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EDITORIALS

Severity of the 2019 influenza season in Australia- a comparison between 2017 and 2019 H3N2 influenza seasons

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Abstract

Background: Annual seasonal influenza infection is unpredictable and varies from season to season. Australia experienced a severe season in 2017, followed by a mild season in 2018. In 2019, it featured unusually high inter-seasonal activity followed by a severe H3N2 season, proclaimed by the media as "the worst ever". Following a severe season in 2017, enhanced vaccines were introduced in 2018 for people aged >65 years.

Aim: To compare the seasonal severity of the 2017 and 2019 influenza season.

Methods: Data were collated from the National Notifiable Diseases Surveillance System (NNDSS) report. Epidemiological trends of seasonal influenza infection were compared between the two years 2017 and 2019. Reported hospitalisations, ICU admissions and deaths were obtained from published sources and compared.

Results: A(H3N2) dominated in both years. There was an early start to influenza circulation in 2019 with an unusually high number of cases seen during summer. There was no significant difference in the number of influenza hospitalisations or deaths reported in 2019 and 2017, but the proportion of hospitalisations that were admitted to ICU was significantly lower in 2019 (6.4% vs 8.9%, $p<0.001$). In both years, while large numbers of cases were reported, the severity of those cases was summarised as moderate. In 2019, 1108 influenza diagnoses per 100,000 population were notified to NNDSS up to October nationally, compared to 1021 per 100,000 for the same time period in 2017. There was variation in influenza activity by state in 2019, with Western Australia recording the highest activity and increased incidence compared to 2017. Most other states did not differ between 2019 and 2017. The 2017 epidemic affected the extremes of age more severely, as did 2019, but there was high activity in the young adult age group in 2019. Available data on the reported number of tests conducted in New South Wales and Western Australia were higher in 2019 than 2017. Vaccine effectiveness (VE) was reported initially as 40-60% for 2019 vs 33% (17-46%) in 2017.

Conclusion: Both 2017 and 2019 were H3N2 seasons with large numbers of infections. Higher numbers of notifications to NNDSS were observed in 2019, probably due to an unusually high level of summer activity and increased testing. Clinical severity was estimated as similar to or less in 2019 compared to 2017. Estimated VE was higher in 2019 compared to 2017 and suggests a benefit of enhanced vaccines.

Key words: Influenza, influenza virus, notifications, season, H3N2

Introduction

The 2019 influenza season in Australia has recorded the highest number of influenza diagnoses ever, and is particularly notable for unprecedented numbers in the inter-seasonal period of summer and autumn (1). It has been labelled in the media as "the worst season ever" (2). Previously, a severe H3N2 season occurred in 2017, which at the time recorded the highest notification rate ever in the country (population rate of 1021/100,000) (3, 4). However, the relative size of epidemics is difficult to compare due to variation in influenza subtypes, changing vaccine policy and possible increased awareness and laboratory testing over time. In 2017, a standard quadrivalent influenza vaccine was available in Australia. In 2017 there was poor vaccine match and low effectiveness, with effectiveness of 10% (95% CI -16 to 31) against H3N2 (5) and 33% (range 17 to 46%) overall. Following the severe season on 2017, the government introduced two enhanced trivalent vaccines (high dose and adjuvanted) for people aged 65 years and over (6). Both vaccines have improved vaccine efficacy of about 20-24% more than standard-dose influenza vaccines in older adults (7, 8). In 2018, both high dose and adjuvanted trivalent vaccines were provided free for people 65 years and over under the National Immunisation Program (NIP) in Australia. In 2019, adults 65 years and over were only provided the adjuvanted trivalent vaccine under the funded NIP in Australia (9).

Australia is in the Southern Hemisphere and has a mostly temperate climate and tropical zones in the north. There is a single winter seasonal peak of influenza each year in most regions, typically in August (10). Severity of an influenza season is affected by the type of influenza circulating, with influenza A typically being more severe than influenza B, vaccination type and rates, and the degree of match between vaccine and circulating strains.

The 2017 Australian season was regarded as the most severe since the 2009 pandemic, with the highest number of cases reported until then (total number= 233,453), an estimated 29,000 admissions to hospital with influenza infection and 745 deaths reported to the National Notifiable Diseases Surveillance System (NNDSS) nationally (4). The large number of hospitalisations and deaths were attributed to the large number of infections. However, it was reported that the severity of infection among hospitalized cases (measured as the proportion that were admitted to intensive care units (ICU)) was moderate in 2017 and was at the lower end of the 5-year average range compared to other seasonal epidemics (4). The aim of this study was to compare the epidemiology of the 2017 and 2019 influenza seasons in Australia using a wide range of data sources to more clearly understand the relative size and severity of the 2019 season.

