

ONLINE FIRST PUBLICATION

Online first papers have undergone full scientific review and copyediting, but have not been typeset or proofread. To cite this article, use the DOIs number provided. Mandatory typesetting and proofreading will commence with regular print and online publication of the online first papers of the *SMJ*.

Assessing the impact of educational methods on influenza vaccine uptake and patient knowledge and attitudes: a randomised controlled trial

Pei Lin Hu^{1,2}, FCFPS, MMed, Eileen Yi Ling Koh¹, BSc, Jolene Shi Han Tay¹, MBChB, Valerie Xin-Bei Chan¹, MBBS, MMed, Shermin Shi Min Goh¹, MBBS, Sinead Zhen Wang^{1,2}, FCFPS, MCI

¹Singapore Health Services Polyclinics, ²Singhealth-Duke NUS Family Medicine Academic Clinical Programme, Singapore

Correspondence: Dr Hu Pei Lin, Consultant, Singapore Health Services Polyclinics, 167 Jalan Bukit Merah, Connection One (Tower 5), #15-10, Singapore 150167. hu.pei.lin@singhealth.com.sg

Singapore Med J 2021, 1–17

<https://doi.org/10.11622/smedj.2021222>

Published ahead of print: 15 December 2021

Online version can be found at
<http://www.smj.org.sg/online-first>

ABSTRACT

Introduction: Although influenza vaccination reduces rates of pneumonia, hospitalisation and mortality, influenza vaccination uptake remains low in older patients. The primary aim was to compare individualised counselling with educational pamphlets alone in improving influenza vaccination uptake. The secondary aims were to evaluate knowledge and attitudes towards influenza vaccination and factors influencing uptake.

Methods: A randomised controlled study was conducted in two government polyclinics with 160 participants per arm. Patients aged 65 years and above attending for doctor consultation were recruited. All participants received an educational pamphlet on influenza vaccination. The intervention group received additional face-to-face counselling. Participants filled a pre- and postintervention questionnaire assessing knowledge of influenza and attitudes towards the vaccine. Follow-up calls and verification of electronic records was done at three months to determine actual vaccine uptake.

Results: At three months, 16 (10%) patients in the intervention group and 20 (12.5%) patients in the control group had completed influenza vaccination ($p = 0.48$). Factors positively associated with vaccine uptake were willingness to receive vaccination immediately after intervention (adjusted odds ratio [OR] 12.15, 95% confidence interval [CI] 4.42–33.38), and male gender (adjusted OR 2.96, 95% CI 1.23–7.12). Individualised counselling was more effective in improving knowledge ($p < 0.01$). Overall knowledge scores did not influence actual vaccine uptake rates. (adjusted OR 1.10 [0.90–1.3]).

Conclusion: Both arms of patient education increased uptake of influenza vaccination. Individualised counselling was not superior to pamphlets alone in improving uptake. Performing vaccination at the initial point of contact improves actual uptake rates.

Keywords: health promotion, influenza vaccines, patient education

INTRODUCTION

Globally, influenza epidemics cause 3–5 million cases of severe illness and result in a quarter million deaths each year.⁽¹⁾ Despite Singapore's tropical climate, influenza was associated with 8.3 deaths per 100,000 in Singapore in 2011⁽²⁾ and a significant number of hospitalisations.⁽³⁾ Influenza vaccination has been shown to reduce influenza-related hospitalisations and deaths.⁽⁴⁻⁶⁾

Despite having national immunisation programmes, influenza vaccine uptake rates remain suboptimal in many countries. Vaccination coverage ranges from 1.5%–2.2% in China,⁽⁷⁾ to 40%–50% in the United States⁽⁸⁾ and Germany.⁽⁹⁾ In Australia, universal funding has further improved the vaccination coverage to 74.8%.⁽¹⁰⁾ In comparison, 15.2% of adults older than 50 years in Singapore had received seasonal influenza vaccination in 2013.⁽¹¹⁾

