



Prevalence and predictors of influenza vaccination among residents of long-term care facilities



Hao Yi Tan^a, Elisa Lai^a, Mohana Kunasekaran^b, Abrar A. Chughtai^a, Mallory Trent^{b,*}, Christopher J. Poulos^{a,c}, Chandini R. MacIntyre^b

^aSchool of Public Health and Community Medicine, UNSW Medicine, University of New South Wales, Sydney, Australia

^bThe Biosecurity Program, Kirby Institute, UNSW Medicine, University of New South Wales, Sydney, Australia

^cHammondCare, Sydney, Australia

ARTICLE INFO

Article history:

Received 2 April 2019

Received in revised form 29 August 2019

Accepted 6 September 2019

Available online 13 September 2019

Keywords:

Influenza
Aged care
Long term care facilities
Outbreaks
Ageing

ABSTRACT

Influenza is a respiratory illness which results in significant morbidity and mortality, especially in the older population. Older people living in Long-Term Care Facilities (LTCFs) have a significantly higher risk of infection and complications from influenza. Influenza vaccine is considered the best strategy to prevent infection in high-risk populations. In Australia, the Communicable Diseases Network Australia (CNDA) suggests a vaccination coverage rate of 95% in both staff and residents¹. This study aims to measure the vaccination coverage rates for residents in LTCFs and identify predictors of vaccination uptake for these individuals.

This study was conducted in nine LTCFs in four sites from March to September 2018. This was done via medical record reviews for residents over 65 years old in these LTCFs, collecting information such as vaccination status, age, gender, ethnicity and occupation. Simple and multivariable logistic regression was used to calculate the Odds Ratio (OR) to determine significant predictors of influenza vaccination uptake.

The overall vaccination rate among LTCF residents was 83.6%. Significant predictors of vaccination were LTCF location, ethnicity and previous year vaccination status. Residents in LTCF Site D were less likely to be vaccinated compared to Site A (OR 0.11, 95% CI 0.02–0.61), non-Caucasians were less likely to get vaccinated (OR 0.09, 95% CI 0.01–0.67), and residents who refused the 2017 vaccine were less likely to be vaccinated (OR 0.04, 95% CI 0.01–0.15).

Compared with previous Australian studies on LTCF vaccination rates, the overall vaccination rate was high in these LTCFs (83.6% versus 66–84%), but it varied across different sites. Reasons for varying vaccination rates should be explored further – for example, lower rates in non-Caucasians with diverse cultural backgrounds. Better understanding the causes of under-vaccination can help improve vaccination programs in LTCFs.

© 2019 Elsevier Ltd. All rights reserved.

1. Introduction

Influenza is a respiratory illness which results in significant morbidity and mortality [2,3], and can lead to severe complications such as bronchiolitis, pneumonia, and death [4]. The influenza virus is extremely adept at evading the human adaptive immune system because of antigenic drift and antigenic shifts of the virus RNA [5]. As such, annual influenza vaccination is currently considered the most effective method for preventing influenza virus infection and its complications [6,7].

Influenza is responsible for considerable disease burden in Australia, as well as other countries, causing significant numbers of

hospitalisations and deaths each year [4,8,9,10]. Although any individual may contract the virus, influenza is especially a threat to older people [4]. In developed countries, the majority of deaths attributable to influenza occur in people age 65 and over, especially those over 80 years old with pre-existing health problems [11] – such as asthma, heart disease, stroke, diabetes, HIV, and cancer – and residents of Long Term Care Facilities (LTCFs) [12–14]. This could be explained by physiological immunosenescence, whereby the immune system declines with age, particularly with decreasing numbers of T cells [15,16]. This makes older people in general particularly susceptible to influenza. However, those who stay in LTCFs are at relatively more risk [2,17–19]. Seasonal influenza outbreaks are often explosive in LTCFs, with high attack rates [14]. Considering the high prevalence of frailty amongst residents, close quarter living arrangement, shared caregivers, and

* Corresponding author.

E-mail address: mallory.trent@unsw.edu.au (M. Trent).

high movement of staff and visitors, it should be of no surprise that this particular subgroup is more susceptible to influenza compared to the general elderly population living in the community [18].

The Australian government strongly encourages individuals in high risk groups to be vaccinated against influenza [20]. The Communicable Diseases Network Australia (CNDA) also suggests a vaccination coverage rate of 95% in both staff and residents [1] of LTCFs in order to have optimal vaccination coverage and minimize the impact of influenza epidemics. This might be the reason why influenza vaccination rates among LTCF residents are tend to be slightly higher compared to the general population [21]. Vaccination rates of LTCF residents were found to be about 66–84% in previous Australian studies [17] and 71–89% in European studies [22]. This is compared to vaccination rates in the general population, which was 80.5% in 2013 [23].

