



Australian Government
Department of Health

COMMUNICABLE DISEASES INTELLIGENCE

2019 Volume 43
<https://doi.org/10.33321/cdi.2019.43.15>

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Communicable Diseases Intelligence

ISSN: 2209-6051 Online

This journal is indexed by Index Medicus and Medline.

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Abstract

Flutracking is a national online community influenza-like illness (ILI) surveillance system that monitors weekly ILI attack rates and seriousness of disease in the Australian community. This article reports on the 2016 findings. From 2015 to 2016 there was an 11.4% increase in participants to 30,998 completing at least one survey with a peak weekly response of 27,094 participants and a minimum weekly response of 26,123. The 2016 Flutracking national weekly percentage of participants with fever and cough peaked in late August at 2.7%, one week earlier than the national counts of laboratory confirmed influenza peaked. A lower percentage of participants took 2 or more days off from work or normal duties and sought medical advice in 2016 (peak level 1.6% and 1.0% respectively) compared with 2015 (peak level 2.0% and 1.3% respectively). Flutracking fever and cough peaked in the same week as death rates for influenza and pneumonia recorded by the NSW Registry of Births, Deaths and Marriages. The percentage of participants aged 0 to 14 years with cough and fever was higher than all other age groups in 2016. Overall, Flutracking surveillance demonstrated that the attack rates and seriousness of disease for the 2016 season at the community level were lower than 2015 and 2014.

Keywords: influenza, surveillance, syndromic surveillance, influenza-like illness, survey, Flutracking.

Introduction

Flutracking provides weekly community level influenza-like illness (ILI) surveillance that is

Key Highlights

- Demonstrated success in targeted rural recruitment campaign
- Attack rates and seriousness of disease for the 2016 season at the community level were lower than 2015 and 2014.
- Flutracking ILI activity peaked in the same week as death rates for influenza and pneumonia.
- The percentage of Flutracking participants with fever and cough that were tested for influenza has increased each year from 1.6% in 2013 to 2.9% in 2016.
- The Flutracking participant base has continued to grow in 2016 to 30,998 participants.

not biased by health seeking behaviour, clinician testing practices or differences in jurisdictional surveillance methods.¹⁻⁴ Flutracking provides an indication of differential ILI attack rates by age and geography, and seriousness of disease at a community level.^{5,6} The Flutracking surveillance system has been incorporated into the weekly Australian Influenza Surveillance Report since 2009.⁷

The main aims of Flutracking are to:

1. contribute community level influenza surveillance to the broader surveillance picture of influenza in Australia;
2. provide consistent surveillance of influenza

attack rates across all jurisdictions and over time; and

3. provide year-to-year comparison of the timing, attack rates, and seriousness of influenza on the community.

In this report, we

- describe the epidemiology of ILI and influenza vaccination in the community for 2016;
- describe the performance characteristics of the Flutracking system; and
- compare Flutracking estimates with notifications for confirmed influenza and death rates for influenza and pneumonia in the 2016 season.

Methods

The Flutracking surveillance system operated for 25 weeks in 2016, from the week ending Sunday 1 May to the week ending Sunday 16 October 2016. In 2016, the recruitment drive was from 14 April to 12 May. Participants may opt out at any time. Recruitment methods in 2016 were similar to those used in 2007–2015.^{1,8,9,10}

The weekly survey questions evolved from 2007–2012.^{1,8} In 2016, in an attempt to reduce the number of unknown influenza laboratory test results, we followed up participants who reported that they had a laboratory test, but did not yet know the result. A follow up question was added at 1, 3, and 5 weeks after participants reported having an influenza test, to ask if they had received the test result yet. Participants who reported an unknown test result in the last 5 weeks of the Flutracking season have less opportunity to receive follow up reminders than participants who reported an ‘unknown’ test result in prior weeks as the survey period is concluded. Therefore, we sent a separate email to these participants to request test results 6 weeks after their initial survey and after the final and concluding survey of the season. The percentage of Flutracking participants with fever and cough

that tested positive for influenza was adjusted in 2014 and 2015 (increased by 18%) to account for 2016 laboratory test results being collected over 5 weeks whereas in 2015 (and prior years) laboratory test results were collected in the first week of ILI only. The adjustment factor of 18% was calculated using the difference between the average weekly percent positivity for 2016 without the 1, 3, and 5 week follow up and the average weekly percent positivity for 2016 with follow up.

Because respondents answered ‘no’ to fever or cough in over 95% of surveys for every household member, in 2016 we trialled an express survey to reduce the burden of participants responding on behalf of other household members. An express survey was offered to a random sample of participants (every participant identification number that was divisible by 7) who were responding on behalf of other household members participating in Flutracking. The express survey was offered in place of the traditional weekly survey to assess how a quicker survey impacted upon weekly participation rates and reported ILI percentages. The express survey contained 2 questions asked weekly: ‘Did you or <Participant 2> or < Participant n> have fever or cough?’; ‘Did you or <Participant 2> or < Participant n> have an influenza vaccine this year?’ A response of ‘yes’ or ‘don’t know’ to either question triggered more detailed survey questions.

From 2014 onwards, once participants have finished their current survey, they have been able to click on any prior surveys from the past 5 weeks to complete.

Descriptive statistics

Descriptive statistics were tabulated and summarised for each state and territory, by age group, gender, education level, Aboriginal and Torres Strait Islander status, and vaccination status.

A participant was defined as anyone who has a survey submitted by them self or on their behalf. A respondent was anyone who submits a survey either for themselves or on behalf of a household member.

The participation rate for state and territory, age group, and gender was calculated using the Australian Bureau of Statistics June 2016 Estimated Resident Population.¹¹ The participation rate for education level was calculated using the 2011 Australian Census data¹², and the participation rate for Aboriginal and Torres Strait Islander status was calculated using June 2011 population estimates¹³.

Unless otherwise stated, a participant with ILI was defined as having both self-reported fever and cough, and both unvaccinated and vaccinated participants were included in ILI analyses. For all ILI analyses any responses of 'don't know' for the 'fever' or 'cough' or 'influenza vaccination status' variables were removed from analysis. This removed 0.9% of all surveys for these analyses. In 2016, reporting of ILI was changed from a prevalence measure to an incidence measure. This adjustment resulted in a weekly average incidence of 2.1% compared to a calculated prevalence of 2.8%. For ILI percentage calculations, the numerator was all persons who completed a survey for the current week and reported new ILI symptoms, and the denominator was all persons who completed a survey for the current week. Where there were consecutive weeks of reporting ILI symptoms, the first week of new symptoms was the incident week. If a person reported ILI symptoms in one week, and then reported at least one week of no symptoms, followed by another report of symptoms, then this second symptom report was considered a new case of ILI.

In 2016, to allow for the delay between receiving influenza vaccination and onset of immunity, the analytic definition for influenza vaccination status was also adjusted. A participant was considered to be effectively vaccinated 2 weeks after they reported to be vaccinated. The exception to this was in the first survey of the year for each participant (for example, if a participant reported having been vaccinated in 2016 prior to commencement of Flutracking surveys or in the week ending 1 May 2016 then their initial vaccination status was retained for all survey weeks).

Weekly ILI percentages were compared by self-reported vaccination status for participants. The unstratified (by vaccination status) ILI percentages were also compared with national laboratory confirmed influenza notifications for 2009 to 2016, and rates of deaths for influenza and pneumonia in NSW for 2011 to 2016. Counts of influenza and pneumonia death registrations were obtained from the NSW Registry of Births, Deaths and Marriages held in the SAPHaRI Death Registration Unit Record File data asset, Centre for Epidemiology and Evidence, NSW Ministry of Health. Weekly death rates were calculated using mid-year estimated resident population for each year¹¹.