Knowledge gaps and misperceptions⁽⁹⁾ regarding influenza vaccine contribute to the poor uptake rates. Conversely, patient education improves vaccination uptake,⁽¹²⁾ and patient education could be provided using printed materials such as pamphlets and posters.⁽¹³⁾ A local study of influenza vaccination uptake in persons with diabetes mellitus found that encouragement from healthcare providers and family members, better information about vaccines, and lower cost encouraged vaccine uptake.⁽¹⁴⁾ In patients previously undecided about influenza vaccination, brief face-to-face patient education improved vaccine uptake.⁽¹⁵⁾

No studies have compared the effectiveness of individualised patient education with the use of printed educational material in improving influenza vaccine uptake.

Our study aimed to evaluate the effectiveness of individualised counselling (IC) as compared with printed educational material alone in improving influenza vaccination uptake. We hypothesised that IC is more effective than printed educational material alone, in improving vaccination uptake rates.

METHODS

We conducted a randomised controlled trial of 320 older adults aged 65 years and older attending SingHealth Polyclinics (SHP). Participants were recruited between July and October 2017. SHP comprises a chain of government-subsidised primary healthcare facilities in Singapore. The inclusion criteria were community-dwelling patients aged ≥ 65 years attending our polyclinics, who had not received influenza vaccination in the preceding two years. The exclusion criteria were patients on anticoagulants, history of egg protein anaphylaxis, history of Guillain-Barre syndrome, and illiteracy. Illiteracy was defined as the inability to read any of the common local languages, namely English, Mandarin, and Malay.

Block randomisation method was used to recruit participants. Patients were divided into block sizes of four, and assigned into the intervention groups in a 1:1 ratio. Allocation was concealed using opaque envelopes prepared by an administrator from the institution's research department who was not part of the study team.

While patients were waiting for vital signs assessment before consultation, they were approached by team members if they were noted to be 65 years or older. Screening for inclusion criteria and obtaining of informed consent was done in a private room, thereafter, eligible and consented patients were enrolled into the study and the questionnaire was administered. Study team members did not identify themselves as doctors, and patients were assured that their participation was not made known to the medical practitioner treating them during that visit.

The 160 patients in the intervention group underwent IC and received a health education pamphlet, whereas the 160 patients in the control group received only the same health education pamphlet (P). Health education pamphlets, available in English, Chinese and Malay, were distributed according to each participant's language preference. Information provided included facts on influenza infection and the benefits, risks, indications, and costs of influenza vaccination. For the IC group, IC was conducted with a standardised script, making use of the

phrases in the pamphlet. Patients were allowed to clarify their uncertainties. Team members were proficient in the language used for this interaction, carried out in spoken English, Mandarin and Malay. If patients asked questions out of the scope of the prepared materials, they were advised to consult their doctor.

Patients filled a pre- and post-intervention questionnaire on the same day to assess their knowledge on influenza, attitudes towards the influenza vaccine, and reasons for not getting vaccinated before the encounter. Self-reported information on medical comorbidities, and recent hospitalisation within the past six months was also gathered. This questionnaire was created based on review of existing literature.^(9,14,16-21)

It comprised 35 questions in four sections. The first section covered demographics and medical history. The second section comprised questions on barriers towards vaccination. The third section assessed knowledge about influenza vaccination. The last section assessed intent to undergo vaccination and reasons why. The questionnaire was piloted on ten patients for face validity and feasibility. Minor changes were made to phrasing. The questionnaire was printed in English, and team members were coached on standardised verbal translations into Mandarin and Malay.

A follow-up phone call and verification of electronic health records were made at three months, between October 2017 and January 2018, to determine the actual uptake of influenza vaccine.

The primary outcome was influenza vaccination uptake at three months. The secondary objectives were to study the factors influencing vaccination uptake, patient's knowledge about influenza and its vaccination, and patients' attitudes and practices pertaining to influenza vaccination.

