

Impact of influenza across 27 public emergency departments in Australia: a 5-year descriptive study

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ABSTRACT

Objective To describe the incidence, characteristics and outcomes of patients with influenza-like symptoms presenting to 27 public hospital emergency departments (EDs) in Queensland, Australia.

Methods A descriptive retrospective study covering 5 years (2005–9) of historical data from 27 hospital EDs was undertaken. State-wide hospital ED Information System data were analysed. Annual comparisons between influenza and non-influenza cases were made across the southern hemisphere influenza season (June–September) each year.

Results Influenza-related presentations increased significantly over the 5 years from 3.4% in 2005 to 9.4% in 2009, reflecting a 276% relative increase. Differences over time regarding characteristics of patients with influenza-like symptoms, based on the influenza season, occurred for admission rate (decreased over time from 28% in 2005 to 18% in 2009), length of stay (decreased over time from a median of 210 min in 2005 to 164 min in 2009) and access block (increased over time from 33% to 41%). Also, every year there was a significantly ($p < 0.001$) higher percentage of access block in the influenza cohort than in the non-influenza cohort.

Conclusions Although there was a large increase over time in influenza-related ED presentations, most patients were discharged home from the ED. Special consideration of health service delivery management (eg, establishing an 'influenza clinic border protection and public rollout of vaccination, beginning with those most at risk') for this group of patients is warranted but requires evaluation. These results may inform planning for service delivery models during the influenza season.

INTRODUCTION

Novel influenza-like illnesses such as sudden acute respiratory syndrome, avian influenza and the 2009 H1N1 influenza have presented as an ongoing global threat over the last 5 years.^{1–6} The impact of these illnesses on a local community can be widespread. Medical consumption increases, mainly for primary care providers (general practitioners and emergency departments (EDs)), leading to isolation/infection control decisions. The impact of higher ED presentations may have an effect on patient ED and length of stay (LOS) (defined as the difference between arrival time and departure time)⁷ and access block (defined as the proportion of admissions with total time in the ED longer than 8 h).⁷ Global overcrowding of EDs has exacerbated the incidence of access block, and several studies have documented that impaired function of the ED

results in less favourable outcomes for patients,^{8–11} including increased mortality.

Despite WHO recommendations in managing influenza, the rate of transmission from person to person and also from country to country is rapid. The impact of influenza on hospital systems has been described in terms of triage for prioritising care (public health considerations of infectiousness should be part of standard triage assessments),¹² staffing levels (high staff absentee rates should be anticipated during pandemics)¹³ and clinical predictors of influenza status to support isolation decisions.¹⁴ What has not been presented in the literature, as far as we are aware, is an analysis of influenza presentations across a number of hospital sites within the southern hemisphere.

It is important to describe ED trends and historical data in health-related outcomes that can be used to inform epidemic planning as well as regular influenza season planning. This paper presents a description of the incidence of ED presentations, subsequent hospital admissions, as well as characteristics and outcomes of patients presenting with influenza-like illnesses over the southern hemisphere influenza season (June–September) for the 5 years from 2005 to 2009.

METHODS

Study design and setting

This retrospective descriptive study was undertaken in Queensland, one of the eight states and territories of Australia. It has a population of 4.5 million and an annual public hospital ED presentation rate of 345/1000 weighted population.¹⁵ The information provided in this paper relates to presentations to 27 public hospitals that provide routinely reported data (such as waiting times and triage categories) to state and national health agencies. All included EDs have >15 000 patients presenting annually and the hospital bed numbers range in size from 69 to 1047. The influenza season was defined as June–September, as typically the majority of reported cases occur during this period.¹⁶ For the study data, the percentage of annual cases that occurred between June and September ranged from 34% in 2005 to 46% in 2007.

For the purposes of this study the following definitions and data groupings were used.

Influenza-like cases are defined using the International Classification of Diseases (ICD-10 coding) to identify patient records with influenza-like symptoms. ICD is the international standard diagnostic classification for epidemiological, health management purposes and clinical use. They were

defined using the following 11 ICD codes: A08.4-Viral Gastroenteritis, B34.9-Viral Infection, J10.8 (Influenza old code), J11.1 (Influenza new code), J11.1S-H1N1 Influenza (Human Swine Influenza) suspected, J18.0-Bronchopneumonia, J18.1-Lobar Pneumonia Unspecified, J18.2-Hypostatic Pneumonia Unspecified, J18.8-Pneumonia—Atypical, J18.9-Pneumonia—Unspecified, Z04.8-Medical Review.

Automatic swab analysis to confirm pathology is not routine ED practice in Queensland, hence the inclusion of these codes comprising possible cases, based on clinician experience. While laboratory-confirmed cases reported to surveillance systems are recognised as one indicator of influenza activity, such laboratory data for Queensland would not comprise all cases. The specified ICD list was chosen in consultation with clinicians working at some of the participating hospitals. Although the definition covers a broad set of conditions (low specificity), it is adequate to reliably capture the diagnoses that a patient presenting with influenza might be likely to receive.