There are many factors that tend to determine vaccination uptake in the general older population (both in LTCFs and in the community). These can take the form of socioeconomic and demographic factors such as sex, age, ethnicity and education level; or they can be factors such as the ready availability of information, knowledge and advice [7,24,25]. Often, these factors will greatly affect beliefs and perceptions, and ultimately the health behaviours of the population [26].

A systematic review [24] of 27 studies of the 2009 influenza A pandemic found that the factors positively influencing influenza vaccination in the general population were male sex, younger age, higher education levels, being in a priority group for which vaccination was recommended, getting prior seasonal influenza vaccination, belief that the vaccine was safe and/or effective, and obtaining information from official medical sources. Additionally, a study in the United States [7] showed that higher education, non-smoking status, being physically active, having current poor physical health, and a history of various chronic diseases were associated with receiving the influenza vaccine.

Furthermore, Martinez-Baz et al. [25] found that people vaccinated against influenza in one season tended to be vaccinated in the following one. Vaccination was moderately associated with sociodemographic, clinical and health care factors. The most important factor was whether their treating physician encouraged the patient to get the vaccine or not.

Even though there are many studies [24,25,27] which investigate the predictors or determinants of influenza vaccination in older people in general, we have not found Australian studies that specifically investigate predictors within LTCFs or study their risk factors separately from the rest of the older population who live in the community. This study therefore helps to fill in this gap in the literature in order to help guide policy with regard to influenza vaccination in LTCF residents.

In this study, we reviewed the medical records of four LTCFs to estimate vaccine coverage and identify the predictors of influenza vaccination specifically among older people living in LTCFs.

1.1. Aims

We aimed to measure the 2018 seasonal influenza vaccination coverage rates for residents in LTCFs in Sydney from March to September 2018, as well as to determine predictors of positive vaccination status.

2. Methods

A descriptive epidemiologic study of residents in LTCFs was conducted. We worked with a single affiliated aged care provider and included all nine facilities in their four sites in metropolitan Sydney, spread out across North, South, and South-western Syd-

ney. We collected vaccination histories and baseline demographic data of the consenting residents through medical record reviews. This included information such as vaccination status, age, gender, smoking, alcohol intake, comorbidities, medications, ethnicity and past occupation. Vaccination is given by treating doctors, but generally arranged by the LTCF in a single month between March and April each year. The LTCF arranges for all treating doctors to vaccinate within a period of about four weeks. Vaccination records are specifically documented with vaccine label stickers in the patient files.

2.1. Recruitment

This study first involved recruitment and obtaining consent from residents or their next-of-kin from all LTCFs. The LTCFs had classified the residents into those who were cognitively impaired (e.g. those suffering from dementia) and therefore had no capacity to consent, and those who were cognitively able to make their own decisions. Those who were cognitively able were approached in person and received information about the study. Written consent was obtained from those that were willing to participate. For those who were cognitively impaired, consent was obtained from their next-of-kin. To do this, next-of-kin were contacted by phone and provided information about the study. If they were agreeable, they were mailed or emailed a consent form to sign and return.

2.2. Data collection

Once consent was received, baseline data was collected from all nine facilities in the four sites. Vaccination status of each resident was recorded, along with the type of vaccine given. Physical medical records were reviewed to acquire other relevant information about the residents, including their age, sex, reason for admission into the LTCF, frequency of visitors, marital status, ethnicity, birthplace, employment history, smoking and drinking status, as well as basic medical and treatment history. Each resident was counted as having a positive vaccination status when the official vaccine label (containing vaccine type, batch number, and expiry date) was present in the physical records, or if there was other proof of vaccination reflected in the medical records, such as a letter from the patient's private doctor or an official hospital discharge summary stating positive vaccination status. Since influenza vaccination was offered to all of the residents in the LTCFs, medical records with no confirmation of vaccination, or those stating that vaccination was declined was defined as a negative vaccination history. Those who moved into the LTCF in the study year after the influenza vaccination and hence lacked a vaccination record were classified as having an "unknown" vaccination history.

2.3. Analysis

Descriptive analysis was conducted for this population according to their demographic characteristics. These demographic characteristics include which LTCF site they were from, age group, sex, reason for admission, frequency of visitors, marital status, ethnicity, birthplace, previous occupation, current smoking and drinking status, presence of any comorbidities, corticosteroid use, and whether or not they had an influenza vaccination in 2017.

The four LTCF sites are labelled: A, B, C and D. Residents were divided into "Caucasian" and "others", as recorded in their medical records. This was because there were a large number of Caucasians and a small number of other ethnicities. Birthplace was divided into "Australia", "other developed nations", and "developing nations", classified using the International Monetary Fund (IMF) World Economic Outlook 2018 [28], as people living in developing countries are less likely to have access to vaccination, or be aware

of benefits of vaccines [29]. Residents' previous occupation was divided into jobs related to the medical field, or not. This was done in order to find out if previous occupation and professional knowledge of infectious diseases would impact the decision to have vaccinations done. Corticosteroid medication use was also recorded, as this could have an immunosuppressive effect on these residents and hence may make them more likely to get vaccinated if they were warned of this side effect by their doctors.