The study was designed to have a power of 80% to detect a small effect size (Cohen's $d = 0.2$) in the intervention compared with the control, assuming a two-sided alpha level of

0.05. The calculated sample size was 107 per group. This was inflated by 30% to account for possible missing data, and the final sample size was rounded up to 160 per group ($n = 320$).

Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp, Armonk, NY, USA). Baseline characteristics were compared in the two study groups using chi-square and two-sample *t*-tests. Those who dropped out were considered as participants with no vaccination uptake at three months. Multivariate logistic regression analyses were used to determine the factors influencing vaccination uptake. Improvements in patient knowledge scores pre- and postintervention were compared between the treatment arms using the two-sample *t*-test. When evaluating patient's attitudes and practices, the cohort was stratified according to whether they had ever received influenza vaccination previously.

Ethics approval was obtained from the SingHealth Centralised Institutional Review Board. Data collection was carried out on hard-copy questionnaires, which were kept in locked cabinets in the clinic to which only the principal investigator held the key.

RESULTS

A total of 320 patients were randomly assigned to either the IC group or the P group, with 160 patients per group. Their mean age was 71.0 ± 12.3 years. The overall loss to follow-up was 7.8% (8.8% IC vs. 6.9% P, $p = 0.53$)

Key baseline characteristics were similar between the two study groups (Table I). Differences between the groups included a higher proportion of smokers and ex-smokers in the control group (13.1% IC vs. 21.9% P), and a lower number of patients in the control group who had chronic kidney disease (6.9% IC vs. 1.9% P).

Table I. Characteristics of patients at baseline.

Demographic	No. (%)		p-value
	Intervention (n = 160)	Control (n = 160)	
Age* (yr)	71.4 ± 12.5	71.0 ± 12.2	0.77
Male gender	75 (46.9)	88 (55.0)	0.15
Chinese ethnicity	146 (91.3)	144 (90.0)	0.70
Body mass index* (kg/m ²)	24.0 ± 3.5	24.3 ± 4.1	0.65
Educational status			0.99
No formal education/primary	76 (47.5)	77 (48.1)	
Secondary level	49 (30.6)	49 (30.6)	
Tertiary level	35 (21.9)	34 (21.3)	
Smoking status (%)			0.039
Smoker/ex-smoker	21 (13.1)	35 (21.9)	
Non-smoker	139 (86.9)	125 (78.1)	
Hospitalisation in past 6 mth	14 (8.8)	9 (5.6)	0.28
Previously received influenza vaccine (> 2 yr ago)	29 (18.1)	30 (18.8)	0.84
Total knowledge score* (13-item questionnaire)	6.3 (2.5)	5.8 (2.5)	0.14
Comorbidities			
Total number of comorbidities [†]	2 (1–3)	2 (1–3)	0.16
Asthma	10 (6.3)	6 (3.8)	0.31
Chronic obstructive lung disease	2 (1.3)	1 (0.6)	> 0.99
Coronary artery disease	23 (14.4)	25 (15.6)	0.75
Chronic kidney disease	11 (6.9)	3 (1.9)	0.029
Diabetes mellitus	50 (31.3)	63 (37.5)	0.13
Hypertension	118 (73.8)	130 (81.3)	0.11
Hyperlipidaemia	104 (65.0)	115 (71.9)	0.19
Stroke/transient ischaemic attack	9 (5.6)	8 (5.0)	0.80

*Data represented as mean ± standard deviation. †Data represented as median (interquartile range).

At three months of follow-up, 16 (10%) patients in the IC group, and 20 (12.5%) patients in the P group had completed influenza vaccination (p = 0.48).

On multivariate analysis (Table II), the factors that were positively associated with influenza vaccination uptake were self-reported willingness to go for influenza vaccination immediately after the study intervention (adjusted OR 12.15, CI 4.42–33.38, p < 0.01), and male gender (adjusted OR 2.96, 95% CI 1.23–7.12, p = 0.02).

Table II. Multivariable analysis of the factors associated with influenza vaccine uptake, with all participants included (n = 320).