We compared the weekly percentage of participants from 2011 to 2016 who had "fever and cough and 2 or more days off work or normal duties" to the weekly percentage of participants from 2011 to 2016 who "visited a general practitioner, emergency department or were admitted to hospital due to fever and cough".

The average weekly percentage of Flutracking participants with fever and cough that were tested for influenza was compared across states and territories from 2014 to 2016.

The cumulative incidence of ILI (fever and cough) was calculated for 2016, at the national level, by age group. Only the first ILI episode of the 2016 season for each participant was included in this analysis. Participants were only included in this analysis if they completed all 25 weeks of surveys in 2016. If a participant changed age groups part way through the season, then they were included in the age group that they had completed most surveys in. Where a participant completed an equal number of weeks in more than one age group, then the age group that participant was in at the start of the 2016 season was used.

Results

Recruitment in 2016

Participants were encouraged to join at any time during the year. Similar to previous years, the most successful recruitment strategy in 2016 was recruitment through invitations forwarded by previous participants. Eighty one percent (22,250) of participants from the 2015 season participated at least once in 2016. The 2015 participants comprised 72.7% of the 2016 participants. From 1 January to 20 April 2016, 267 people had joined. Prior to launching recruitment in April, the mean number of joins per week in January to March 2016 ranged from 1 to 5 participants

On 27 and 28 April 2016, an email was sent to all active participants (20,320 respondents) requesting respondents invite friends to join the survey. On 27, 28 and 29 April 2016, respectively 253, 1,283 and 706 participants joined. A further 651 participants joined on 2 May, 226 participants joined on 9 May, and 384 participants joined on 16 May: these spikes correspond to the dates the first, second and third Flutracking survey emails were sent to respondents.

With a view to improve rural participation in Flutracking and granularity of ILI data, on 30 June 2016 an email was sent to 5,805 respondents with less than 20 participants in their postcode, requesting them to invite local friends. On 30 June 2016, 1 July 2016 and 4 July 2016, respectively 307, 300 and 178 participants joined (Figure 1). Of the 1,258 targeted postcodes, 18 reached 20 or more participants in the 4 weeks following this email.

To improve representation of Aboriginal and Torres Strait Islander participants in Flutracking data, on 11 August 2016, an email was sent to 255 existing Aboriginal and Torres Strait Islander participants, asking for participants to post 'join www.flutracking.net to help track flu' to social media, forward the email to friends inviting them to participate in Flutracking, or ask their workplace to invite employees to participate. On

11 August 2016, 12 August 2016 and 15 August 2016, respectively 8, 3, and 7 Indigenous participants joined.

As a result of the above recruitment strategies and media coverage a total of 8,609 participants joined the survey in 2016, compared with the 9,987 that joined in 2015.

Participation in 2016

At least one survey was completed by 18,194 respondents and 12,804 household members for a total of 30,998 participants. Of the 28,251 participants who completed a survey during the first 4 survey weeks, 63.6% completed all available surveys, and 79.2% completed more than 90% of available surveys.

There was an 11.4% increase in the number of participants who completed at least one survey in 2016, compared with 2015 (Figure 2). At a state and territory level, increases in peak weekly participation were most marked in the Australian Capital Territory, Victoria and New South Wales. Notably Western Australia had a decrease in participation from 2015 to 2016. In 2016, Tasmania had the highest rate of Flutracking participation per 100,000 persons, followed by the Northern Territory and the Australian Capital Territory. New South Wales, Victoria, and Queensland all had lower rates of participation than the general Australian population (Figure 3 and Appendix A).

Socio-demographic characteristics

Of the participants who completed at least one survey in 2016 and completed the demographic questions (87.4% of participants completed all demographics relevant for their age), 58.3% were aged 35–64 years, 60.7% were female, 62.8% had completed a bachelor degree, graduate diploma or certificate or postgraduate degree, and 1.5% identified as Aboriginal and/or Torres Strait Islander (Appendix B).

Express survey evaluation

There was a slightly lower survey completion rate for the express survey compared to the non-express survey in participants who had joined prior to the start of the 2015 season (88.8% and 89.7%, respectively). There was a slightly higher survey completion rate for the express survey compared to the non-express survey in participants who had joined in 2016 (82.6% and 80.3%, respectively).

There were similar ILI percentages (total number of ILI cases for the year/total number of surveys for the year) for the express survey compared to the non-express survey in participants who had joined prior to the start of the 2015 season (2.1% and 2.0%, respectively). There was a much lower ILI percentage for the express survey compared to the non-express survey in participants who had joined in 2016 (2.1% and 2.6%, respectively).

Time to respond to survey each week

Most participants responded within 24 hours of the survey being sent, with a mean 24 hour

response of 72.9% over the 25 weeks. The 65 years or over age group had a mean 24 hour response of 80.9% over the 25 weeks which was the highest of all age groups.

Percentage of participants vaccinated

Seasonal vaccination levels among participants were similar from 2013 to 2016. At the final survey of each participant for 2016, 58.4% (18,088/30,998) of participants had received the 2016 seasonal vaccine, compared with 59.9% (16,676/27,828) of participants by the end of 2015. Of the 6,159 participants who identified as working face-to-face with patients in 2016, 4,881 (79.2%) received the vaccine compared with 80.0% by the end of 2015. In 2016, 17.8% (422/2,376) of participants less than 10 years of age were vaccinated with the seasonal influenza vaccine by the end of the season, compared with 17.2% in 2015 (Figure 4).

Figure 1: Significant Flutracking recruitment events and impact, 2016

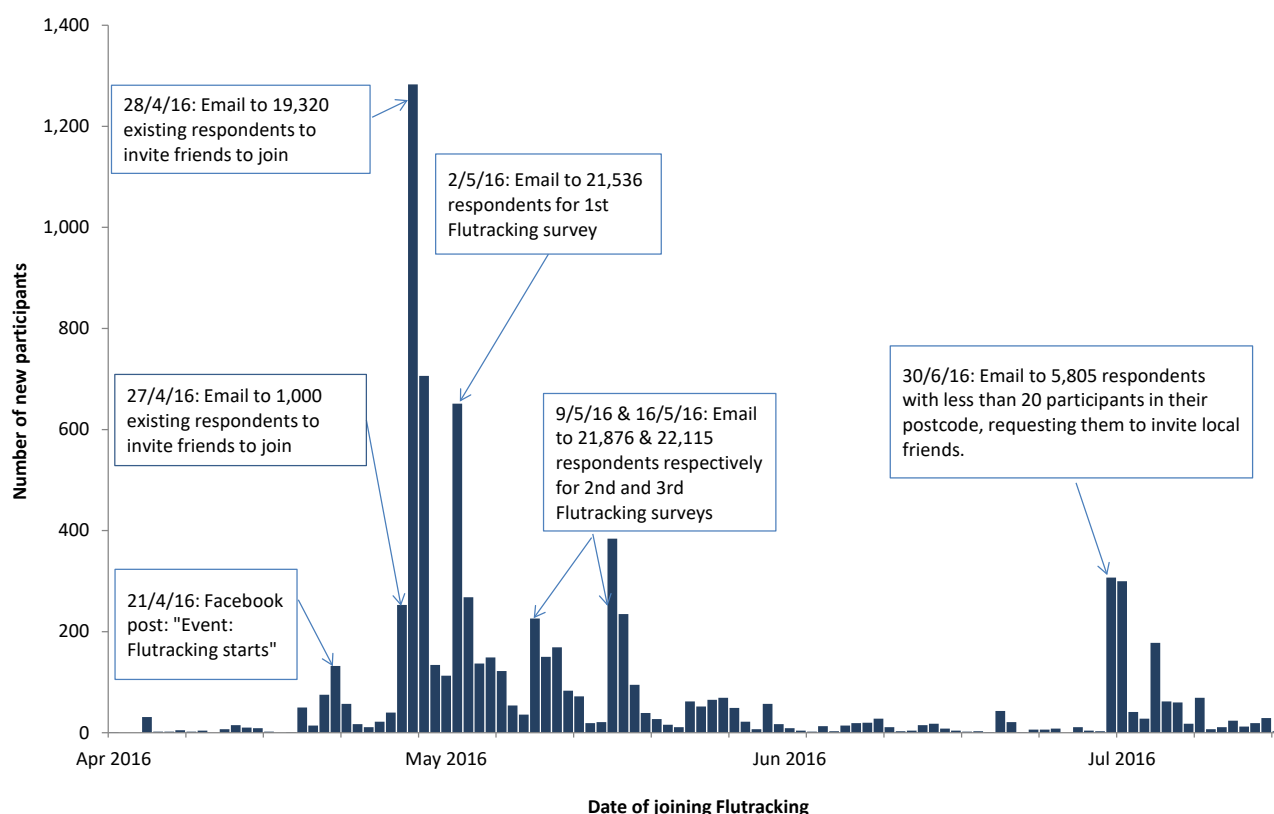


Figure 2: Number of participants who completed at least one survey, Australia, 2006 to 2016, by year

