

# Influenza vaccine uptake and associated factors in adult patients with type 2 diabetes in a general outpatient clinic in Hong Kong

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## Background and objective

This study examined the uptake of influenza vaccine (Vaxigrip Tetra, Sanofi-Aventis) among local patients with type 2 diabetes (T2D) and their intention to receive future flu vaccines. We also explored associations between factors pertinent to the Health Belief Model (HBM) and vaccination behaviour. Based on these findings, targeted strategies to improve flu vaccine uptake are proposed.

## Methods

In all, 499 patients with diabetes were recruited from a government general outpatient clinic (GOPC) in Hong Kong between 1 and 14 March 2021. A cross-sectional, questionnaire-based study to investigate vaccination behaviours and the HBM was conducted. A self-reported questionnaire that included sociodemographic data of participants' and patients' knowledge and perceptions related to flu vaccines based on the HBM framework was used. Study subjects aged <18 years and those who were unable to provide consent or had contraindications to flu vaccine were excluded from the study.

## Results

Among the study sample, the reported flu vaccine uptake rate was 42% during 2020. Results from multivariate logistic analyses revealed a positive correlation between the likelihood of vaccination and factors pertinent to the HBM, such as knowledge that flu vaccine is required annually, not considering side effects from flu vaccine uptake and having better access to flu vaccine.

## Discussion

The rate of flu vaccine uptake in our study population was suboptimal. Given the significance of influenza among patients with T2D, various public health interventions should be used to promote annual flu vaccine uptake.

**INFLUENZA** is a viral disease that causes yearly epidemics and has a major impact on hospitalisations, especially for patients with chronic diseases such as diabetes. Vaccination is associated with a 79% reduction in influenza-associated hospitalisations among patients with diabetes<sup>1</sup> and is therefore recommended for this population regardless of age. Yet, many studies have revealed that the vaccination rate among individuals with diabetes remains suboptimal.<sup>2–5</sup> In Hong Kong, the coverage rate of flu vaccine (Vaxigrip Tetra, Sanofi-Aventis) in the 2020–21 season was 44.6% for those aged ≥65 years and only 12.3% for those aged 50–64 years,<sup>6</sup> which is far below the coverage rate recommended by the World Health Organization (WHO) of at least 75%.<sup>7</sup>

The Health Belief Model (HBM) is one of the most widely used cognitive models<sup>8</sup> to examine health behaviours, and local studies have confirmed its applicability in the Chinese population.<sup>8,9</sup> Predictors in the HBM include perceived susceptibility to the disease, perceived severity of the illness, perceived benefits with the health behaviour, perceived barriers to action, self-efficacy and cues to action.<sup>8</sup> Numerous studies have found that vaccinated individuals are more likely to perceive the benefits of flu vaccine uptake, have better knowledge of flu vaccine and perceive fewer side effects from vaccination.<sup>2,5,10</sup> Other factors that facilitate the uptake of flu vaccine include healthcare workers' recommendations<sup>2,3,8–13</sup> and improved access to vaccine-related services.<sup>8</sup>

Overseas studies have found a positive impact of the pandemic on vaccination adherence and incentive as a result of changes in risk perception and better adherence to good public health practices.<sup>14–16</sup>

In Hong Kong, general outpatient clinics (GOPC) provide public primary care services, including medical consultations, drug injections, health risk assessments for patients with chronic diseases and targeted treatment services, such as fall prevention clinics by allied health professionals. Since 2004, Hong Kong citizens aged ≥65 years have been eligible for free flu vaccinations in GOPC. The Hong Kong government rolled out the Vaccination Subsidy Scheme in 2018, whereby residents aged 50–64 years are partially funded to receive flu vaccine in private clinics enrolled in the program.

Despite 10% of the population in Hong Kong having type 2 diabetes (T2D),<sup>17</sup> the vaccination behaviour in this group has not been studied. Thus, we investigated the uptake of flu vaccine and associated factors among local T2D patients using the HBM.

## Methods

A cross-sectional questionnaire-based study was chosen after literature reviews on vaccination behaviours and HBM. The study was conducted at the Sai Wan Ho GOPC, where diabetes is the second most frequent chronic illness. A self-reported questionnaire using Champion's Health Belief Model Scale<sup>18</sup> and based on that used in a previous study<sup>13</sup> was chosen for data collection in the present study for its content relevance and applicability to the Chinese population.

The questionnaire from the previous study was written in English. For use in the present study, the questionnaire was translated from English into Chinese by two different bilingual translators. Before data collection, a panel of five family medicine specialists were invited to comment on the questionnaire for content validity. In addition, some of the questions were rephrased after a pilot study with 15 patients with diabetes to help participants' understanding.

The first part of the questionnaire collected sociodemographic data, information regarding flu vaccine uptake during the 2020 flu season and the respondents' intention to be vaccinated in the coming 12 months.

The second part of the questionnaire used the HBM framework to examine patients' knowledge related to flu vaccines, the perceived benefits of vaccination, the perceived side effects of flu vaccine, the perceived susceptibility towards influenza, the perceived severity of consequences if influenza was contracted and cues for vaccination uptake.

Study subjects were recruited by the principal investigator (RWK Chan) by consecutive sampling of all patients with diabetes aged  $\geq 18$  years between 1 and 14 March 2021. Patients aged  $< 18$  years and those who were unable to provide consent

or had contraindications to flu vaccine were excluded from the study.