Variables	Crude OR (95% CI)	p-value	Adjusted OR* (95% CI)	p-value
Study intervention				
Pamphlet alone	1	–	1	–
Individualised counselling	0.78 (0.39–1.56)	0.48	0.64 (0.28–1.49)	0.30
Post-education knowledge score	1.12 (0.96–1.31)	0.16	1.1 (0.9–1.34)	0.35
Expressed willingness to undertake vaccination post education				
No/unsure	1	–	1	–
Yes	13.15 (4.95–34.93)	< 0.01	12.15 (4.42–33.38)	< 0.01
Age	0.99 (0.97–1.01)	0.26	0.99 (0.97–1.02)	0.83
Gender				
Female	1	–	1	–
Male	2.4 (1.14–5.07)	0.02	2.96 (1.23–7.12)	0.02
Ethnicity				
Malay/Indian/others	1	–	1	–
Chinese	0.81 (0.26–2.46)	0.7	1.14 (0.32–4.06)	0.84
Smoking status				
Non-smoker	1	–	1	–
Smoker/ex-smoker	0.74 (0.27–1.99)	0.55	0.35 (0.11–1.09)	0.07
Educational status				
Tertiary level	1	–	1	–
Secondary level	1.96 (0.66–5.77)	0.22	1.52 (0.46–5.02)	0.49
No formal education/primary	1.71 (0.61–4.8)	0.31	1.93 (0.61–6.15)	0.26
Hospitalisation in past 6 mth				
No	1	–	1	–
Yes	1.74 (0.56–5.45)	0.34	1.82 (0.49–6.73)	0.37
Previously received influenza vaccine (> 2 yr ago)				
No	1	–	1	–
Yes	0.87 (0.35–2.2)	0.77	0.97 (0.35–2.72)	0.96

*Adjusted for study intervention, knowledge score, willingness to undertake vaccination post education, age, gender, ethnicity, smoking status, educational level, recent hospitalisation, and previously taken flu vaccine

Based on the results of the postintervention questionnaire, 61 (38.1%) patients in each intervention group reported willingness to take up influenza vaccination. Among these patients, those who planned to do so early (within one month of study recruitment), were more likely to complete the vaccination (adjusted OR 13.18, CI 4.1–42.33, $p < 0.01$). Smokers and ex-

smokers were less likely to complete the vaccination (adjusted OR 0.21, CI 0.05–0.87, $p = 0.03$) (Table III).

Table III. Multivariable analysis of factors associated with influenza vaccine uptake (n = 122).*

Factor	OR (95% CI)	p-value
Study intervention		
Pamphlet along	1	–
Individualised counselling	0.53 (0.19–1.53)	0.24
Post-education knowledge score	0.92 (0.71–1.19)	0.53
Plan to go for vaccination		
Within 3 mth–1 yr	1	–
Today, to up to a month	13.18 (4.1–42.33)	< 0.01 [†]
Gender		
Female	1	–
Male	1.9 (0.65–5.58)	0.24
Ethnicity		
Malay/Indian/others	1	–
Chinese	0.97 (0.21–4.59)	0.97
Smoking status		
Non-smoker	1	–
Smoker/ex-smoker (quit > 6 mth)	0.21 (0.05–0.87)	0.03 [†]
Number of comorbidities	1.08 (0.74–1.58)	0.70
Education status		
Tertiary level	1	–
Secondary level	1.08 (0.24–4.73)	0.92
No formal education/primary	1.09 (0.27–4.41)	0.90
Recent hospitalisation in past 6 mth		
No	1	–
Yes	2.45 (0.42–14.47)	0.32
Received vaccination before previously received influenza vaccine (> 2 yr ago)		
No/unsure	1	–
Yes	1.48 (0.41–5.4)	0.55

*Only those who were willing to be vaccinated were included. [†] $p < 0.05$ was considered statistically significant. CI: confidence interval; OR: odds ratio

Intervention was more effective than the control in improving the patient's knowledge regarding influenza infections, and the indications and benefits of receiving the influenza vaccine ($p < 0.01$). However, overall knowledge scores did not influence actual vaccine uptake rates at three months (adjusted OR 1.10, 95% CI 0.90–1.34, $p = 0.35$). The breakdown of knowledge scores between intervention groups are summarised in Table IV.