All patients presenting to an Australian ED are triaged using the Australasian Triage Scale (ATS) which comprises five categories.¹⁷ These categories range from patients who require resuscitation (ATS 1 and should be seen immediately) to patients whose medical needs are not urgent (ATS 5 and should be seen within 2 h of arrival at the ED).

The age brackets used when assessing age-related differences were chosen in accordance with those used by Australia's National Health and Welfare Statistics and Information Agency (AIHW)¹⁸ of 0–15, 16–24, 25–64, 65+ brackets, which are useful clinically—that is, children, young adults, adults and older people. The youngest age bracket was further split (0–5, 6–10, 11–15 years) as clinical advice indicates possible differences between them, particularly regarding the 2009 H1N1 influenza vaccine which was not offered to those aged <10 years until 3 December 2009.¹⁹

The data were cleaned to exclude cases of unknown gender, age >104 years (a known age wild card), and LOS in the ED >8000 min (based on assessing the LOS frequency distribution).

Data analysis

Data were stored and collated using Microsoft Office Excel (V.2007 2006, Microsoft Corporation). Descriptive and inferential statistics were performed. Descriptive statistics, presented as mean (\pm SD) and median (Md) (IQR) were used to explore the patient characteristics (such as age) and outcome measures (ED LOS) between the groups (influenza or non-influenza) and years. Frequency distributions were used for binary categorical outcome variables of ED LOS (>8 h) and hospital mortality. Inferential statistics were used to identify differences between groups (influenza or non-influenza) and between years. *t* Tests were used for normally distributed data, the Mann–Whitney *U* test for non-normally distributed data and χ^2 tests for categorical variables. One-way ANOVA was used for comparisons across multiple years. Two-tailed tests were used and a level of significance was set at $p < 0.05$ with 95% confidence limits. SPSS V.17.0 was used for these data analyses. Analysis of variance tests were performed using Matlab (V.7.2.0.232 R2006a, The MathWorks Inc).

RESULTS

There were approximately 1.7 million ED presentations in Queensland public hospitals in the 2005–9 southern hemisphere influenza seasons (June–September). Influenza and non-influenza presentations and subsequent admissions across the

2005–9 influenza seasons are shown in table 1. In every year the influenza cohort differed significantly ($p < 0.001$) from the non-influenza cohort in every characteristic apart from gender of hospital admissions. Influenza-related presentations increased significantly over the 5 years from 3.4% in 2005 to 9.4% in 2009, reflecting a 276% relative increase. This increase occurred in the presence of increasing growth in patient presentations (36% across the 5 years), which was well beyond official population growth (10% over 5 years).²⁰ This finding was reproduced for patients who were admitted—influenza admissions increased from 4.3% in 2005 to 7.6% in 2009 (176% relative increase) in the presence of increasing growth in hospital admissions (38% across the 5 years). Figure 1 shows mean growth rates across the study period, generated from assessing changes between consecutive years.

Figure 2 shows the trends in influenza presentations and admissions in terms of patient numbers and timing. The trend in patient numbers was generally stable from 2005 to 2007, followed by a small fall in 2008 before a peak in 2009. There was a strongly significant ($p < 0.001$) increase in both influenza presentations and influenza hospital admissions in 2009 as well as an earlier peak of presentations in the influenza season.

Further differences between influenza seasons and influenza/non-influenza patient cohorts are explored in terms of age, triage category (ATS), diagnosis, admission rate, LOS and access block.

Age

For every year in the study period, patients presenting with influenza symptoms were significantly younger than the non-influenza cohort (mean 27.4 vs 34.8 years, $p < 0.001$). The mean age of influenza presentations increased from 25.5 years (95% CI 25.1 to 25.9) in 2007 to 26.2 years (95% CI 25.8 to 26.6) in 2008, to 27.9 (95% CI 27.6 to 28.2) in 2009. Over the 5-year study period, admitted patients with influenza tended to be younger than patients without influenza, although this was not significantly different (mean 45.3 vs 47.5 years, $p = 0.06$).

Although the 0–5 age bracket contributes only around 8% of the Queensland patient population, interestingly, this patient group contributes significantly more ($p < 0.001$) to ED presentations and subsequent admissions to hospital, and particularly more so when diagnosed with influenza-like symptoms. While there are proportionately significantly ($p < 0.001$) more patients aged 0–5 years in the influenza cohort than in the non-influenza cohort, it can be seen that, for 2009, the proportion of patients with influenza aged 0–5 years (presentations) decreased significantly ($p < 0.001$) compared with previous years. Conversely, the proportions of the 16–24 and 25–64 age brackets increased significantly ($p < 0.001$) in 2009. This is particularly interesting considering the significant increases in influenza presentations and ED admissions in 2009.