Following this, logistic regression was done using IBM SPSS[®] software to determine the association between each demographic variable and influenza vaccination in 2018, expressed as odds ratios at a 95% confidence interval. A p-value of 0.05 or less was considered significant. This is shown in Table 2 in the Analysis section of Results, with the outcome being an influenza vaccination in 2018. A multivariable regression analysis was done to determine if other factors had a significant confounding effect on the relationship between these factors and vaccination rate. This is shown in Table 3. All of the variables in univariate analysis were considered in the multivariate analysis. However, all the different comorbidities were pooled under one variable, which was "Presence of comorbidities".

2.4. Ethics approval

Ethics approval for this project was provided by the UNSW HREC (No. HC17996). Approval was given by the research and governance office of the care provider (project code R153).

3. Results

A total of 262 out of 628 residents (41.7%) were recruited and had medical records reviewed. 30 participants had an unknown 2018 influenza vaccination status and were excluded; hence 232 participants were included in the analysis.

The overall vaccination rate for influenza was found to be 83.6% (194/232). The demographic characteristics of the 232 included participants of this study are shown in Table 1 below.

The analysis was done based on the 232 residents with known 2018 vaccination status, and results are shown in Table 2 below. Of these 232, 127 residents (54.7%) received the high dose trivalent vaccine, while 24 residents (10.3%) received the adjuvanted trivalent vaccine, and 17 residents (7.3%) received the standard quadrivalent influenza vaccine; a further 26 residents (11.2%) had confirmed vaccination status but unknown vaccine type, while 38 residents (16.4%) received no vaccination.

In the univariate analysis, the particular LTCF site, ethnicity, and previous year influenza vaccination were significant predictors of influenza vaccination status in 2018. Compared to Site A, vaccination rates were significantly lower in Site B (OR 0.26 [95% Confidence Interval (CI) 0.11–0.63]) and Site D (OR 0.33 [95% CI 0.13–0.86]). Non-Caucasian residents were less likely to have an influenza vaccination compared to Caucasians (OR 0.29, 95%CI 0.10–0.85). Those who did not have an influenza vaccination in the previous year were also much less likely to have positive vaccination status this year (OR 0.10, 95% CI 0.04–0.26).

Multivariable analysis was done on all of the above-mentioned variables and is shown in Table 3 below.

Covariates included site, age group, sex, reason for admission, frequency of visitors, marital status, ethnicity, birthplace, previous occupation, smoking status, drinking status, presence of comorbidities, use of corticosteroid medication, and flu vaccination in 2017. In multivariable analysis, Site B became non-significant now with an Adjusted Odds Ratio (AOR) of 0.32 (95% CI 0.07–1.50) after adjusting for other variables. All the other variables remained significant, with Site D site having an AOR of 0.11 (95%

Table 1
Demographic Characteristics of all participants in the study.

Variable	Number	Percentage (%)
<i>Site</i>		
A	120	51.7
B	37	15.9
C	45	19.4
D	30	12.9
<i>Age Group (Years)</i>		
65–75	37	15.9
76 and above	195	84.1
Mean age	84.2 (±8.14)	NA
<i>Sex</i>		
Female	162	69.8
Male	70	30.2
<i>Reason for Admission</i>		
Dementia	174	75.0
Non-Dementia	58	25.0
<i>Frequency of Visitors</i>		
Frequent ¹	170	75.0
Non-Frequent ²	40	17.2
Unknown	22	9.5
<i>Marital Status</i>		
Married	96	41.4
Widowed/Divorced	121	52.2
Never Married	15	6.5
<i>Ethnicity</i>		
Caucasian	216	93.1
Others ³	16	6.9
<i>Birthplace</i>		
Australia	150	64.7
Other Developed Nations	55	23.7
Developing Nations	27	11.6
<i>Previous Occupation</i>		
Medical Related	15	6.5
Non-medical Related	176	75.9
Unknown	41	17.7
<i>Current Smoker</i>		
No	222	95.7
Yes	10	4.3
<i>Current Drinker</i>		
No	210	90.5
Yes	22	9.5
<i>Any Co-morbidities</i>		
No	2	0.9
Yes	230	99.1
<i>Corticosteroid use</i>		
No	216	93.1
Yes	16	6.9
<i>Flu Vaccination in 2017</i>		
No	22	9.5
Yes	140	60.3
Unknown	70	30.2

¹ More than once a week.

² Less than once a week.

³ Asian, Indigenous, or Pacific Islander.

CI 0.02–0.61) compared to the reference Site A, non-Caucasians with an AOR of 0.09 (95% CI 0.01–0.67), and negative status for previous year vaccination with an AOR of 0.04 (95% CI 0.01–0.15).