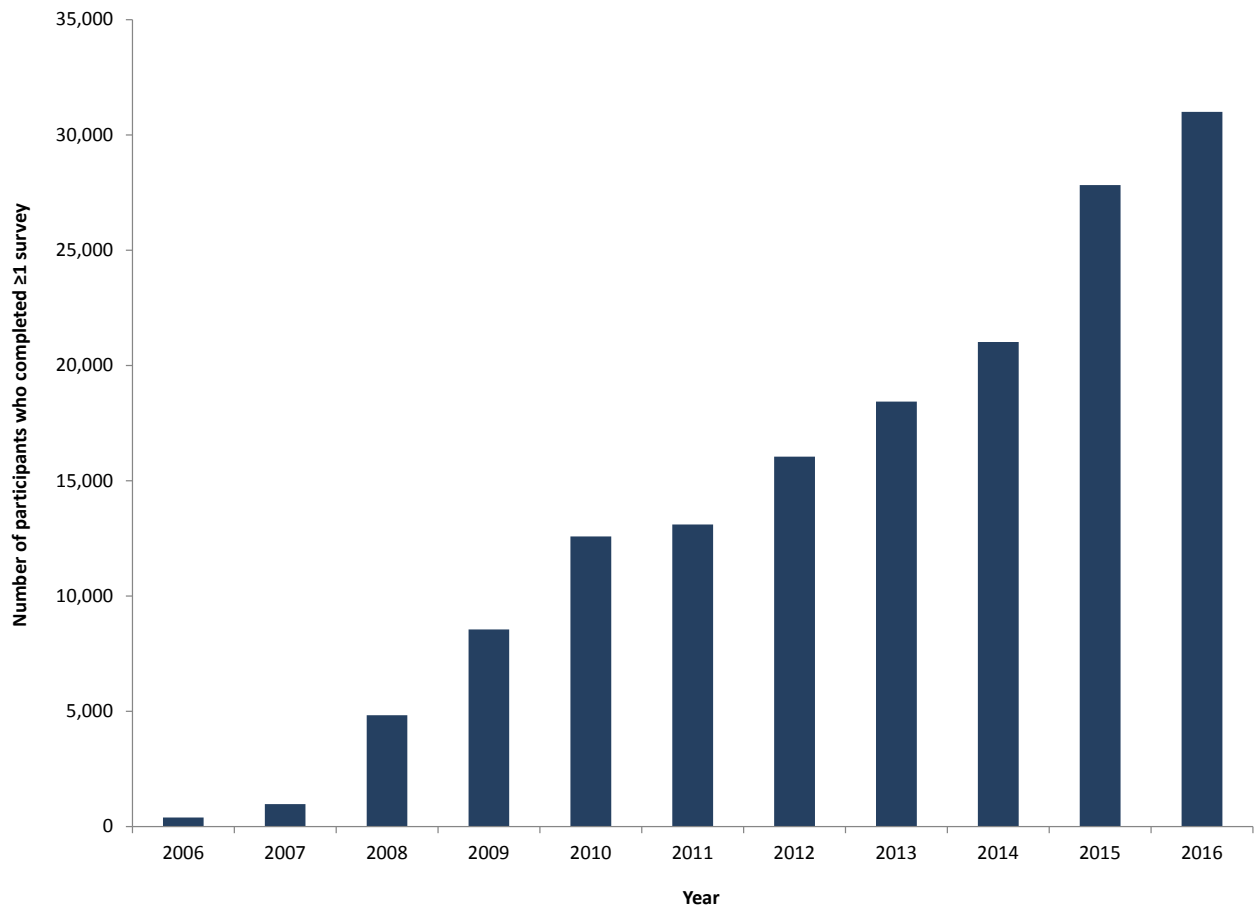


Figure 3: Flutracking participation per 100,000 population for participants who completed at least one survey, Australia, 2016, by state/territory.

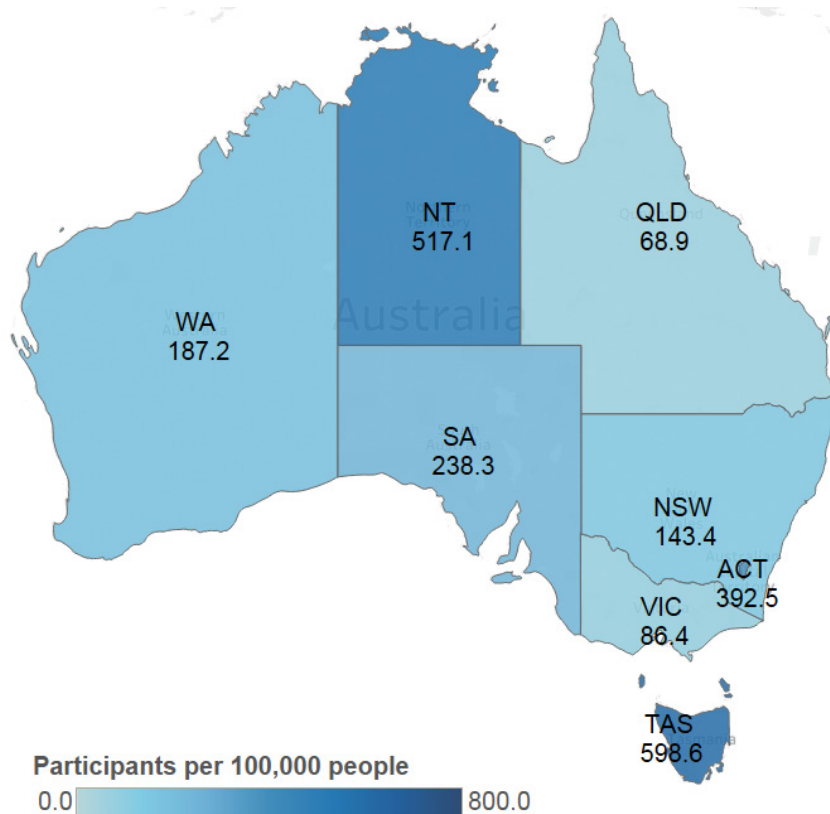
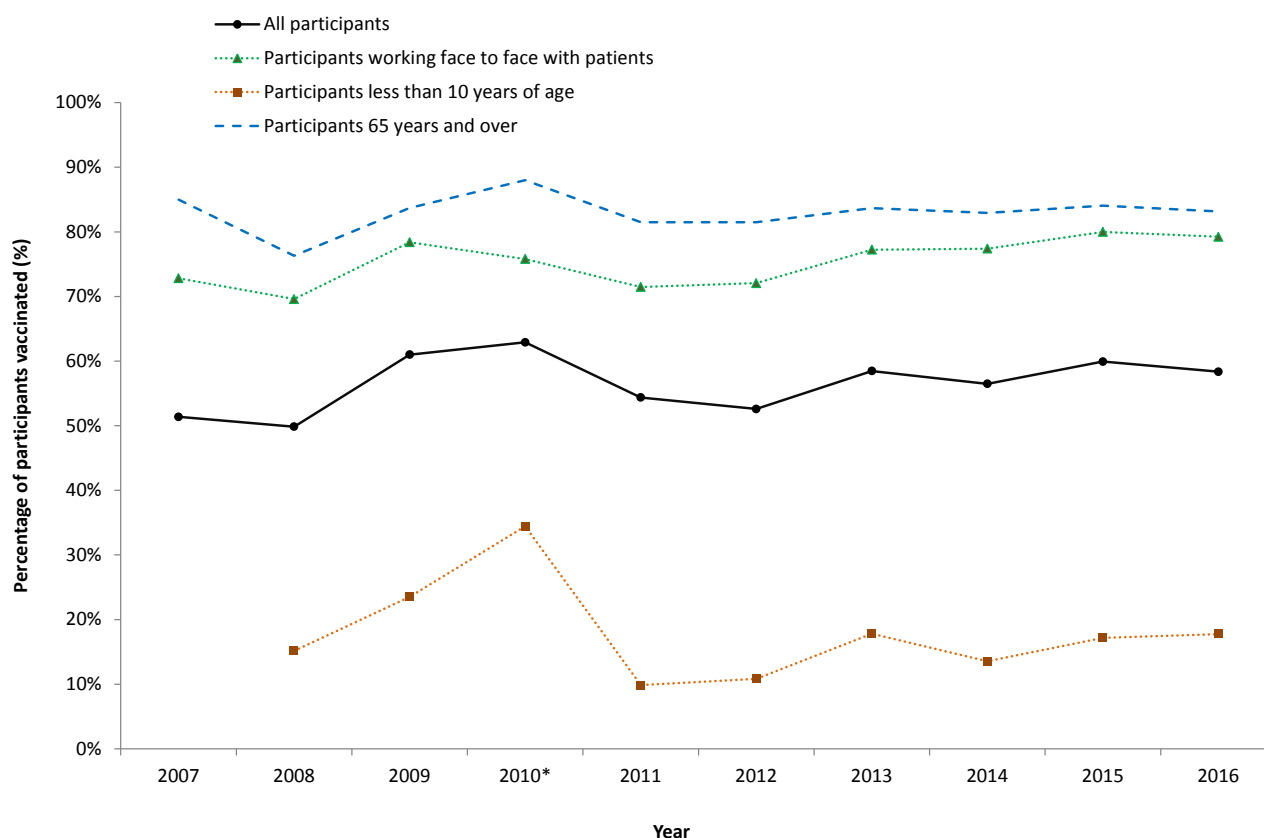