Triage category/urgency

For all years, influenza presentations had a significantly ($p < 0.001$) lower proportion of ATS 1 and 2 (most urgent) patients than non-influenza presentations. Influenza admissions also had significantly ($p < 0.001$) lower proportions of ATS 1 and 2 than the non-influenza admitted cohort, suggesting lower urgency of influenza patients compared with the non-influenza cohort. However, the criticality/triage levels of admitted patients were not significantly different proportionally in 2009 ($p = 0.2$).

Diagnosis

Viral infections (B34.9) comprise most of the 'influenza' presentations, yet pneumonia diagnoses dominate the

Table 1 Characteristics of emergency department (ED) presentations and subsequent hospital admissions: June–September 2005–9

ED presentations	2005		2006		2007		2008		2009	
	Flu	No flu	Flu	No flu	Flu	No flu	Flu	No flu	Flu	No flu
n, %	9544 (3.4%)	271 360 (96.6%)	11 262 (3.8%)	281 295 (96.2%)	20 836 (6.1%)	320 530 (93.9%)	20 172 (5.5%)	344 693 (94.5%)	35 970 (9.4%)	345 448 (90.6%)
Age (years)										
Mean (SD)	30.5 (28.1)	34.7 (24.6)	26.8 (27.7)	34.3 (24.8)	25.5 (27.2)	34.6 (25.0)	26.2 (27.6)	35.3 (24.7)	27.9 (24.9)	35.3 (24.5)
Median (IQR)	23 (4–50)	30 (16–52)	19 (2–44)	30 (15–52)	16 (2–43)	30 (15–53)	16 (2–44)	31 (16–53)	22 (5–44)	31 (16–53)
Age group (years)										
0–5	2642 (27.7%)	36 599 (13.5%)	3977 (35.3%)	40 432 (14.4%)	7855 (37.7%)	47 468 (14.8%)	7329 (36.3%)	44 606 (12.9%)	9134 (25.4%)	43 828 (12.7%)
6–10	660 (6.9%)	14 082 (5.2%)	785 (7.0%)	14 238 (5.1%)	1729 (8.3%)	16 411 (5.1%)	1742 (8.6%)	17 218 (5.0%)	2766 (7.7%)	17 187 (5.0%)
11–15	430 (4.5%)	15 731 (5.8%)	460 (4.1%)	16 546 (5.9%)	804 (3.9%)	18 138 (5.7%)	912 (4.5%)	20 242 (5.9%)	2105 (5.9%)	20 736 (6.0%)
16–24	1204 (12.6%)	44 371 (16.4%)	1321 (11.7%)	45 976 (16.3%)	2068 (9.9%)	50 376 (15.7%)	1906 (9.4%)	56 064 (16.3%)	5346 (14.9%)	56 075 (16.2%)
25–64	3013 (31.6%)	119 651 (44.1%)	3082 (27.4%)	122 233 (43.5%)	5586 (26.8%)	138 289 (43.1%)	5353 (26.5%)	152 721 (44.3%)	12 525 (34.8%)	154 459 (44.7%)
65+	1595 (16.7%)	40 926 (15.1%)	1637 (14.5%)	41 870 (14.9%)	2794 (13.4%)	49 848 (15.6%)	2930 (14.5%)	53 842 (15.6%)	4094 (11.4%)	53 163 (15.4%)
Gender										
Male	4726 (49.5%)	144 260 (53.2%)	5663 (50.3%)	148 261 (52.7%)	10 421 (50.0%)	169 303 (52.8%)	10 042 (49.8%)	180 674 (52.4%)	17 778 (49.4%)	180 764 (52.3%)