Table IV. Comparison of post-intervention knowledge scores between groups.

Item	No. (%) / Mean \pm SD		p-value
	Intervention (n = 160)	Control (n = 160)	
Total score (13-item questionnaire)	10.5 \pm 2.2)	9.0 \pm 2.7	< 0.01
Knowledge about influenza infection			
Influenza is caused by a virus	139 (86.9)	115 (71.9)	< 0.01
The following patients are at higher risk of developing severe influenza-related complications			
<i>Pregnant</i>	145 (90.6)	128 (80.0)	0.01
<i>Child</i>	147 (91.9)	135 (84.4)	0.04
<i>Older person</i>	155 (96.9)	145 (90.6)	0.02
<i>Male</i>	121 (75.6)	111 (69.4)	0.21
<i>Frequent traveller</i>	72 (45.0)	54 (33.8)	0.04
<i>Smoker</i>	56 (35.0)	46 (28.8)	0.23
Influenza outbreaks are responsible for increased deaths among older patients	153 (95.6)	139 (86.9)	< 0.01
Knowledge about influenza vaccination			
People who have received influenza vaccination can still fall sick with running nose or cough	126 (78.8)	107 (66.9)	0.02
Influenza vaccine is safe for pregnant women	130 (81.3)	92 (57.5)	< 0.01
Influenza vaccine is safe for people with mild egg allergy	121 (75.6)	94 (58.8)	< 0.01
Influenza vaccine is effective for 1 yr	157 (98.1)	129 (80.6)	< 0.01
Knowledge about alternative payment option in Singapore			
MediSave can be used to pay for influenza vaccination (in the elderly)	153 (95.6)	146 (91.3)	0.11

SD: standard deviation

A total of 261 (81.6%) recruited patients had never received influenza vaccination in their lifetime. The main reasons cited were as follows: (a) seldom contracting flu (43%); (b) lack of awareness of the influenza vaccine (39.8%); and (c) influenza vaccine had not been recommended by their healthcare provider (35.7%). Among all the recruited patients, 59 (18.4%) reported they had previously received influenza vaccination more than two years ago but did not continue with regular annual vaccination thereafter. Main reasons cited were as follows: (a) seldom contracting flu (45.8%); (b) seldom travelling overseas (42.4%); and (c) unsure that regular repeat vaccination was required (15.3%). The full list of reasons for not opting for influenza vaccination is detailed in Table V.

Table V. Reasons for not receiving influenza vaccination.

Patients with no previous influenza vaccination (n = 261)	No. (%)
I seldom suffer from flu or cough	111 (42.5)
I was not aware there is such a vaccine	103 (39.8)
The vaccine was not recommended by my healthcare provider	92 (35.7)
I prefer to rely on my natural immunity (rather than on the vaccine)	76 (29.3)
I was not sure where to get vaccinated	43 (16.7)
I seldom travel overseas	30 (11.6)
Influenza is not a serious illness	24 (9.3)
I am worried about the side effects of the vaccine	13 (5.0)
I have no time to take the vaccine	9 (3.5)
Vaccination is too expensive	7 (2.7)
Patients who received influenza vaccination > 2 yr ago (n = 59)	
I seldom suffer from flu or cough	27 (45.8)
I seldom travel overseas	25 (42.4)
I was not sure that I needed regular vaccination	9 (15.3)
I did not receive reminders from my healthcare provider	7 (11.9)
The vaccine was not recommended by my doctor	6 (10.2)
I forgot to return for subsequent vaccination	5 (8.5)
The influenza vaccine was not effective	4 (6.8)
Vaccination is too expensive	4 (6.8)
I am worried about the side effects of the vaccine	3 (5.1)
I have no time to take the vaccine	1 (1.7)