4. Discussion

In this study, we have shown that the overall 2018 seasonal influenza vaccination rate in residents across four LTCFs was relatively high, and were similar to other studies that showed Australian LTCF vaccination rates [17,21,22]. However, this is still well below the 95% target rate set by the CNDA, and below rates

Table 2
Univariate Analysis of predictors of 2018 Influenza Vaccination.

Variable	Number of Positive Vac Status/total number of each category	Rate (%)	Univariate Analysis (OR, 95% CI)	Significance (P Value)
<i>Site</i>				
A	105/120	87.5	Ref	
*B	24/37	64.9	0.26 (0.11–0.63)	0.003
C	44/45	97.8	6.29 (0.81–49.05)	0.080
*D	21/30	70.0	0.33 (0.13–0.86)	0.023
<i>Age Group (Years)</i>				
65–75	32/37	86.5	1.30 (0.47–3.59)	0.608
76 and above	162/195	83.1	Ref	
<i>Sex</i>				
Female	136/162	84.0	Ref	
Male	58/70	82.9	0.92 (0.44–1.96)	0.836
<i>Reason for Admission</i>				
Dementia	147/174	84.5	Ref	
Non-Dementia	47/58	81.0	0.79 (0.36–1.70)	0.539
<i>Frequency of Visitors</i>				
Frequent ¹	140/170	82.4	Ref	
Non-Frequent ²	33/40	82.5	1.01 (0.41–2.50)	0.982
Unknown	21/22	95.5	4.50 (0.58–34.76)	0.149
<i>Marital Status</i>				
Married	77/96	80.2	Ref	
Widowed/Divorced	104/121	86.0	1.51 (0.74–3.09)	0.261
Never Married	13/15	86.7	1.60 (0.33–7.71)	0.556
<i>Ethnicity</i>				
Caucasian	184/216	85.2	Ref	
*Others³	10/16	62.5	0.29 (0.010–0.85)	0.018
<i>Birthplace</i>				
Australia	125/150	83.3	Ref	
Other Developed Nations	46/55	83.6	1.02 (0.44–2.35)	0.959
Developing Nations	23/27	85.2	1.15 (0.37–3.6)	0.811
<i>Previous Occupation</i>				
Non-medical Related	151/176	85.8	Ref	
Medical Related	11/15	73.3	0.46 (0.13–1.54)	0.206
Unknown	32/41	78.0	0.59 (0.25–1.38)	0.223
<i>Current Smoker</i>				
Yes	9/10	90.0	1.80 (0.22–14.64)	0.577
No	185/222	83.3	Ref	
<i>Current Drinker</i>				
Yes	17/22	77.3	0.63 (0.22–1.84)	0.398
No	177/210	84.3	Ref	
<i>Any Co-morbidities</i>				
Yes	192/230	83.5	–	–
No	2/2	100	–	–
<i>Asthma</i>				
Yes	14/18	77.8	0.66 (0.21–2.13)	0.486
No	180/214	84.1	Ref	
<i>Chronic Lung Disease</i>				
Yes	26/31	83.9	1.02 (0.37–2.85)	0.968
No	168/201	83.6	Ref	
<i>Heart Disease</i>				
Yes	60/73	82.2	0.86 (0.41–1.80)	0.69
No	134/159	84.3	Ref	
<i>Previous Stroke</i>				
Yes	23/28	82.1	0.89 (0.32–2.50)	0.822
No	171/204	83.8	Ref	
<i>Diabetes</i>				
Yes	46/54	85.2	1.17 (0.50–2.72)	0.723
No	148/178	83.1	Ref	
<i>Mobility Problems</i>				
Yes	119/144	82.6	0.83 (0.40–1.71)	0.605
No	75/88	85.2	Ref	
<i>Other Comorbidities (Besides those named)</i>				
Yes	191/228	83.8	1.72 (0.17–17.0)	0.638
No	3/4	75.0	Ref	
<i>Corticosteroid use</i>				
Yes	11/16	68.8	0.40 (0.13–1.25)	0.096
No	183/216	84.7	Ref	

Table 2 (continued)

Variable	Number of Positive Vac Status/total number of each category	Rate (%)	Univariate Analysis (OR, 95% CI)	Significance (P Value)
<i>Flu Vaccination in 2017</i>				
Yes	123/140	87.9	Ref	
*No	9/22	40.9	0.10 (0.04–0.26)	<0.001
Unknown	62/70	88.6	1.07 (0.44–2.62)	0.880

¹ More than once a week.

² Less than once a week.

³ Asian, Indigenous, or Pacific Islanders.

Table 3

Multivariate Analysis of predictors of 2018 Influenza Vaccination.