Female	4818 (50.5%)	127 100 (46.8%)	5599 (49.7%)	133 034 (47.3%)	10 415 (50.0%)	151 227 (47.2%)	10 130 (50.2%)	164 019 (47.6%)	18 192 (50.6%)	164 684 (47.7%)
Triage criticality										
ATS 1	36 (0.4%)	1707 (0.6%)	28 (0.2%)	1936 (0.7%)	62 (0.3%)	2408 (0.8%)	66 (0.3%)	2637 (0.8%)	110 (0.3%)	2902 (0.8%)
ATS 2	627 (6.6%)	21 725 (8.0%)	723 (6.4%)	22 810 (8.1%)	1226 (5.9%)	28 643 (8.9%)	1259 (6.2%)	32 632 (9.5%)	2050 (5.7%)	34 308 (9.9%)
ATS 3	4693 (49.2%)	92 924 (34.3%)	5585 (49.6%)	100 617 (35.8%)	9420 (45.2%)	116 078 (36.2%)	9713 (48.2%)	128 924 (37.4%)	15 287 (42.5%)	135 837 (39.3%)
ATS 4	3864 (40.5%)	126 897 (46.8%)	4545 (40.4%)	130 485 (46.4%)	9343 (44.8%)	141 180 (44.1%)	8454 (41.9%)	146 456 (42.5%)	15 617 (43.4%)	144 620 (41.9%)
ATS 5	324 (3.4%)	27 784 (10.3%)	381 (3.4%)	25 194 (9.0%)	782 (3.8%)	31 940 (10.0%)	680 (3.4%)	33 663 (9.8%)	2904 (8.1%)	27 709 (8.0%)
Mode of arrival										
Amb-Road	2408 (25.2%)	70 055 (26.0%)	2704 (24.0%)	76 294 (27.3%)	4891 (23.5%)	88 232 (27.5%)	4664 (23.1%)	94 598 (27.5%)	6568 (18.3%)	93 297 (27%)
Walked in/self	7073 (74.1%)	193 848 (71.8%)	8484 (75.3%)	198 719 (71.0%)	15 830 (76.0%)	227 294 (70.9%)	15 424 (76.5%)	244 891 (71.0%)	29 139 (81.0%)	246 964 (71.5%)
Other	63 (0.7%)	5970 (2.2%)	74 (0.7%)	4779 (1.7%)	115 (0.5%)	4982 (1.6%)	84 (0.4%)	5204 (1.5%)	263 (0.7%)	5187 (1.5%)
Length of stay in ED (min)										
Mean (SD)	290.3 (350.3)	227.8 (314.7)	280.8 (303.3)	238.7 (260.0)	272.1 (278.7)	248.9 (271.4)	288.3 (295.7)	259.7 (278.6)	235.5 (249.2)	260.8 (270.5)
Median (IQR)	210 (120–341)	163 (86–281)	208 (120–337)	171 (92–294)	196 (110–331)	172 (91–305)	206 (115–347)	178 (94–318)	164 (89–287)	180 (97–321)
Departure status										
Discharged	6690 (70.1%)	182 817 (67.4%)	8147 (72.4%)	189 217 (67.3%)	15 597 (74.9%)	213 887 (66.7%)	14 559 (72.2%)	230 499 (66.9%)	28 753 (79.9%)	228 345 (66.1%)
Admitted	2653 (27.8%)	58 746 (21.7%)	2893 (25.7%)	59 381 (21.1%)	4782 (23.0%)	67 721 (21.1%)	5033 (25.0%)	74 010 (21.5%)	6419 (17.8%)	78 059 (22.6%)
Did not wait	13 (0.1%)	22 563 (8.3%)	32 (0.3%)	24 857 (8.8%)	38 (0.2%)	28 547 (8.9%)	41 (0.2%)	28 376 (8.2%)	114 (0.3%)	26 574 (7.7%)
Died in ED	8 (0.1%)	233 (0.1%)	6 (0.1%)	244 (0.1%)	13 (0.1%)	259 (0.1%)	11 (0.1%)	262 (0.1%)	25 (0.1%)	285 (0.1%)
Other	177 (1.9%)	6821 (2.5%)	181 (1.5%)	7363 (2.7%)	405 (1.8%)	10 053 (3.2%)	528 (2.5%)	11 541 (3.3%)	659 (1.9%)	12 185 (3.5%)