A total of 122 patients reported willingness to take the influenza vaccination immediately after the study intervention. The top reasons supporting this decision were as follows: (a) awareness of the benefits of the influenza vaccine (67.2%); (b) knowledge that the vaccination was recommended in those aged 65 years and older (55.7%); (c) awareness of the health complications of severe influenza infection (38.5%); and (d) awareness of the presence of the influenza vaccine (37.7%). There was no difference in the reasons cited in the two intervention groups. The full list of reasons supporting patients' decision to undertake the influenza vaccination is detailed in Table VI.

Table VI. Reasons for being willing to undergo influenza vaccination after the study intervention (n = 122).

Reason	No. (%)
I am now aware of the benefits of the influenza vaccination	82 (67.2)
The influenza vaccination is recommended for people within my age group	68 (55.7)
I am now aware of the health problems associated with the influenza virus	47 (38.5)
I am now aware that there is such a vaccine	46 (37.7)
I can use MediSave to pay for the vaccination	20 (16.4)
The influenza vaccination is recommended for people with chronic medical conditions	14 (11.5)
The influenza vaccination is affordable	11 (9.0)

DISCUSSION

The World Health Organization (WHO) recommends annual seasonal influenza vaccination for pregnant women, children aged six to 59 months, older adults, persons with specific chronic medical conditions, and healthcare workers.⁽¹⁾

In Singapore, the uptake of influenza vaccination among adults older than 50 years remains low. Only 15.2% had received vaccination per a National Health Surveillance Survey conducted in 2013.⁽¹¹⁾ To address this issue, the Ministry of Health Singapore introduced the National Adult Immunization Schedule in October 2017, with the aim of increasing public awareness and uptake of important vaccines. Concurrently, flexible payment options were introduced, which allowed the use of MediSave for the payment of influenza vaccination in target populations.

Influenza vaccination uptake is adversely affected by patients' knowledge gaps and misperceptions⁽⁹⁾ regarding the vaccine. In contrast, patient education has been shown to improve vaccination uptake. Such education can be provided using printed materials or face-to-face interactions between patients and their healthcare providers.⁽¹⁵⁾

Our study has found that the use of educational brochure was as effective as IC in improving influenza vaccination uptake among the community-dwelling older adults in

Singapore. Immediately postintervention, an equal proportion (38.1%) of patients in both intervention arms reported willingness to receive the influenza vaccine. However, the actual vaccination uptake at the three-month follow-up was lower, at 10.9% and 14.3% in the IC and P group, respectively; this difference was not statistically significant. To date, there have been no other trials directly comparing IC with distribution of informational materials. Both modalities have separately been shown to be mostly effective. Counselling together with pamphlets have been more effective than no intervention at all.⁽¹⁵⁾ Education by community pharmacists improved knowledge and vaccination uptake.⁽²²⁾ Patient education by staff was alone insufficient in increasing vaccine uptake compared with the addition of an enabling systemic workflow.⁽²³⁾ Educational mailers have been effective in increasing vaccine uptake in urban senior populations.^(24,25)

Among the 261 participants who had never received influenza vaccination previously, there was a large proportion of them who reported they were unaware of the availability of such a vaccine (39.8%) and also that their healthcare provider had not recommended vaccination to them before (35.7%).

We also found that both educational methods (pamphlets and IC) improved patients' knowledge ($p < 0.01$ for both) about the consequences of influenza infection, and the indications and benefits of vaccination. However, IC was more effective than pamphlets alone in improving overall knowledge scores.

In particular, significantly more study participants in the IC group were aware that older adults were at higher risk of developing severe influenza-related complications and that influenza outbreaks were responsible for increased deaths among older adults. There were also significantly more subjects in the IC group who knew about the duration of efficacy of the influenza vaccine and that the vaccine was safe to administer in people with mild egg allergy.