Figure 4: Percentage of participants vaccinated with the seasonal influenza vaccine at the final survey of each participant, by participant characteristics, Australia, 2007 to 2016, by year



* This percentage calculation for 2010 included participants who received either the monovalent H1N109 influenza vaccine in 2009 or 2010, or received the 2010 seasonal influenza vaccine.

Percentage of participants with influenza-like illness symptoms

Of participants who completed a survey in the national peak week of ILI for 2016, 2.7% reported fever and cough compared with 3.1% in 2015 and 3.4% in 2014. Of participants who completed at least one survey in the national peak 4 weeks of ILI for 2016, 9.6% reported fever and cough, compared with 10.7% in 2015 and 11.5% in 2014.

Detection of influenza-like illness

Figure 5 shows the 2009 to 2016 weekly ILI percentages by vaccination status. Peak ILI activity for 2016 for the unvaccinated group was during the week ending 14 August (3.0%), and for the vaccinated group was during the week ending 28 August (2.5%). Divergence between the vaccinated and unvaccinated participants' ILI

percentages was highest during the week ending 14 August (3.0% in the unvaccinated group and 2.3% in the vaccinated group).

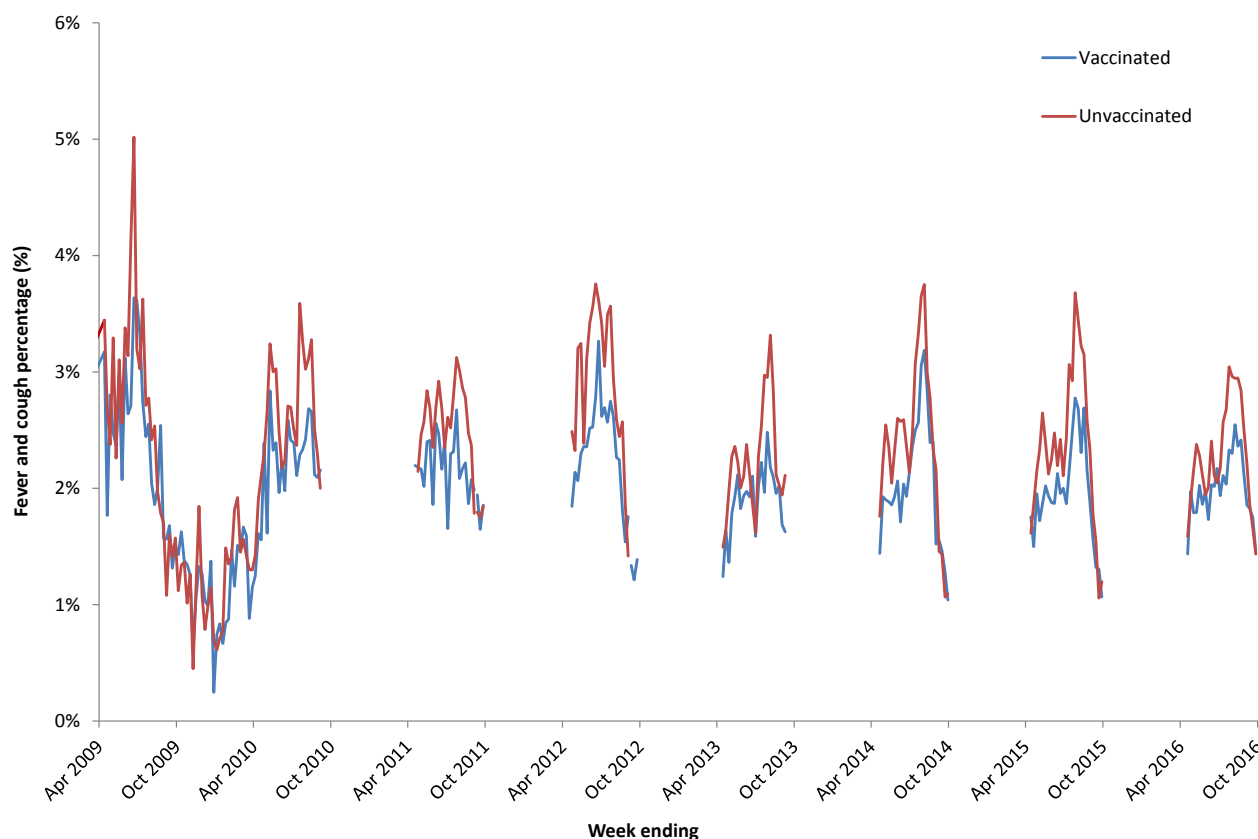
Comparison with national laboratory influenza notifications

There was a decrease in both the peak number of laboratory confirmed cases of influenza reported to the National Notifiable Diseases System and the peak Flutracking ILI percentage unstratified by vaccination status from 2015 to 2016. In 2016, Flutracking ILI levels peaked one week earlier than laboratory notifications of influenza (Figure 6).