Continued

Table 1 Continued

Hospital admissions	2005		2006		2007		2008		2009	
	Flu	No flu	Flu	No flu	Flu	No flu	Flu	No flu	Flu	No flu
n, %	2653 (4.3%)	58 746 (95.7%)	2893 (4.6%)	59 381 (95.4%)	4782 (6.6%)	67 721 (93.4%)	5033 (6.4%)	74 010 (93.6%)	6419 (7.6%)	78 059 (92.4%)
Age (years)										
Mean (SD)	48.4 (31.2)	46.6 (27.0)	42.8 (32.5)	46.5 (27.2)	44.9 (32.5)	48.0 (27.1)	45.6 (32.3)	48.4 (26.9)	44.7 (30.4)	47.9 (26.7)
Median (IQR)	55 (19–76)	48 (24–70)	45 (5–73)	48 (24–70)	50 (6–76)	50 (25–72)	52 (9–76)	51 (26–72)	48 (16–72)	50 (26–71)
Age group (years)										
0–5	483 (18.2%)	5548 (9.4%)	735 (25.4%)	5919 (10.0%)	1130 (23.6%)	6268 (9.3%)	1115 (22.2%)	6305 (8.5%)	1187 (18.5%)	6595 (8.4%)
6–10	81 (3.1%)	1789 (3.0%)	120 (4.1%)	1746 (2.9%)	197 (4.1%)	1838 (2.7%)	176 (3.5%)	2013 (2.7%)	289 (4.5%)	2030 (2.6%)
11–15	58 (2.2%)	1992 (3.4%)	54 (1.9%)	2009 (3.4%)	87 (1.8%)	2170 (3.2%)	155 (3.1%)	2317 (3.1%)	151 (2.4%)	2482 (3.2%)
16–24	119 (4.5%)	5518 (9.4%)	145 (5.0%)	5585 (9.4%)	220 (4.6%)	6003 (8.9%)	219 (4.4%)	6611 (8.9%)	413 (6.4%)	7219 (9.2%)
25–64	838 (31.6%)	25 187 (42.9%)	826 (28.6%)	25 255 (42.5%)	1359 (28.4%)	28 540 (42.1%)	1409 (28.0%)	31 526 (42.6%)	2226 (34.7%)	34 071 (43.6%)
65+	1074 (40.5%)	18 712 (31.9%)	1013 (35.0%)	18 867 (31.8%)	1789 (37.4%)	22 902 (33.8%)	1959 (38.9%)	25 238 (34.1%)	2153 (33.5%)	25 662 (32.9%)
Gender										
Male	1379 (52.0%)	30 738 (52.3%)	1499 (51.8%)	31 223 (52.6%)	2434 (50.9%)	35 478 (52.4%)	2500 (49.7%)	38 478 (52.0%)	3270 (50.9%)	40 433 (51.8%)
Female	1274 (48.0%)	28 008 (47.7%)	1394 (48.2%)	28 158 (47.4%)	2348 (49.1%)	32 243 (47.6%)	2533 (50.3%)	35 532 (48.0%)	3149 (49.1%)	37 626 (48.2%)
Triage criticality										
ATS 1	27 (1.0%)	1236 (2.1%)	23 (0.8%)	1379 (2.3%)	54 (1.1%)	1694 (2.5%)	50 (1.0%)	1857 (2.5%)	85 (1.3%)	1999 (2.6%)
ATS 2	406 (15.3%)	12 415 (21.1%)	486 (16.8%)	12 822 (21.6%)	752 (15.7%)	15 636 (23.1%)	799 (15.9%)	17 276 (23.4%)	1047 (16.3%)	18 763 (24.0%)
ATS 3	1753 (66.1%)	31 146 (53.0%)	1849 (63.9%)	31 489 (53.0%)	2996 (62.7%)	36 064 (53.3%)	3229 (64.2%)	39 670 (53.6%)	4126 (64.3%)	42 330 (54.2%)
ATS 4	458 (17.3%)	13 113 (22.3%)	523 (18.1%)	13 022 (21.9%)	954 (19.9%)	13 411 (19.8%)	935 (18.6%)	14 139 (19.1%)	1076 (16.8%)	14 146 (18.1%)
ATS 5	9 (0.3%)	820 (1.4%)	12 (0.4%)	650 (1.1%)	26 (0.5%)	905 (1.3%)	20 (0.4%)	1027 (1.4%)	85 (1.3%)	819 (1.0%)
Mode of arrival										
Amb-Road	1352 (51.0%)	28 895 (49.3%)	1333 (46.1%)	29 559 (49.9%)	2386 (49.9%)	35 345 (52.2%)	2477 (49.2%)	38 502 (52.0%)	2942 (45.8%)	39 537 (50.7%)
Walked in/self	1257 (47.4%)	27 239 (46.5%)	1504 (52.0%)	27 315 (46.1%)	2327 (48.7%)	29 895 (44.1%)	2492 (49.5%)	33 017 (44.6%)	3359 (52.3%)	35 845 (45.9%)
Other	44 (1.6%)	2465 (4.2%)	56 (1.9%)	2372 (4.0%)	69 (1.4%)	2481 (3.7%)	64 (1.3%)	2491 (3.4%)	118 (1.9%)	2677 (3.4%)
Length of stay in ED (min)										
Mean (SD)	517 (542.4)	423 (450.7)	507.3 (460.1)	446.1 (394.5)	517.1 (402.3)	484.3 (398.9)	537.9 (415.6)	502.5 (396.8)	520.4 (378.3)	501.2 (374.1)
Median (IQR)	377 (258.5–571.5)	48 (24–70)	382 (268.3–576)	345 (219–539)	407 (275–617)	373 (236–597)	414 (284–639)	388 (247–622)	417 (279–640)	396 (254–625)
Access block										
ED LOS < 8 h	1766 (66.6%)	42 933 (73.1%)	1912 (66.1%)	41 233 (69.5%)	2941 (61.5%)	43 682 (64.5%)	3012 (59.9%)	46 268 (62.5%)	3808 (59.3%)	48 168 (61.7%)
ED LOS > 8 h	887 (33.4%)	15 783 (26.9%)	981 (33.9%)	18 120 (30.5%)	1840 (38.5%)	24 017 (35.5%)	2020 (40.1%)	27 731 (37.5%)	2609 (40.7%)	29 883 (38.3%)

LOS, length of stay.

Triage: ATS1 = immediate assessment, ATS2 = 10 min, ATS3 = 30 min, ATS4 = 60 min, ATS5 = 120 min.