Variable	Multivariate Analysis (OR, 95% CI)	Significance (P Value)
<i>Site</i>		
A	Ref	
B	0.32 (0.07–1.50)	0.150
C	4.84 (0.41–57.11)	0.211
*D	0.11 (0.021–0.61)	0.011
<i>Age Group (Years)</i>		
65–75	1.38 (0.35–5.44)	0.645
76 and Above	Ref	
<i>Sex</i>		
Female	Ref	
Male	0.758 (0.27–2.12)	0.598
<i>Reason for Admission</i>		
Dementia	Ref	
Non-Dementia	0.481 (0.11–2.19)	0.344
<i>Frequency of Visitors</i>		
Frequent ¹	Ref	
Non-Frequent ²	0.99 (0.30–3.27)	0.987
Unknown	3.80 (0.28–50.95)	0.313
<i>Marital Status</i>		
Married	Ref	
Widowed/Divorced	1.57 (0.55–4.48)	0.396
Never Married	0.77 (0.10–5.90)	0.802
<i>Ethnicity</i>		
Caucasian	Ref	
*Others³	0.09 (0.01–0.67)	0.019
<i>Birthplace</i>		
Australia	Ref	
Other Developed Nations	0.87 (0.28–2.69)	0.809
Developing Nations	3.48 (0.47–25.81)	0.222
<i>Previous Occupation</i>		
Non-medical Related	Ref	
Medical Related	0.49 (0.09–2.64)	0.409
Unknown	0.68 (0.20–2.31)	0.537
<i>Current Smoker</i>		
No	Ref	
Yes	4.77 (0.25–92.33)	0.302
<i>Current Drinker</i>		
No	Ref	
Yes	0.24 (0.06–1.06)	0.060
<i>Any Co-morbidities</i>		
No	NA	NA
Yes	NA	NA
<i>Corticosteroid use</i>		
No	Ref	
Yes	0.14 (0.03–0.76)	0.023
<i>Flu Vaccination in 2017</i>		
Yes	Ref	
*No	0.04 (0.01–0.15)	0.000
Unknown	1.32 (0.37–4.74)	0.671

¹ More than once a week.

² Less than once a week.

³ Asian, Indigenous, or Pacific Islander.

achieved in the funded infant vaccination program [1]. The rate of influenza vaccination in the general population in 2013 was 80.5% [23] and 71.6% in 2016, and there are no routine annual coverage data available [30]. Given the increased risk of an influenza outbreak happening in a LTCF compared to in the community, the facility management is likely to encourage vaccination amongst the residents to provide influenza protection. In addition, the Australian government also recommends and funds vaccination for people aged >65 years, because they are one of the high-risk groups [31]. The severe epidemic of influenza in 2017, which affected LTCFs badly [10], may have increased the general public's awareness of the severity of influenza, and therefore caused an increase in influenza vaccination rates in 2018. As a result of the 2017 epidemic, the Australian government introduced two enhanced vaccines for people >65 years in 2018, the high dose TIV and the adjuvanted TIV. Yet some residents still received the standard quadrivalent vaccine in 2018. LTCFs we studied would arrange vaccination within their facilities with treating doctors, making it readily available to their residents, and therefore make it an easier process compared to people living in the community.

We have also found that that the predictors of vaccination in LTCFs studied include site, ethnicity of residents and previous year vaccination status. Individual sites had statistically significant differences in vaccination rates. This may be because of differences in the application of policies and guidelines with respect to vaccination, and/or different primary care providers servicing each site. In general, the process across all sites was for the registered nurses (RNs) to gain consent for influenza vaccination, whether from cognitively-able residents or the next-of-kin of cognitively impaired residents, and then for the resident's designated General Practitioner (GP) to administer the vaccine. The differences between sites may lie in the way that the importance of vaccination is communicated to the residents or the next-of-kin, and in the practices and views of individual GPs. Furthermore, the demographic and clinical backgrounds of the residents at each site varied. For example, the proportion of residents with dementia was different for the different facilities. The locations of each LTCF site might affect which part of Sydney the residents tended to come from. This may indicate that each site may contain individuals from different socio-economic backgrounds, and therefore impacting vaccination rates differently [32]. Perceptions of the residents or next-of-kin towards vaccine may also play a role in vaccination status of the residents in LTCFs [33].

We have also shown that Caucasian residents are significantly more likely to be vaccinated. This mirrors existing data in other developed countries such as the United States [27]. There may be several reasons for this. For example, it is well documented that immigrants and individuals who are brought up in a non-western education system tend to be less trusting of western medication compared to those native to a western culture [34]. Furthermore, though immigration status was not found to be significant in this study, other studies have consistently shown that immigrant groups to western countries tend to have generally lower rates of vaccination, regardless of vaccine type [35].

Although the residents in this study did not need to pay for their influenza vaccination, it would be important to note that in general, financial factors may present a barrier to vaccination. Because of this, poorer individuals, those who are not aware of government policies which pay for vaccination, or individuals from certain ethnic groups may perceive the cost of vaccination as too high or not worth paying for [36], and therefore choose not to be vaccinated.

