillance commenced in 2009. Virological surveillance suggested influenza A(H1N1)pdm09 predominated across most jurisdictions throughout the season, however influenza A(H3N2) was predominant in New South Wales and the Australian Capital Territory.[4] Influenza B (B/Yamagata-lineage) was less common in this season than in 2013.[13] Due to differences in the number and size of sentinel hospitals in each jurisdiction, the relative number of cases between jurisdictions may not represent differences in true influenza incidence.

Compared with previous years, the 2014 season was slightly earlier (mid-August to early September

compared with mid-September in 2013). Patients admitted in 2014 (47% were over 65 years) were older than in 2013 (32% over 65 years), but had a similar age profile to those in 2012 (46% over 65 years).

In contrast to other studies, we found that the demographic profile and proportion with chronic comorbidities was similar in patients who were admitted to ICU compared with those admitted to the general wards.[14] Older patients were under-represented in ICU; this is likely to reflect a lower severity of illness, as older patients with mild disease may still require care in hospital. This may also reflect policies discouraging admission of the frail elderly into ICU if deemed futile.

We found that the length of stay was longer in those with more severe illness (ICU admission) and functional impairment. Interestingly, some risk groups (elderly, pregnant, Indigenous Australians) had a shorter length of hospital stay suggesting that the severity of illness is the primary driver for length of stay, rather than underlying risk factors. It may also reflect ascertainment bias in that patients with risk factors may have been more likely to be tested for influenza.

With a mean length of stay of 6.6 days, the patients with laboratory-confirmed influenza detected in this surveillance system represent over 9,870 bed days in the 15 sentinel hospitals. As the hospitals represented in this network represent approximately 12% of the national hospital bed capacity, the cases detected here are likely to represent approximately 15,000 admissions and almost 100,000 bed days nationally. Although the estimate of disease-attributable cost varies widely according to the method of calculation,[15] recent Australian costing data suggest that the direct hospital inpatient cost of admissions with confirmed influenza is approximately A$60 million to A$100 million based on accounting costs.[16] This is likely to represent a minimum estimate due to influenza case under-ascertainment, healthcare costs incurred following discharge and costs borne by other payers.

There are several limitations to this study. There may be under-ascertainment of influenza due to poor quality sample collection or the lack of use of influenza laboratory tests, despite the diagnosis of influenza having implications for infection control and antiviral use in hospitals. Delayed presentations or secondary bacterial pneumonia may be associated with false negative influenza tests as the influenza infection may be cleared by the time of presentation. Ascertainment in tropical regions is limited by sampling in the winter season only.

In summary, we detected a large number of hospital admissions with laboratory-confirmed influenza in a national observational study in 2014 compared with previous years. A high proportion of patients with severe influenza, and almost all deaths, occurred in patients with chronic comorbidities. In admitted patients, younger age was associated with ICU admission, highlighting the importance of this under-vaccinated risk group.

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