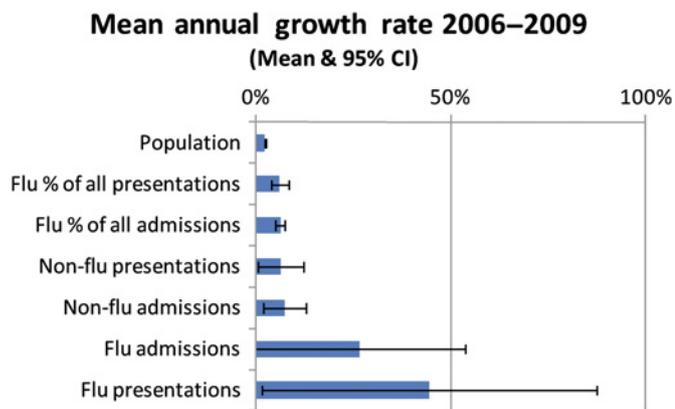


Figure 1 Relative changes in emergency department characteristics over the study period.

'influenza' hospital admissions. Previous years also show negligible influenza (J10.8, J11.1, J11.1S) diagnoses which appear in the 2009 data. It should be remembered that the overall scale of these cases is small (approximately 1% of the state population).

Departure/disposition status and influenza admission rate

Between 2005 and 2008 the proportion of patients admitted with influenza was significantly higher compared with the admitted non-influenza patient cohort (25.3% vs 21.3%, $p < 0.001$) but in 2009 it was significantly lower (17.8% vs 22.6%, $p < 0.001$). While there were significantly higher numbers of patients admitted with influenza in 2009 compared with previous years ($p < 0.001$), the admission rate for influenza patients (percentage of influenza presentations that were admitted) decreased over the study period from 28% in 2005 to

18% in 2009. The admission rate in 2009 for influenza was significantly less than in previous years ($p < 0.001$) while the admission rate for the non-influenza cohort was fairly constant at 22%. Patients who died in the ED remained constant every year at 0.1% for both the influenza and non-influenza patient cohorts.

ED LOS and access block

Between 2005 and 2008, patients with influenza experienced significantly longer ($p < 0.001$) stays in the ED than the non-influenza patient cohort (figure 3A). In 2009, however, ED LOS was significantly shorter for patients with influenza than for the non-influenza cohort (236 min vs 261 min, $p < 0.001$). For patients with influenza who were admitted, however, the ED LOS was significantly longer than for the non-influenza admitted cohort (eg, 520 min vs 501 min in 2009).

Across the study period, each year there were more patients whose LOS exceeded 8 h (access-blocked patients) than the preceding year (figure 3B). For influenza patients the proportion of access-blocked patients increased from 33.4% in 2005 ($n=887$) to 40.7% in 2009 ($n=2609$), representing a 122% proportional increase (and an almost 300% increase in access-blocked patient numbers). For non-influenza patients, the proportional increase was 142% with a 190% increase in access-blocked patients. Also every year there was a significantly ($p < 0.001$) higher percentage of access block in the influenza cohort than in the non-influenza cohort.

DISCUSSION

From our data it is evident that influenza presentations are increasing each year, with a dramatic increase in 2009. Confirmed cases of 2009 H1N1 influenza across June–September 2009 in Queensland have been reported previously,¹⁶ and