Furthermore, studies have consistently shown that there are appreciable disparities in healthcare use in general due to ethnicity and due to differences in English language fluency [37,38]. In terms of influenza vaccination specifically, other studies have shown that there is significant racial or ethnic difference in the rates of influenza vaccination, especially in high risk groups [39–41]. Additionally, a US study found that although institutionalised aged care helps to increase vaccination rates across the board, it does not reduce the racial disparity in vaccination rates across the groups [40]. These studies look primarily at US data and their different ethnic groups. However, it is possible to infer this for an Australian population as both are English-speaking developed countries with predominantly Caucasian populations, but with significant migrant populations.

However, it is important to note that a vast majority of our sample size was Caucasian (216/232). This means that other races may not have been sufficiently represented, and a larger sample size will more accurately ascertain the role of race and ethnicity in vaccination status.

Our study did not look at individual reasons why people rejected the vaccination. However, it is clear from the literature that negative perception of vaccination is highly correlated with negative vaccination status [7,24]. Fears regarding vaccine safety and vaccine side effects are amongst the top reasons people decline influenza immunisation. There is also widespread distrust or disconnect between public health measures and the general population, as well as some misconceptions about the potential severity of influenza infection [33,42,43]. An Australian study [33] done looking at the 2009 influenza pandemic showed that 65% of the population surveyed were not vaccinated at the time of the survey, which took place in the middle of the 2009 influenza season. Thirteen percent of the people surveyed opted to “wait and see” if there were any adverse effects of the vaccine, and 17% were not willing to be vaccinated. Of these 17%, 39% had the perception that vaccines were unnecessary, 26% had doubts about vaccine safety in general, and 17% did not believe in vaccines.

These findings point to the fact that negative perception is still a major barrier, and if we want to further increase influenza vaccination rates in LTCFs, we need to take steps to specifically address fears, doubts, and misconceptions of individuals and their relatives or legal guardians.

We have not found other studies which look at predictors of vaccination for residents of LTCFs specifically. However, it is important for the medical research community to study this, if we are to use evidence-based medicine to shape aged care policy regarding vaccination and make informed decisions that tackle specific barriers to vaccination uptake.

This study has some limitations. First and foremost, this study was confined to LTCFs operated by one provider, and only those facilities that were situated in metropolitan Sydney. Therefore, results may not necessarily represent other LTCFs around Australia, whose situation, operating procedure, and other variables might differ significantly from the ones we studied. This LTCF provider is also a respected market leader with decades of operational experience. Years of experience and operational know-how, coupled with the fact that it is a stable charity, could mean that it may represent the more “ideal” end of the spectrum. For example, the National Immunisation Program offers free vaccination to all people over 65, but all the LTCFs we studied helped to administer this

vaccine. They do this through a consent-gaining process, simultaneously explaining to residents and relatives the importance of immunity to influenza. This is followed by ordering vaccines to each site. The allocated GPs then administer the vaccines to the residents. This process is streamlined and well thought out but requires significant organisational prowess that other less established LTCFs may not possess. Hence, the observed rate of vaccination here may be an overestimate of rates Australia-wide.

Furthermore, selection bias may have occurred. People who are health conscious may be more aware of the science behind vaccination and herd immunity and may be more willing to participate in the study. Individuals against vaccination may be more likely to decline to participate. As a result, there may be an overestimation of the vaccination uptake rate and this could limit the generalisability of the study findings. The length of stay in the LTCF is important as well, as people that have been in the facility long tended to have more complete medical records compared to those who were relatively new residents. This could affect the completeness of the information we collected. Additionally, we only managed to recruit 262 residents out of 628 (41.7%) of the total residents. This too may limit generalisability due to the relatively small number of participants and these participants did not form the majority of this aged care provider.

It is also important to clarify that although we did state that influenza vaccination is currently the most effective prevention method we have against the seasonal flu, this paper does not discuss the effectiveness of the influenza vaccination in terms of clinical outcomes. There is currently uncertainty regarding the effectiveness of the influenza immunisation at an individual level in the elderly [44], but this is beyond the scope of this paper.

However, the study has several strengths. Our recruitment strategy involved explaining to potential participants that they could choose to remain unvaccinated even if they participated in the study. This would discourage the selection bias mentioned above and would provide us with both a vaccinated and unvaccinated group enrolled in our study, providing a reasonable estimate of vaccine uptake rates.

Finally, the data collected was objective. Many studies looking at vaccination rates and its determinants tend to use subjective terms such as attitudes, understanding and perceived benefits [19,45,46]. Using such variables increases the risk of influencing the participants and causing selection bias in the study. The use of demographic data as variables limits subjectivity in the questionnaires.