Percentage of self-reported laboratory influenza tests

There was considerable diversity of rates of testing across jurisdictions. The average weekly percentage of Flutracking participants with

Figure 5: Fever and cough percentage stratified by vaccination status, Australia, 2009 to 2016, by week



fever and cough that were tested for influenza has increased each year from 2013 to 2016 at the national level, with small increases from 2014 (2.6%) to 2016 (2.9%). This trend was also seen in New South Wales, Queensland, South Australia, and Tasmania. Testing was also at its highest level since 2013 for Northern Territory (Figure 7).

Time off work or normal duties and health seeking behaviour

The peak weekly percentage of participants taking time off work or normal duties was 1.6% in 2016 and 2.0% in 2015, while the peak weekly percentage of participants seeking health advice was 1.0% in 2016 and 1.3% in 2015 (Figure 8).

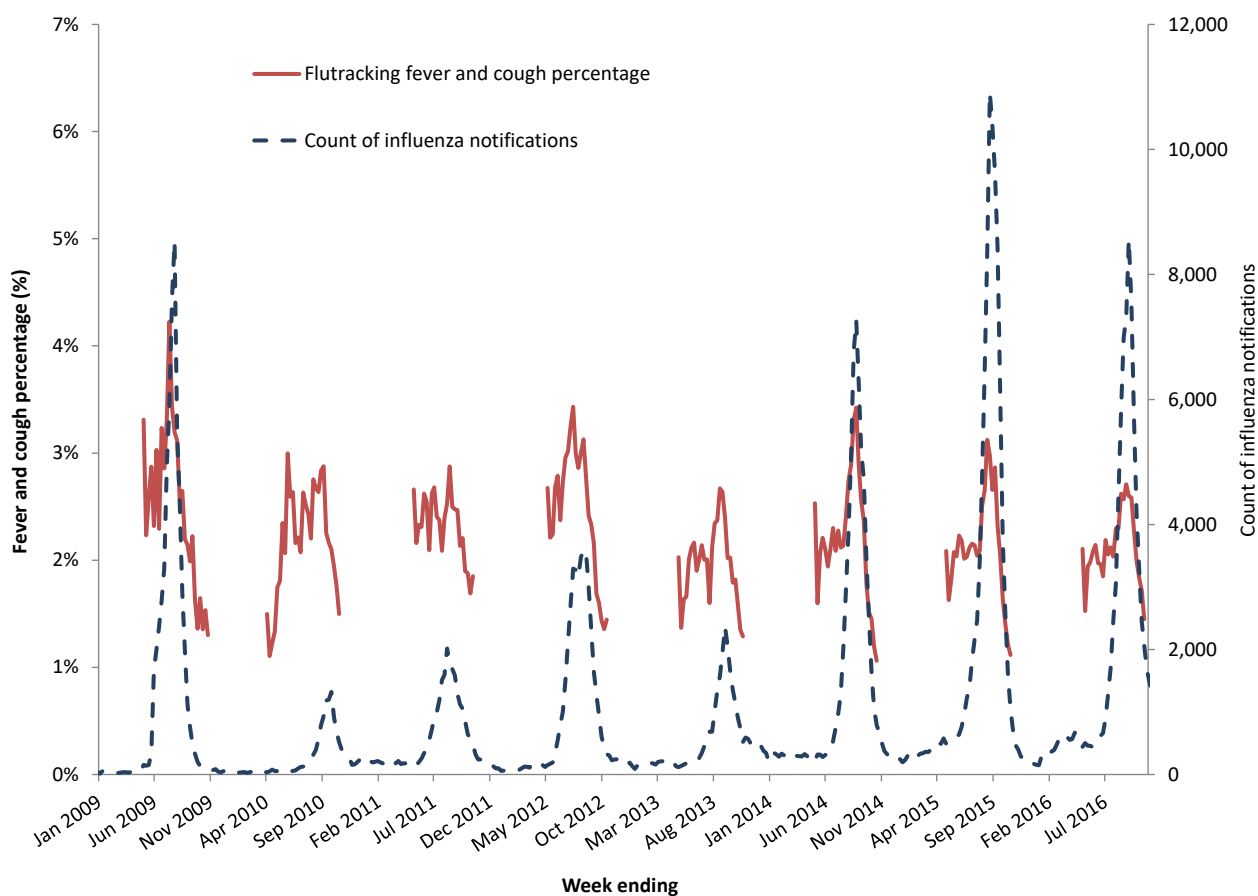
Comparison of Flutracking influenza-like illness with deaths with pneumonia or influenza reported on the death certificate

The peak rate of deaths classified as caused by pneumonia and influenza was similar in 2016 to 2015, and lower than 2014. In 2016 the timing of the peak week of NSW Flutracking ILI levels (fever and cough) was the same as the timing of the peak week of pneumonia and influenza deaths (week ending 11 September 2016) (Figure 9).

Percentage of participants with influenza-like illness by age group

The highest percentage of Flutracking participants with cough and fever was in those aged 0 to 14 years (Figure 10).

Figure 6: Fever and cough percentage, 1 April to 31 October* compared with national influenza laboratory notifications, Australia, 2009 to 2016, by week



* Not stratified by vaccination status.

Cumulative incidence of influenza-like illness

The cumulative incidence of ILI for 2016 was highest in children, especially those aged 0-4 years (63.3%), and lowest in those aged 65 years or older (23.2%). There was a mostly linear change in cumulative incidence for all age groups, with a sharper rise in ILI during May/June for the 0-4 years age group (Figure 11).

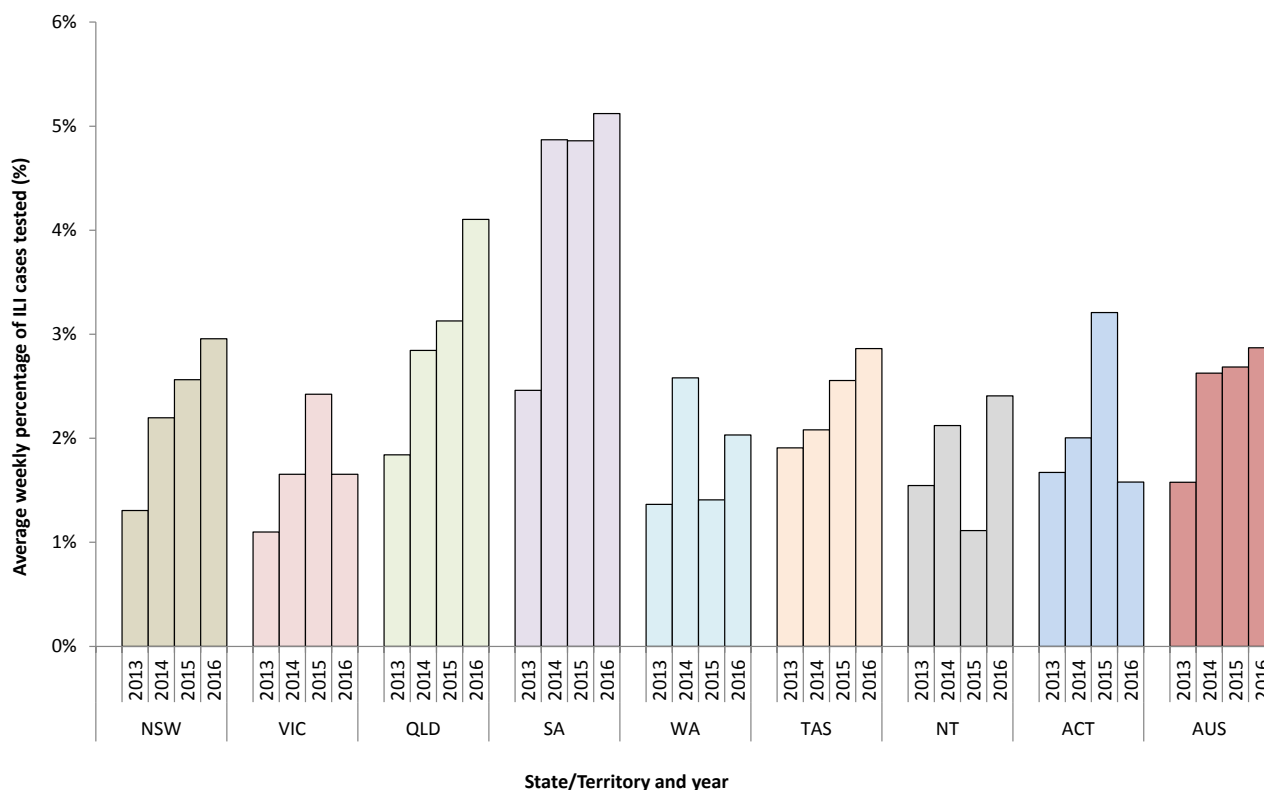
Discussion

The number of participants enrolled in Flutracking has increased each year from 394 participants in 2006 to 30,998 participants in 2016. Over 50% of the national increase in participation in 2016 may be attributed to participants joining in New South Wales (NSW). The highest proportion of Flutracking participants in 2015 were from NSW, and dissemination of email invitations to friends, fam-