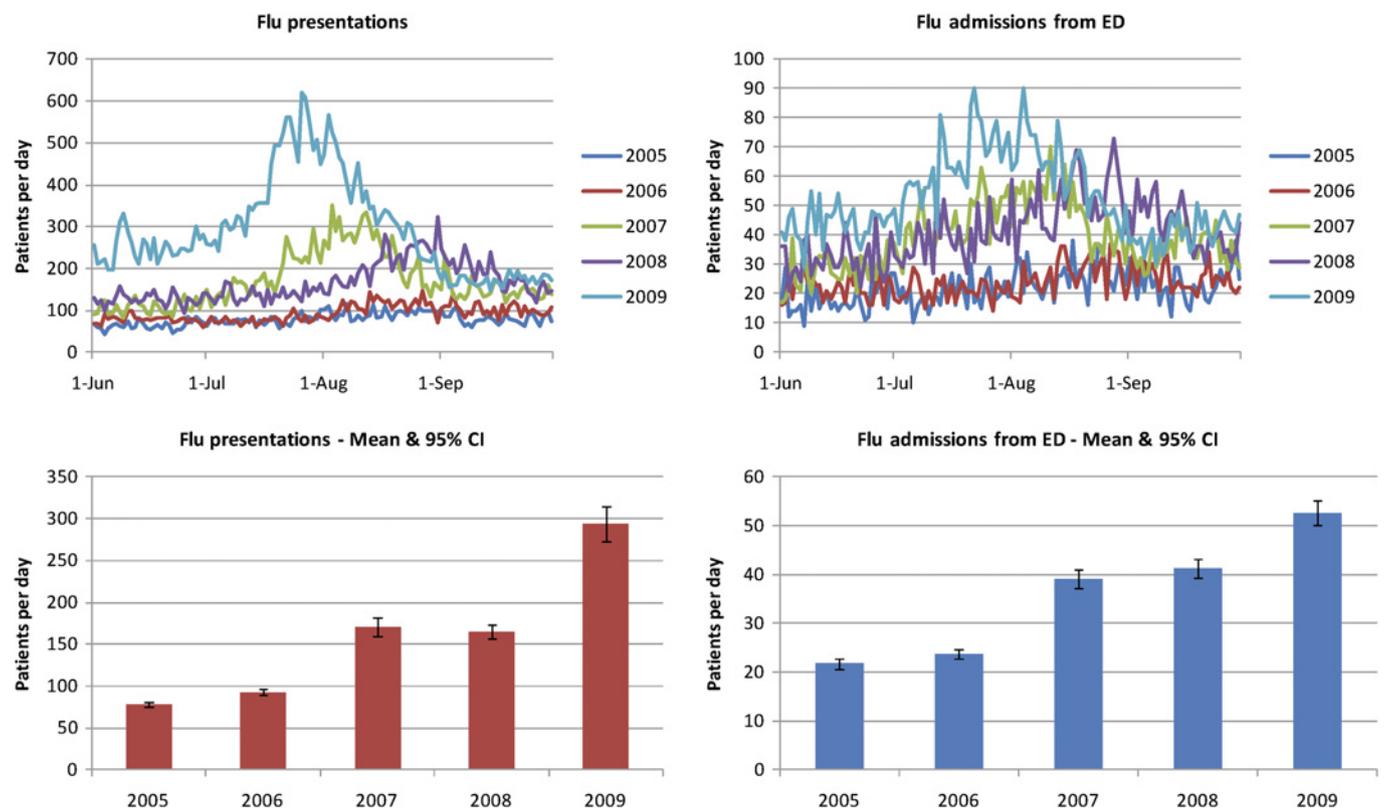


Figure 2 Influenza presentations and hospital admissions 2005–9.

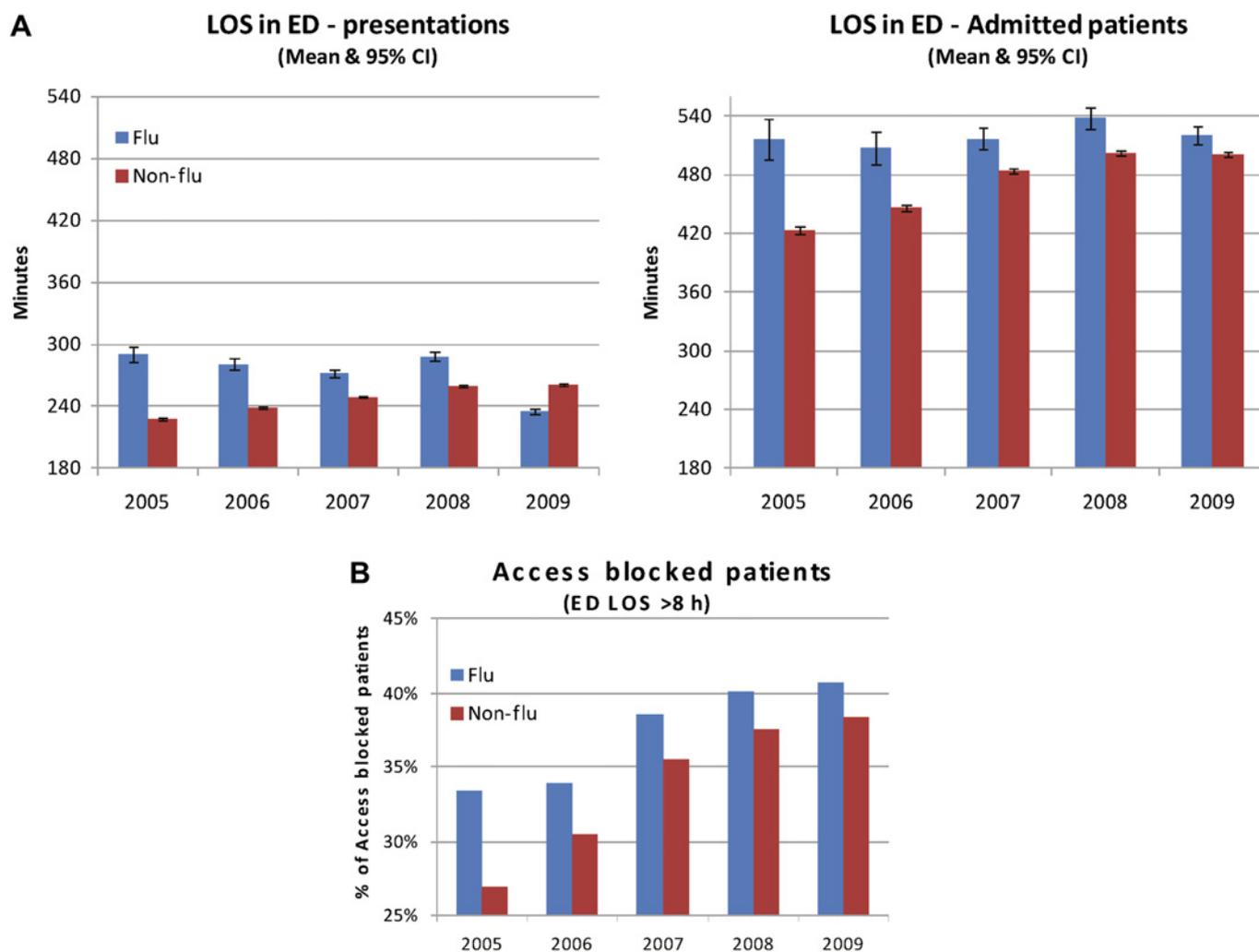


Figure 3 Changes in (A) emergency department length of stay (ED LOS) and (B) access block 2005–9.