Methods

We conducted a descriptive epidemiologic analysis of influenza data from 2017 and 2019. Influenza notification data were extracted from the National Notifiable Diseases Surveillance System, a publicly available resource, on 16 September 2019 (3). The influenza case definition requires laboratory confirmation (11). We aggregated data on numbers of influenza tests and positivity rates from New South Wales (NSW) influenza surveillance reports in 2017 (12) and 2019 (13), and the Western Australian report for 2019 (14), but this data was not publicly available from other states or territories.

We compared notifications with other published data to see whether they reflect the expected patterns of virus circulation and severity. We used FluCAN (15) data to compare hospitalization rates, as well as reports of influenza-related deaths in National Influenza Surveillance Reports (11) and state and territory surveillance reports (12-14, 16-19). We obtained circulating subtypes from national reports (11), and vaccine effectiveness from a published report for 2017 (4) and the National Surveillance Report for 2019 (11). There were some variations in surveillance reports among states and territories, thus we had made similar comparison as we could from the available information in both years. We determined the statistical significance of differences in counts of cases and hospitalisations by overlapping 95% confidence intervals of their Poisson distributions, and differences in proportions were tested using the chi-squared test.

Results

Seasonal timing

In 2019, Australian influenza activity started with an unusually large number of cases in the beginning of the year (summer period); there were 6,834 cases in January and 18,615 cases by April, which was about 3-9 times higher than in the summer of 2017. An earlier than average peak was observed in July 2019 (Figure 1) (3). In contrast, 2017 influenza activity started around May and peaked in August, which is the average peak month (10). In May 2019, the notification rate of 121.6/100,000 was approximately 14 times higher than the previous five-year average (8.9/100,000 population) and 9 times higher than in 2017 (13.3/100,000) (3).

The summer and autumn influenza activity in 2019 was accompanied by unusually high number of institutional outbreaks, influenza-like-illness (ILI) presentations to general practice and emergency departments, hospitalizations and deaths, suggesting there was a real and unusually high level of activity in the 2019 summer and autumn, prior to the official influenza season (1, 11, 20). For the year to date until October 2019, a total of 445 institutional outbreaks occurred in NSW, including 379 in the residential care facilities (13). In 2017, a high number of institutional outbreaks also occurred; a total of 591 institutional outbreaks were reported in NSW alone, including 543 residential facilities, but mostly during the winter season (12).

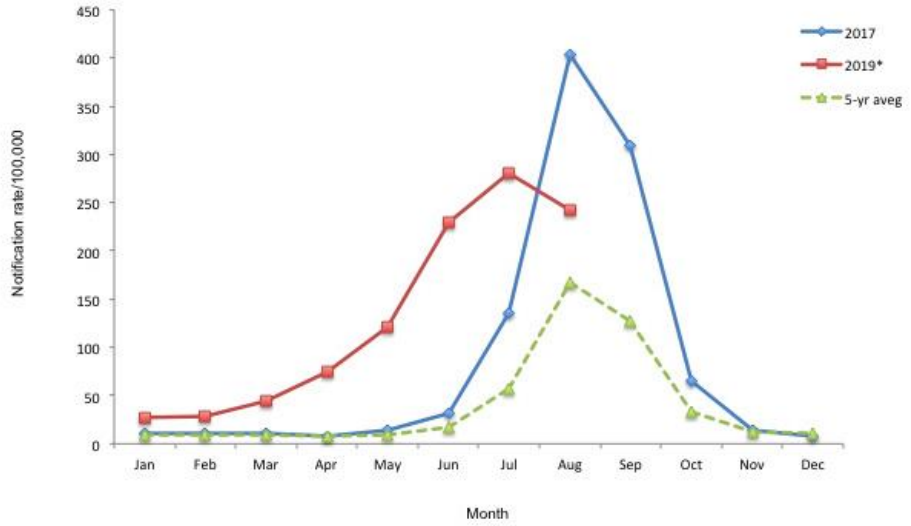
Geographic differences

While data for 2019 are not yet complete, in most states and territories notification rates were similar to the rates observed during the 2017 season, except in Western Australia (Table 1). The 2019 notification rate in Western Australia was nearly four times higher (860 vs 233 per 100,000 persons) than the 2017 season.