ily and work colleagues of existing participants was the most effective method of recruitment. Western Australia was the only state/territory to have a decrease in participation from 2015 to 2016 (10.8% decrease). In 2015, the Western Australian Department of Health encouraged employees to sign up to Flutracking to participate in a vaccine effectiveness (VE) study. As most new participants from 2015 only signed up for the purpose of the VE study, it was expected that participation numbers may decline in Western Australia in 2016.

As highlighted in the 2015 annual report⁶, the recruitment strategies in 2016 were similar to prior years, with additional targeted recruitment for Indigenous participants and participants from postcodes with small numbers. There is still under-representation of participants in the 0-34 years and 65 years or over age groups, males, participants with non-tertiary education and Aboriginal and Torres Strait Islander

Figure 7. Average weekly percentage of Flutracking participants with fever and cough that were tested for influenza, by state/territory, 2013-2016.



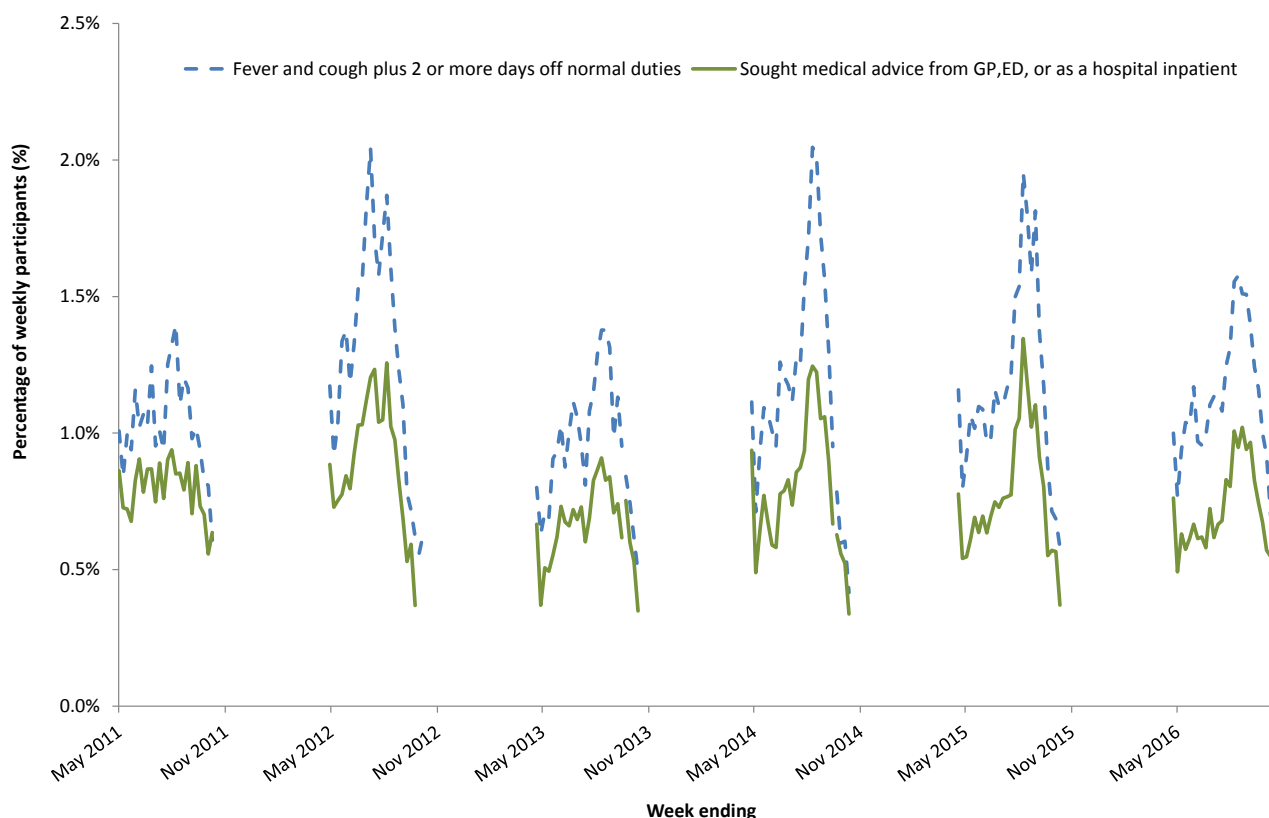
participants. A 2017 recruitment campaign is underway liaising with Indigenous community representatives, and targeting social media messages to potential Aboriginal and Torres Strait Islander participants, and future 2017 recruitment will target the remaining underrepresented demographic groups.

Comparing the express survey and non-express survey provided little evidence of improved response rates for the shorter survey. The lower ILI percentage for the express survey compared to the non-express survey in participants who had joined in 2016 may reflect an underestimate of ILI as there is no prompt for asking about each family members' symptoms.

Based on Flutracking fever and cough weekly percentages, the peak community ILI levels in the 2016 season were lower than the peak community ILI levels in the 2014 and 2015 seasons. There was also a decrease in national influenza laboratory notifications from 2015 to 2016, supporting this decrease in community level ILI. Flutracking analyses also suggest lower levels

of time off work or normal duties and health care seeking behaviour at the national level in the community in 2016, as compared to 2015. At the NSW level, the peak rate of deaths attributed to influenza and pneumonia suggested that the 2015 and 2016 seasons were not meaningfully different. There were 5,153 deaths reported in association with influenza and pneumonia in 2016 compared to 5,052 in 2015. Overall, the rate of deaths associated with influenza and pneumonia was slightly higher in 2016 than in 2015¹⁴. This suggests that while community attack rates and health seeking behaviour for ILI was lower in 2016, the impact on those who had confirmed influenza may have been slightly more severe. While the 2015 influenza season was marked by a transition to predominantly influenza B strain circulation⁷, circulation of influenza A dominated the 2016 season at both the NSW and national level. Influenza A(H1N1)pdm09 predominated the season up to July, with influenza A(H3N2) dominating from July onwards⁷. A(H3N2) is typically more prevalent

Figure 8: Influenza-like illness severity, Australia, 2011 to 2016, by week*



* The denominator is the number of weekly participants.

in the elderly than other age groups¹⁵, which may explain this slight increase in severe outcomes from influenza in 2016.

In summary, Flutracking attack rates and seriousness of disease during the 2016 season at the community level was less than 2015 and 2014. The comparison of NSW mortality rates from pneumonia and influenza appear to align with the timing and severity of Flutracking ILI data which is interesting considering they are tracking influenza related illness at different ends of the severity spectrum. We will continue to explore this correlation with adjustment for age and other markers of severity.