reached a peak in mid July 2009. Our data are consistent with this and additionally show that, from 2005 to 2007, the number of influenza presentations doubled and then almost doubled again from 2007 to 2009. As populations around the world become more urbanised, influenza is going to become a major burden on the health system with potentially increased infection rates and more virulent influenza viruses.

The age results are interesting in that they suggest a more pronounced susceptibility in the 25–64 year age bracket compared with previous years, whereas in other years most influenza admissions were older patients aged 65+ years. One possible explanation is an improved immunity of patients exposed to an influenza strain in the 1950s.²¹ On a year-by-year basis, the data show that the highest influenza presentation rates were for the very young.

A previous report has indicated that the 2009 H1N1 virus had a substantial effect on hospitals during the 2009 winter.⁶ Access block is one of several measures of hospital performance²² and has been linked to poorer health outcomes.^{8–11} A large proportion of patients in our study who required hospital admission had an ED LOS that exceeded 8 h (access-blocked patients). This increased over time from 27% in 2005 to 38% in 2009. The increase in access block was noted for both influenza and non-influenza patient admissions across every year of the study period. It is possible that these increases in access block

figures reflect broader hospital-wide system issues which were exacerbated by the 2009 H1N1 virus.

Recommendations for future research and application concern the ability to forewarn health authorities of such events. Without pandemic cycles there can be little basis for predicting pandemic emergence.²³ As such, there is potential benefit in the areas of surveillance monitoring of influenza cases to signal unusual activity, generating forecasts based on historical data and using internet search data as outbreak notifications among a population.²⁴ The authors have commenced research in this area.

Analysis of historical data can inform service delivery planning (eg, in rostering extra staff): the fact that influenza presentations have a shorter and lower urgency than non-influenza cases could lead to the conclusion that relatively junior medical staff could handle this in a clinical setting with a higher turnover, taking away pressures from the ED.

Limitations of the study

This study has the following limitations. It focuses on the impact on public hospitals and their EDs and it was therefore outside the scope of the study to describe actual disease prevalence (ie, patients with the disease presenting to private hospitals, primary care physicians or not at all). We have not included data from general practitioners which may be considered the

front line in diagnosis. Private hospitals do not contribute to national collection of triage data,¹⁵ hence these data were not included.

Swabbing was not undertaken to confirm influenza status and, indeed, is usually only taken for certain clinical indications such as pregnancy, patients with comorbidities and patients who are immunocompromised. It is therefore possible that the results do not reflect influenza and may instead relate to other respiratory viruses with similar characteristics to influenza. Diagnosis of influenza may have been confirmed with laboratory testing for a reasonable proportion of cases, but these data were not available to use. The diagnosis as reported was therefore assumed correct as per ICD coding of diagnosis, but this may have led to under- or over-reporting of cases. However, this would have been similar over the years and is therefore unlikely to be the cause of the observations.

Although statistically significant differences between influenza and non-influenza patients were found, some of these differences may have limited direct clinical relevance (such as 20 min differences in LOS or age differences of 1–2 years) and so be important to observe and identify trends.

Finally, this study was carried out in one state that may be seen to have a particular demographic and climatic profile. As such, the patients may not be representative of those presenting to other EDs and may lack external validity.

CONCLUSIONS

This study shows clear trends over a large population group in the southern hemisphere. Influenza-like presentations were less urgent than non-influenza presentations, and in 2009 had a significantly shorter ED LOS as well as significantly lower hospital admission rates contrary to previous years in the study. The 2009 H1N1 influenza outbreak did represent a significant departure from the normal ED influenza workload relative to previous years and resulted in significantly more hospital admissions and an increased number of access-blocked patients.

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Ethics approval The Queensland Health Central Office human research ethics committee .

Contributors JL initially conceived the study which was further developed by JB, JC, MW, GK and JL. JC cleaned the data and was responsible for developing the data table included in the manuscript (table 1). The design (comparing influenza with no-influenza cohorts) was the responsibility of JC, GK, JL and JB. Data analysis, including statistical comparisons, was performed by JC and JB. JB was responsible for drafting the initial article and MW contributed to strengthening the text with

appropriate references. RS and LR were involved in reviewing important statistical content and aspects of data presentation. All authors had full access to all of the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors were involved in reviewing the article and giving final approval for the version to be published.

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