5. Conclusion

Overall vaccination rate in the studied LTCFs were high, though it varied across sites and by ethnicity. There is a need to conduct larger scale studies to more accurately determine predictors of vaccination among LTCF residents, using a larger sample size and more detailed investigation into cultural and lifestyle factors. Furthermore, future studies could collect qualitative data on the reasons why some residents of LTCFs do not get influenza vaccination, identifying both individual, next of kin, cultural and organisational reasons for non-vaccination. This way, policy makers in Australia can be better informed, and older people residing in long term care homes may be better protected from influenza.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Professor CR MacIntyre has received funding for investi-

gator driven research from Sanofi and Seqirus, and has been on advisory boards for the same.

Acknowledgements

The authors thank the staff at the four participating LTCFs for their assistance with the study. Your help has been greatly valued. CR MacIntyre is supported by a NHMRC Principal Research Fellowship, grant number 1137582.

References

- [1] Australian Government Department of Health. Mandatory Influenza (flu) vaccination program for residential aged care providers. 15 February 2019. <https://agedcare.health.gov.au/mandatory-influenza-flu-vaccination-program-for-residential-aged-care-providers> (accessed 7th August 2019).
- [2] Booy R, Lindley RI, Dwyer DE, et al. Treating and preventing influenza in aged care facilities: a cluster randomised controlled trial. *PLoS ONE* 2012;7(10):e46509.
- [3] Paules C, Subbarao K. Influenza. *The Lancet*; 390(10095): pp. 697–708.
- [4] Simonsen L, Taylor TH, Viboud C, Miller MA, Jackson LA. Mortality benefits of influenza vaccination in elderly people: an ongoing controversy. *Lancet Infect Dis* 2007;7(10):658–66.
- [5] Stephenson I, Zambon M. The epidemiology of influenza. *Occup Med* 2002;52(5):241–7.
- [6] World Health Organisation. Influenza. 2018. <http://www.who.int/influenza/vaccines/en/> (accessed 08/08 2018).
- [7] Takayama M, Wetmore CM, Mokdad AH. Characteristics associated with the uptake of influenza vaccination among adults in the United States. *Prev Med* 2012;54(5):358–62.
- [8] Jean Li-Kim-Moy JKY, Patel Cyra, Beard Frank H, Chiu Clayton, Macartney Kristine K, McIntyre Peter B. Australian vaccine preventable disease epidemiological review series: Influenza 2006 to 2015. *Commun. Dis. Intell.* 2016;40(4).
- [9] European Centre for Disease Prevention and Control. Factsheet about Seasonal Influenza. 2018. <https://ecdc.europa.eu/en/seasonal-influenza/facts/factsheet> (accessed 08/08 2018).
- [10] Australian Government - Department of Health. 2017 Influenza Season in Australia. A summary from the National Influenza Surveillance Committee. In: Health Do, editor. Australia: Australian Government; 2017.
- [11] Centers for Disease Control and Prevention. People at High Risk For Flu Complications. 2019. <https://www.cdc.gov/flu/highrisk/index.htm> (accessed 8 August 2019).
- [12] Sayers G, Igoe D, Carr M, et al. High morbidity and mortality associated with an outbreak of influenza A (H3N2) in a psycho-geriatric facility. *Epidemiol Infect* 2013;141(2):357–65.
- [13] Talbot HK. Influenza in older adults. *Infect Dis Clin* 2017;31(4):757–66.
- [14] McPhie K, McNulty J, Bush K, et al. Antiviral prophylaxis in the management of an influenza outbreak in an aged care facility. *Commun Dis Intell Quart Rep* 2004;28(3):396.
- [15] Aw D, Silva AB, Palmer DB. Immunosenescence: emerging challenges for an ageing population. *Immunology* 2007;120(4):435–46.
- [16] Helbert M. Immunology for medical students E-book. Elsevier Health Sci 2016.
- [17] Rosewell A, Chiu C, Lindley R, et al. Surveillance for outbreaks of influenza-like illness in the institutionalized elderly. *Epidemiol Infect* 2010;138(8):1126–34.
- [18] Gaillat J, Chidiac C, Fagnani F, et al. Morbidity and mortality associated with influenza exposure in long-term care facilities for dependant elderly people. *Eur J Clin Microbiol Infect Dis* 2009;28(9):1077–86.
- [19] Elias C, Fournier A, Vasiliu A, et al. Seasonal influenza vaccination coverage and its determinants among nursing homes personnel in western France. *BMC public health* 2017;17(1):634.
- [20] Australian Technical Advisory Group on Immunisation (ATAGI). Australian Immunisation Handbook. In: Health Do, editor. Canberra: Australian Government Department of Health; 2018.
- [21] Monto AS, Rotthoff J, Teich E, et al. Detection and control of influenza outbreaks in well-vaccinated nursing home populations. *Clin Infect Dis* 2004;39(4):459–64.