Figure 9: Percentage of Flutracking participants with fever and cough compared with the rate of deaths classified as influenza and pneumonia per 100 000 NSW population, NSW, 2011 to 2016, by week

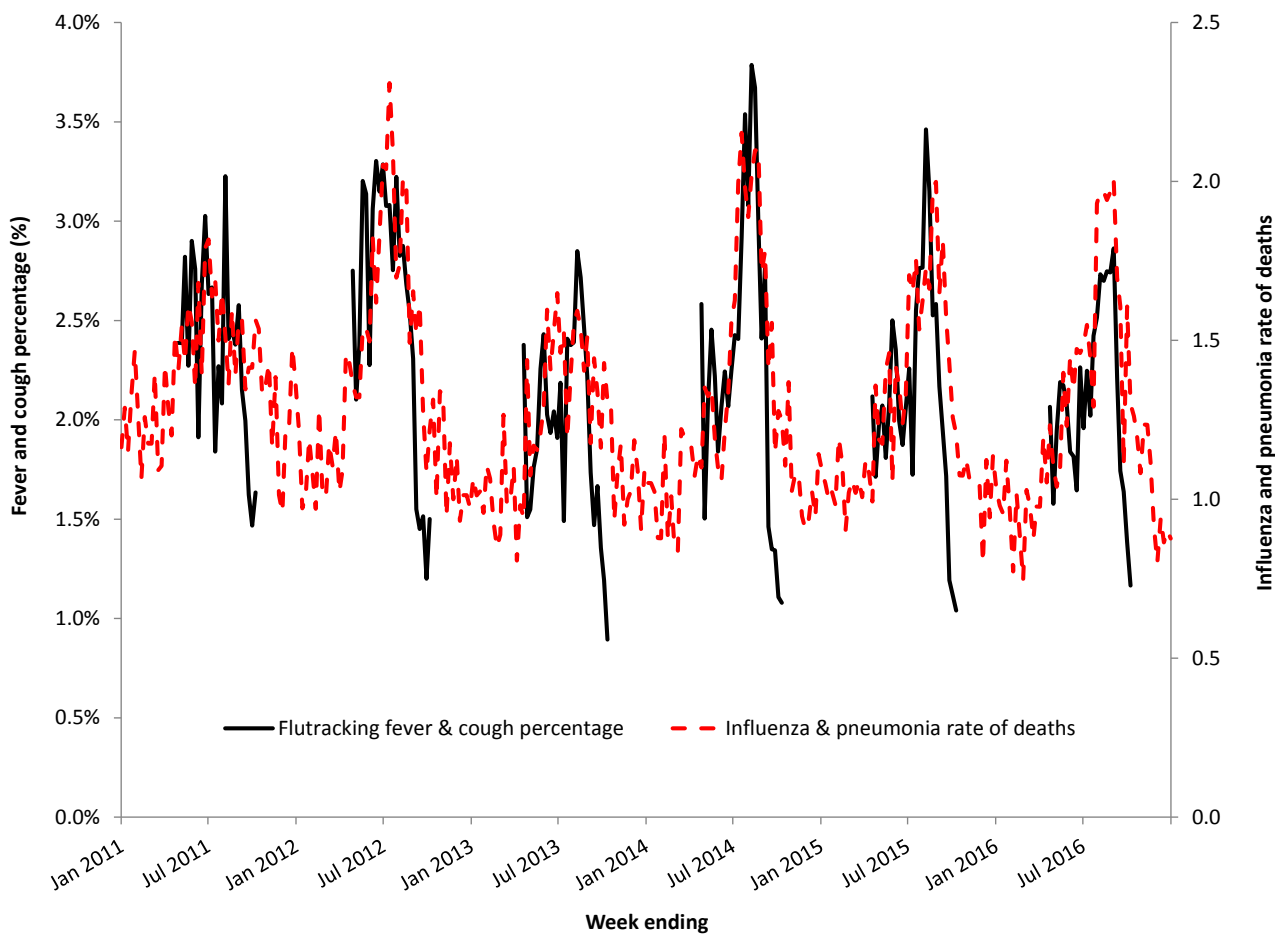
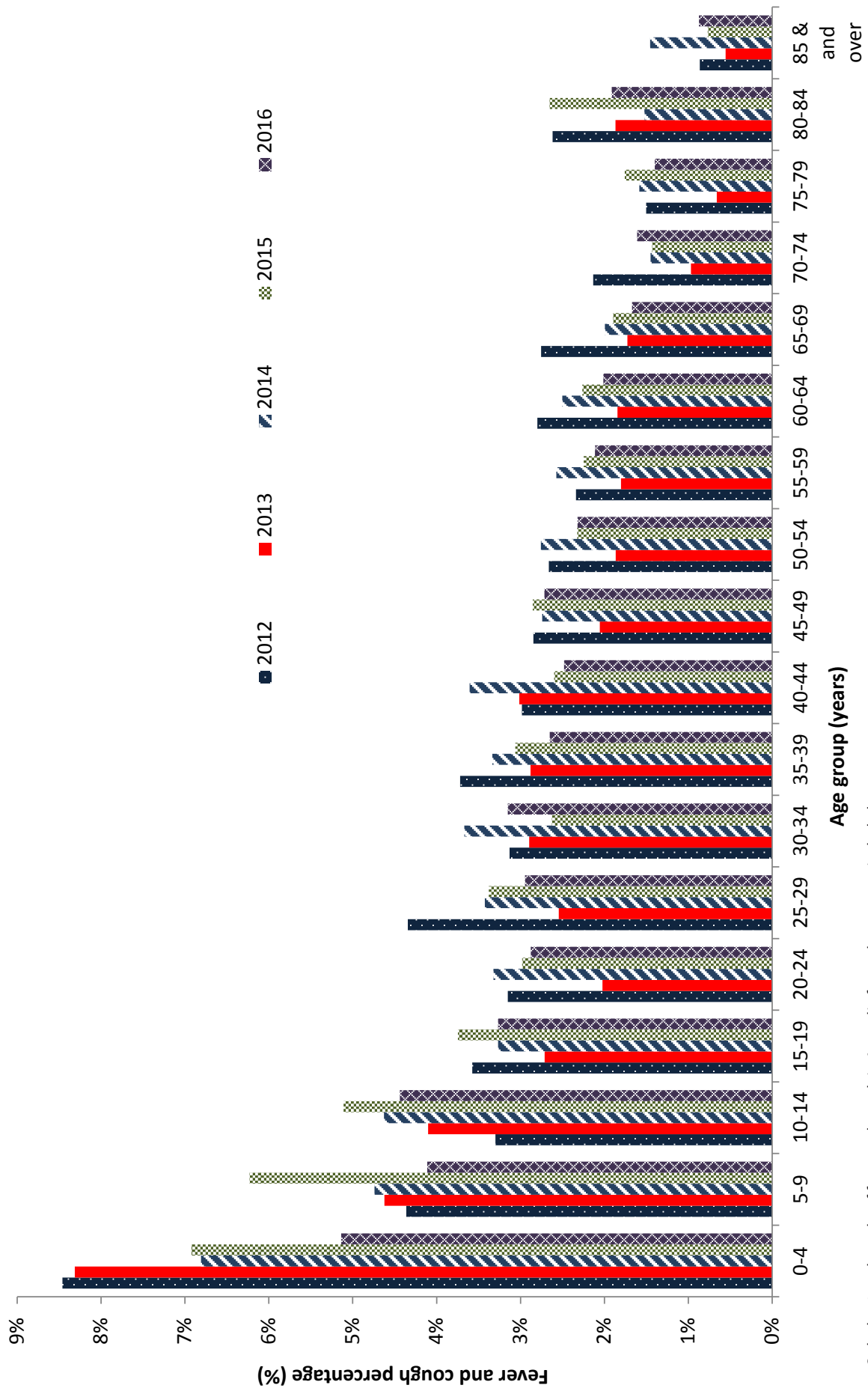
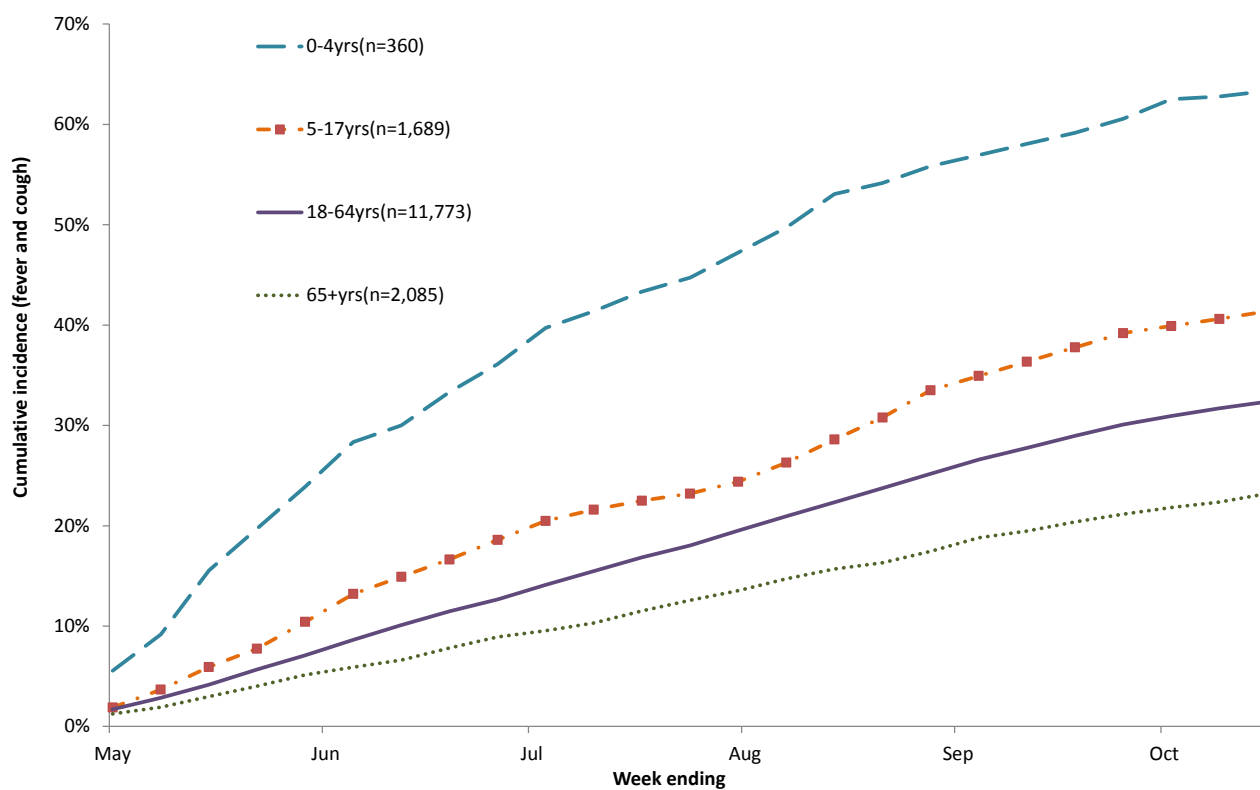