Better knowledge scores in the IC group did not translate to higher vaccination uptake rates. Instead, we found that the self-reported willingness to receive influenza vaccination (adjusted OR 12.2) was the strongest predictor of eventual vaccine uptake, followed by male gender (adjusted OR 3.0). This may be consistent with the results of a study in Hong Kong where education via IC seemed to affect mainly the subgroup of patients with uncertain intent to receive vaccination.⁽¹⁵⁾ We also found that male patients were more likely to undergo vaccination; in contrast, univariate analysis of data from the National Health Surveillance Survey⁽¹¹⁾ showed that women were more likely to be vaccinated (OR 1.22 [1.02–1.46]), though this was no longer significant after multivariate analysis.

Such findings have important implications in busy primary care practice settings (in which this study was conducted). Family practitioners looking to holistic management of their patients often struggle with balancing time constraints and preventive care needs of their patients. This could explain the relative lack of awareness of influenza vaccination among the study cohort. In addition, vaccine educational pamphlets are traditionally placed in the patient waiting areas. This requires patients to take the initiative to pick up the brochure and proactively approach their healthcare provider with queries on vaccination. Our results suggest that healthcare providers can initiate the conversation by recommending influenza vaccination to their patients and support their decision-making process by handing them the educational pamphlet for further self-reading.

Because of the high attrition in vaccination uptake rates from the time that patient education is received, we also recommend that vaccination be performed early: within a month from the time that the patient had expressed willingness to receive vaccination, or even as an unscheduled event on the same day.

A key strength of our study is the robust randomised controlled trial design. We had successfully achieved the projected recruitment. The loss to follow-up rate was kept low in

both intervention arms. One limitation is the selection of only literate patients to participate, which could limit the generalisability of the results.

Future research should focus on enabling systematic interventions to facilitate persons who have already indicated willingness to undergo vaccination. Similar studies on persons with lower literacy levels could be conducted, as they may have different perceptions and barriers towards vaccination.

In conclusion, the uptake of influenza vaccination improved after either modality of patient education. However, IC was not superior to pamphlets alone in improving uptake. Performing vaccination at the initial point of contact with the healthcare provider may improve actual uptake rates.

ACKNOWLEDGEMENTS

We would like to thank our study team members for their contributions: Dr Cheng Ke Yi, Dr Jean Chen Yanjun, Dr Chiang Swee Kiat Clarence, Dr Sin Yew Leong, and Dr Soh Feng Wei. We also thank the Singapore Health Services Family Medicine Residency Programme for their support, and Ms Tan Yang Thong and Ms Usha Sankari from our institution's research department for their administrative support.

REFERENCES

1. World Health Organization. Influenza position paper. November 2012. Available at: http://www.who.int/immunization/policy/position_papers/influenza/en/. Accessed November 25, 2018.
2. Yang L, Ma S, Chen PY, et al. Influenza associated mortality in the subtropics and tropics: results from three Asian cities. *Vaccine* 2011; 29:8909-14.

3. Ang LW, Lim C, Lee VJ, et al. Influenza-associated hospitalizations, Singapore, 2004–2008 and 2010–2012. *Emerg Infect Dis* 2014; 20:1652-60.
4. Colquhoun AJ, Nicholson KG, Botha JL, Raymond NT. Effectiveness of influenza vaccine in reducing hospital admissions in people with diabetes. *Epidemiol Infect* 1997; 119:335-41.
5. Talbot HK, Griffin MR, Chen Q, et al. Effectiveness of seasonal vaccine in preventing confirmed influenza-associated hospitalizations in community dwelling older adults. *J Infect Dis* 2011; 203:500-8.
6. Nichol KL, Baken L, Nelson A. Relation between influenza vaccination and outpatient visits, hospitalization, and mortality in elderly persons with chronic lung disease. *Ann Intern Med* 1999; 130:397-403.
7. Yang J, Atkins KE, Feng L, et al. Seasonal influenza vaccination in China: landscape of diverse regional reimbursement policy, and budget impact analysis. *Vaccine* 2016; 34:5724–35.
8. Williams WW, Lu PJ, O'Halloran A, et al. Surveillance of vaccination coverage among adult populations – United States, 2015. *MMWR Surveill Summ* 2017; 66:1-28.
9. Bödeker B, Remschmidt C, Schmich P, Wichmann O. Why are older adults and individuals with underlying chronic diseases in Germany not vaccinated against flu? A population-based study. *BMC Public Health* 2015; 15:618.
10. Dyda A, Karki S, Hayen A, et al. Influenza and pneumococcal vaccination in Australian adults: a systematic review of coverage and factors associated with uptake. *BMC Infect Dis* 2016; 16:515.
11. Ang LW, Cutter J, James L, Goh KT. Factors associated with influenza vaccine uptake in older adults living in the community in Singapore. *Epidemiol Infect* 2017; 145:775-86.