Laboratory testing patterns

The number of reported influenza tests in NSW increased from 370,000 in 2017 to 570,000 in 2019 while the percentage of those tests that were positive decreased slightly from 15.8% to 14.6% (21). A similar pattern was seen in data from Western Australia, where the influenza notification rate in 2019 was more than twice as high than in any other of the previous five years, but the total proportion positive was only slightly higher (14).

Figure 1. Influenza notification rate by month and year, Australia



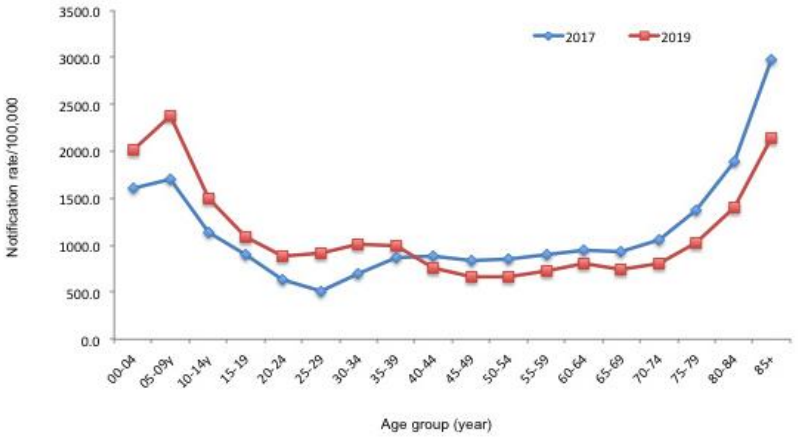
* Data reported as of at 16 September 2019.
Source: The National Notifiable Diseases Surveillance System (3).

Table 1. Influenza notification rate by states and territories, and by year

Year	States and territories								Aust
	ACT	**NSW**	**NT**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	
2014	324.6	278.3	333.5	379.0	654.6	131.0	167.1	208.7	288.3
2015	304.7	398.0	276.3	587.3	920.2	278.4	286.7	235.9	422.4
2016	397.9	460.4	285.3	480.5	459.6	203.9	209.4	306.6	375.7
2017	751.9	1320.2	595.5	1148.5	1652.6	671.1	761.2	233.4	1021.1
2018	113.1	219.3	483.0	313.2	339.6	85.6	182.0	226.3	235.6
2019*	873.5	1318.6	521.4	1203.6	1386.4	501.9	884.4	859.8	1107.7

* Data reported as of at 16 September, 2019.
Source: The National Notifiable Diseases Surveillance System (NNDSS) (3).

Figure 2. Influenza notification rate by age group and year, Australia.



Source: The National Notifiable Diseases Surveillance System (3).

Influenza types and age distribution

The 2019 season to date was dominated by influenza A (77%), with more circulation of A(H3N2) than A(H1N1)pdm09 (ratio>4:1). Influenza B comprised 23% of notifications (15). In 2017, influenza A also dominated but to a lesser extent [63%, ratio of A(H3N2): A(H1N1)pdm09, 4:1], while a greater proportion of cases were attributable to influenza B (37%) (4). This may partly explain the earlier peak in 2019, as influenza B usually presents later in the season. Both 2017 and 2019 had higher notification rates among children and older adults compared to other age groups. However, the notification rate was greater among children aged 5-9 years in 2019 than in 2017 (Figure 2). In addition, there were more cases among young adults aged 25-44 years in 2019, while elderly adults (≥85 years) were disproportionately affected in 2017.