Figure 10: Percentage of participants with fever and cough episodes, by year and age group, Australia, 2012 to 2016*



* Only the 4 peak weeks of fever and cough in Australia for each year were included.

Figure 11: Cumulative incidence of influenza-like illness, by age, Australia, April to October, 2016, by week*



* Only first ILI episode of each participant for the 2016 season were included.

Competing interests

All authors declare that they have no competing interests.

Acknowledgements

The authors would like to acknowledge the University of Newcastle for their continued support, and the Australian Government Department of Health and the Hunter Medical Research Institute for their funding and support. We would also like to acknowledge Stephen Clarke for software and database development, and John Fejsa for his contribution to the design of the project, and the thousands of Flutracking participants who give their time freely each week to contribute to influenza surveillance.

Author contributions

Craig Dalton conceived and designed the project, oversaw the statistical analysis, and contributed to writing of the manuscript. Sandra Carlson contributed to the writing of the manuscript and the statistical analysis. Daniel Cassano contributed to the writing of the manuscript and the statistical analysis. David Durrheim contributed to the design of the project and writing of the manuscript. Michelle Butler also contributed to the statistical analysis.

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Appendix A: Recruitment to Flutracking, 2015 and 2016, by state or territory

State or territory	2015			2016			% Distribution of Aust. population	Percentage change
	Number of participants (peak week)	Flutracking participation per 100,000 population	Per cent of participants (peak week)	Number of participants (peak week)	Flutracking participation per 100,000 population	Per cent of participants (peak week)		
NSW	7,525	97.4	30.0	8,643	111.9	31.9	32.0	14.9
Vic	3,482	57.4	13.9	4,002	66.0	14.8	25.2	14.9
Qld	2,283	47.1	9.1	2,594	53.5	9.6	20.1	13.6
SA	3,355	196.4	13.4	3,471	203.2	12.8	7.1	3.5
WA	4,041	154.4	16.1	3,604	137.7	13.3	10.8	-10.8
Tas	2,368	456.2	9.4	2,635	507.6	9.7	2.2	11.3
NT	954	389.5	3.8	921	376.1	3.4	1.0	-3.5
ACT	1,062	268.1	4.2	1,224	309.0	4.5	1.6	15.3
Total	25,070	103.9	100.0	27,094	112.3	100.0	100.0	8.1

Appendix B: Socio-demographic characteristics of Flutracking participants who completed at least one survey during 2015 and 2016

	2015			2016			% Distribution of the Australian population
	Frequency	Per cent	Rate per 100,000*	Frequency	Per cent	Rate per 100,000	
Age (years)							
0–15	3,547	12.4	73.5	4,100	12.9	84.9	20.0
16–34	5,300	18.6	82.3	5,479	17.3	85.1	26.7
35–49	7,284	25.6	150.4	7,877	24.9	162.7	20.2
50–64	9,572	33.6	220.8	10,576	33.4	243.9	18.1
65 and over	2,792	9.8	75.8	3,635	11.5	98.7	15.0
Total participants	28,495	100.0	118.1	31,667	100.0	131.3	100.0
Gender							
Male	10,153	38.4	84.7	11,683	39.3	97.4	49.7
Female	16,253	61.6	133.9	18,015	60.7	148.5	50.3
Total reported	26,406	100.0	109.4	29,698	100.0	123.1	100.0
Highest level of education completed by participant[^]							
Year 11 or below (or equiv) or Certificate I/II/III/IV	3,913	19.8	50.3	4,307	20.1	55.3	44.1
Year 12 (or equivalent)	1,612	8.2	49.6	1,689	7.9	52.0	16.6
Advanced Diploma/Diploma	1,787	9.1	101.8	1,982	9.2	112.9	8.0
Completed Bachelor Degree	4,926	25.0	158.8	5,341	24.9	172.2	13.5
Grad Diploma/Grad Certificate	2,662	13.5	528.6	2,808	13.1	557.6	1.7
Postgraduate Degree	4,832	24.5	493.1	5,328	24.8	543.7	3.6
Total reported[#]	19,732	100		21,455	100		
Aboriginal and/or Torres Strait Islander							
Yes	304	1.3	45.4	412	1.5	61.5	3
No	23,641	98.7	109.1	27,016	98.5	124.7	97
Total reported	23,945	100.0	107.2	27,428	100.0	122.8	100

[^] Note that the rate per 100,000 was calculated using participants aged 15–74 years. This age adjustment was necessary to match the age groups in the ABS data.

[#] Total includes participants aged 15 years or older who nominated an ABS equivalent education level.