12. Stinchfield PK. Practice-proven interventions to increase vaccination rates and broaden the immunization season. *Am J Med* 2008; 121(7 Suppl 2):S11-21.
13. Thomas RE, Russell M, Lorenzetti D. Interventions to increase influenza vaccination rates of those 60 years and older in the community. *Cochrane Database Syst Rev* 2010; (9):CD005188.
14. Tan EK, Lim LH, Teoh YL, Ong G, Bock HL. Influenza and seasonal influenza vaccination among diabetics in Singapore: knowledge , attitudes and practices. *Singapore Med J* 2010; 51:623-30.
15. Leung KC, Mui C, Chiu WY, et al. Impact of patient education on influenza vaccine uptake among community-dwelling elderly: a randomized controlled trial. *Health Educ Res* 2017; 32:455-64.
16. Kravos A, Kračun L, Kravos K, Iljaž R. The impact of patient's socio-demographic characteristics, comorbidities and attitudes on flu vaccination uptake in family practice settings. *Zdr Varst* 2015; 54:204-11.
17. Mangtani P, Breeze E, Stirling S, et al. Cross-sectional survey of older peoples' views related to influenza vaccine uptake. *BMC Public Health* 2006; 6:249.
18. Kwong EWY, Lam IOY, Chan TMF. What factors affect influenza vaccine uptake among community-dwelling older Chinese people in Hong Kong general outpatient clinics? *J Clin Nurs* 2009; 18:960-71.
19. Böhmer MM, Walter D, Krause G, et al. Determinants of tetanus and seasonal influenza vaccine uptake in adults living in Germany. *Hum Vaccin* 2011; 7:1317-25.
20. Klett-Tammen CJ, Krause G, Seefeld L, Ott JJ. Determinants of tetanus, pneumococcal and influenza vaccination in the elderly: a representative cross-sectional study on knowledge, attitude and practice (KAP). *BMC Public Health* 2016; 16:121.

21. Abu-Rish EY, Elayeh ER, Mousa LA, Butanji YK, Albsoul-Younes AM. Knowledge, awareness and practices towards seasonal influenza and its vaccine: implications for future vaccination campaigns in Jordan. *Fam Pract* 2016; 33:690-7.
22. Marrero W, Hernández L, García R, Gutiérrez LM. [Immunization program against influenza for adults 65 years or older at a community pharmacy in Puerto Rico]. *P R Health Sci J* 2006; 25:35-42.
23. Herman CJ, Speroff T, Cebul RD. Improving compliance with immunization in the older adult: results of a randomized cohort study. *J Am Geriatr Soc* 1994; 42:1154-9.
24. Armstrong K, Berlin M, Schwartz JS, Propert K, Ubel PA. Educational content and the effectiveness of influenza vaccination reminders. *J Gen Intern Med* 1997; 14:695-8.
25. Krieger JW, Castorina JS, Walls ML, Weaver MR, Ciske S. Increasing influenza and pneumococcal immunization rates: a randomized controlled study of a senior center-based intervention. *Am J Prev Med* 2000; 18:123-31.