- [22] Lansbury LE, Brown CS, Nguyen-Van-Tam JS. Influenza in long-term care facilities. *Influenza Other Respir Viruses* 2017.
- [23] Dyda A, Karik S, Hayden A, et al. Influenza and pneumococcal vaccination in Australian adults: a systematic review of coverage and factors associated with uptake. *BMC Infect Dis* 2016;16(1):515.
- [24] Brien S, Kwong JC, Buckeridge DL. The determinants of 2009 pandemic A/H1N1 influenza vaccination: a systematic review. *Vaccine* 2012;30(7):1255–64.
- [25] Martínez-Baz I, Aguilar I, Morán J, Albéniz E, Aldaz P, Castilla J. Factors associated with continued adherence to influenza vaccination in the elderly. *Prev Med* 2012;55(3):246–50.
- [26] MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. *Vaccine* 2015;33(34):4161–4.
- [27] Winston CA, Wortley PM, Lees KA. Factors associated with vaccination of medicare beneficiaries in five US communities: results from the racial and ethnic adult disparities in immunization initiative survey, 2003. *J Am Geriatr Soc* 2006;54(2):303–10.
- [28] International Monetary Fund. World Economic and Financial Surveys. World Economic Outlook. 2018. <https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/groups.htm> (accessed 11 August 2019).
- [29] Stöhr K. Influenza—WHO cares. *Lancet Infect Dis* 2002;2(9):517.
- [30] Hendry A, Hull B, Dey A, Campbell-Lloyd S, Beard F. NSW Ann Immun Coverage Rep 2016:2018.
- [31] Australian Government Department of Health. Flu (influenza) immunisation service. 1/8/2018 2018. <https://beta.health.gov.au/services/flu-influenza-immunisation-service> (accessed 8 January 2019).
- [32] Gilbert GL, Cretikos MA, Hueston L, Doukas G, O'Toole B, Dwyer DE. Influenza A (H1N1) 2009 antibodies in residents of New South Wales, Australia, after the first pandemic wave in the 2009 southern hemisphere winter. *PLoS ONE* 2010;5(9):e12562.
- [33] Eastwood K, Durrheim DN, Jones A, Butler M. Acceptance of pandemic (H1N1) 2009 influenza vaccination by the Australian public. *Med J Aust* 2010;192(1):33–6.
- [34] Hebert PL, Frick KD, Kane RL, McBean AM. The causes of racial and ethnic differences in influenza vaccination rates among elderly Medicare beneficiaries. *Health Serv Res* 2005;40(2):517–38.
- [35] Jain A, van Hoek A, Boccia D, Thomas SL. Lower vaccine uptake amongst older individuals living alone: a systematic review and meta-analysis of social determinants of vaccine uptake. *Vaccine* 2017;35(18):2315–28.
- [36] Bates AS, Wolinsky FD. Personal, financial, and structural barriers to immunization in socioeconomically disadvantaged urban children. *Pediatrics* 1998;101(4):591–6.
- [37] Sheikh-Mohammed M, MacIntyre CR, Wood NJ, Leask J, Isaacs D. Barriers to access to health care for newly resettled sub-Saharan refugees in Australia. *Med J Aust* 2006;185(11–12):594–7.
- [38] Fiscella K, Franks P, Doeschner MP, Saver BG. Disparities in health care by race, ethnicity, and language among the insured: findings from a national sample. *Med Care* 2002;40:52–9.
- [39] Egede LE, Zheng D. Racial/ethnic differences in influenza vaccination coverage in high-risk adults. *Am J Public Health* 2003;93(12):2074–8.
- [40] Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM. Racial disparity in influenza vaccination: does managed care narrow the gap between African Americans and whites? *JAMA* 2001;286(12):1455–60.
- [41] Barrett SC, Schmaltz S, Kupka N, Rasinski KA. Impact of race on immunization status in long-term care facilities. *J Racial Ethnic Health Disp* 2019;6(1):153–9.
- [42] Schwarzwinger M, Flicoteaux R, Cortarenoda S, Obadia Y, Moatti J-P. Low acceptability of A/H1N1 pandemic vaccination in French adult population: did public health policy fuel public dissonance? *PLoS ONE* 2010;5(4):e10199.
- [43] Sypsa V, Livaniotis T, Psychogiou M, et al. Public perceptions in relation to intention to receive pandemic influenza vaccination in a random population sample: evidence from a cross-sectional telephone survey. *Eurosurveillance* 2009;14(49):19437.
- [44] Demicheli V, Jefferson T, Di Pietrantonj C, et al. Vaccines for preventing influenza in the elderly. *Cochr Database Syst Rev* 2018;2.
- [45] Halliday L, Thomson JA, Roberts L, Bowen S, Mead C. Influenza vaccination of staff in aged care facilities in the ACT: how can we improve the uptake of influenza vaccine? *Aust N Z J Public Health* 2003;27(1):70–5.
- [46] Lester RT, McGeer A, Tomlinson G, Detsky AS. Use of, effectiveness of, and attitudes regarding influenza vaccine among house staff. *Infect Control Hosp Epidemiol* 2003;24(11):839–44.