Severity

Between April and September 2019, there were 3732 people admitted to sentinel hospitals due to influenza, and of those, 237 (6.4%) were admitted to ICU. For the same period in 2017, there were 3,536 hospitalisations with confirmed influenza and 315 (8.9%) of them were admitted to ICU. The Poisson 95% confidence intervals of the number of hospitalisations in the two years overlapped (3613-3854 vs 3420-3655) indicating they were not statistically significantly different, but a significantly higher proportion were admitted to ICU in 2017 (χ^2 16.9, $p<0.001$). A total of 705 influenza-associated deaths were notified between January and September 2019 (15), compared to 417 in 2017. However, this later reached 745 deaths in 2017, reflecting a later seasonal peak (22). These counts were not statistically significantly different (654-759 vs 692-800). The 2017 season had moderate clinical severity based on ICU admissions among hospitalised cases (4), and a similar clinical severity was reported for 2019 (23). Influenza contributes the majority of ILI during the season, and in 2019, ILI consultations in sentinel general practices nationally were 13.5 per 1000 during the peak week (week 23), compared to 23 per 1000 consultations in the 2017 seasonal peak (week 33) (4, 24). Again, the pattern differed across jurisdictions: in Western Australia the peak in ILI consultations in 2019 was almost double that in 2017 (14), in Victoria the ILI consultation rate was the same in both years (6.9/1000 consultations) (19, 25), and in NSW influenza admissions to sentinel hospitals were not significantly different in 2019 (917, 95% Poisson CI 859-978) (13) and 2017 (953, 893-1015) (12), while in Queensland there were significantly fewer admissions to public hospitals due to influenza in 2019 (3,012, 2905-3122) compared to 2017 (6,070, 5918-6225) (17, 18).

Vaccine types and effectiveness

The southern hemisphere influenza vaccine was reported to have had a good match in 2019 with the circulating strains (in particular to A(H1N1)pdm09 and B-Yamagata lineage), with some degree of mismatch reported for A(H3N2) strain and B-Victoria lineage in the season (15). Vaccine effectiveness of 40-60% was reported in 2019 (11). In 2017 there was poor vaccine match and effectiveness, with effectiveness of 10% (95% CI -16 to 31) against H3N2 and 33% (17 to 46) overall (5).

Discussion

The severity of influenza, as defined by numbers of hospitalised cases and ICU admissions, was similar in 2017 and 2019, but the proportion of hospitalisations admitted to ICU was lower in 2019. The number of influenza deaths reported in those two years was not significantly different. Notification rates were similar in 2017 and 2019 in all jurisdictions with the exception of Western Australia, which had notifications nearly four times higher in 2019 compared to 2017 (4). In Queensland, 2019 was significantly less severe (17). The large numbers of influenza notifications in both years suggest that there was more widespread than average circulation of influenza in these years. We have shown that there were no statistically significant differences in the number of reported hospitalisations and deaths between 2017 and 2019; but proportion of ICU admissions was significantly higher during the 2017 season. However, while the total number of notifications for the 2019 season is greater than in 2017, data on numbers of tests performed and positivity rates suggest that overall the 2019 influenza season might be similar to or lesser activity than 2017 (11, 21).

Although influenza can affect all ages, different influenza types impact certain populations or age groups more than others (26-29). Influenza A tends to have greater impact on young children and older adults, while influenza B has a greater effect on older children (26). A(H1N1)pdm09 virus reportedly results in higher disease burden among younger adults aged <65 years (28), in contrast to A(H3N2) virus, which primarily affects older adults. Although A(H3N2) was the dominant strain in the circulation in both 2017 and 2019, lower notification rates were observed among older adults in 2019 compared to 2017. This difference in age profile of notifications is not expected given that A(H3N2) predominated in both years. The expected epidemiology for A(H3N2) would be peaks of incidence at the extremes of age (U-shaped distribution by age), so 2019 displayed an unusual peak in young adults, which is more like the W-shaped curve expected for pandemic age-specific epidemiology. The reasons for this are unclear, and cannot be attributed to enhanced vaccines, as these would be expected to blunt the incidence in older people, not to increase the incidence in younger people.

In 2019 there was unprecedented inter-seasonal influenza activity from January to May during summer and autumn when activity is usually very low, followed by an early peak. We have previously shown that the apparent trend of increasing inter-seasonal influenza activity over time is not reflected in hospitalization data, and probably reflects increased testing (30). In 2019 however, while early diagnoses may have contributed towards increased awareness in the community (31, 32) and increased influenza testing by general practitioners, the high notification rates in the inter-seasonal period appear to reflect a true increase in inter-seasonal activity. In contrast to 2017, when vaccine effectiveness was low, a good vaccine match with higher vaccine effectiveness was estimated for 2019 influenza season. Again, it is not known whether the improved vaccine effectiveness in 2019 can be attributed to the use of enhanced influenza vaccine and/or a better vaccine match for the season, or a combination of both.

In summary, 2019 and 2017 influenza seasons appear to have had a similar impact; however, 2019 had an unusual inter-seasonal pattern with regional variation and a W-shaped age-specific epidemic curve. The reasons for this unusual epidemiology are unclear.

Competing Interests

Robert Menzies is Senior Medical Manager, Sanofi Pasteur. Other authors declare no competing interests.

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