Patients were invited to participate in the study upon attending follow-up. After obtaining verbal consent, the questionnaire was given to patients, who were instructed to hand in their completed questionnaire to the principal investigator during the consultation. Patients who declined to participate in the study continued with the routine consultation and their management was not affected. Questionnaires were reviewed for completeness and written informed consent was obtained at the same time. In case of any missing responses, the questionnaires were filled in by the principal investigator based on participants' responses.

The study was approved by the Hong Kong East Cluster Research Ethics Committee (Ref. no.: HKEC REC-2020-111).

## Statistical analyses

Our sample size was calculated using the Raosoft online sample size calculator ([www.raosoft.com/sample\\_size.html](http://www.raosoft.com/sample_size.html)). Approximately 3600 diabetes patients attend regular follow-up at the Sai Wan Ho GOPC. Assuming the population proportion of being vaccinated to be 50%,<sup>10,19</sup> in order to estimate the largest sample size with a 95% confidence level and a 5% margin of error, the calculated sample size is 348. An estimated number of 598 patients with diabetes is seen in a 2-week period. Factoring in the expected response rate of 70%, it was calculated that 420 subjects needed to be recruited to the study.

Statistical analyses were conducted using SPSS Statistics 27 (IBM Corp., Armonk, NY, USA). Chi-squared tests were used to analyse the effects of sociodemographic data on the two

**Table 1. Sociodemographic characteristics of participants**

	N	%
<b>Sex</b>		
Male	219	43.9
Female	278	55.7
<b>Age group (years)</b>		
<64	179	35.9
$\geq 65$	319	63.9
<b>Education level</b>		
Primary or below	192	38.5
Secondary	238	47.7
Tertiary or above	62	12.4
<b>Monthly household income (HKD)</b>		
<15,000	279	55.9
15,000–30,000	101	20.2
>30,000–50,000	65	13
>50,000	23	4.6
<b>Intend to receive flu vaccine in the coming year</b>	253	50.7
<b>Vaccinated in the past 12 months</b>	209	41.9

Note, frequencies may not add up to the total because missing values were not included in the denominator. Valid percentages are reported.

outcome variables: patients' flu vaccine uptake and their intention to get vaccinated in the coming year. Univariate logistic regression was performed to assess the strength of association between all Health Belief Model-based factors included in the questionnaire and the two outcome variables. Significant variables (two-tailed  $P < 0.05$ ) were included in multivariate regression analyses.

## Results

### Participant demographics

In all, 499 patients with diabetes completed the questionnaire (response

rate 80%). As indicated in Table 1, 55.7% of patients were female and 63.9% were aged  $\geq 65$  years. The uptake of flu vaccine in the past 12 months was 41.9%, and 50.7% of respondents intended to receive flu vaccine in the coming 12 months.

### Factors associated with flu vaccination in the previous flu season

Patients with diabetes who were female or aged  $\geq 65$  years were more likely to have received the flu vaccine in the previous flu season (Table 2). Individuals who had not attained education above secondary school level and had a monthly household income above HKD50,000 were less likely to get

vaccinated (Table 2). The three HBM-based factors that showed a positive association with flu vaccination in the previous flu season included a belief that annual flu vaccination is required, perceiving flu vaccine to be efficacious and perceiving that the uptake of flu vaccine was not associated with any side effects (Table 3).

### Intention to take up flu vaccination in the coming year

Older patients and those who had coronary artery disease were more willing to take up flu vaccine in the coming 12 months. Participants with a secondary school education level and those with a household

**Table 2. Sociodemographic characteristics associated with flu vaccine uptake and intention to receive flu vaccine in the coming year**

	Had taken up flu vaccine during the 2020 flu season			Intend to receive flu vaccine in the coming year		
	ORu (95% CI)	ORm (95% CI)	P value	ORu (95% CI)	ORm (95% CI)	P value
<b>Demographics</b>						
Sex						
Male	1.0	1.0	0.04	1.0	-	0.42
Female	1.47 (1.02, 2.12)	1.51 (0.98, 2.34)		0.86 (0.60, 1.23)	-	
Age group (years)						
<64	1.0	1.0	<0.01	1.0	1.0	<0.01
$\geq 65$	5.04 (3.28, 7.76)	1.93 (0.96, 3.86)		2.72 (1.86, 3.97)	1.01 (0.51, 1.99)	
Income (HKD)						
<15,000	1.0	1.0	<0.01	1.0	1.0	0.01
15,000–30,000	0.44 (0.27, 0.71)	1.09 (0.48, 2.49)	<0.01	0.49 (0.31, 0.78)	0.95 (0.45, 2.02)	<0.01
>30,000–50,000	0.54 (0.31, 0.95)	0.84 (0.32, 2.20)	0.03	0.56 (0.32, 0.97)	0.64 (0.26, 1.57)	0.04
>50,000	0.35 (0.13, 0.91)	0.23 (0.06, 0.83)	0.03	0.94 (0.40, 2.21)	1.05 (0.29, 3.86)	0.88
Education level						
Primary or below	1.0	1.0	<0.01	1.0	1.0	<0.01
Secondary	0.55 (0.37, 0.81)	0.75 (0.39, 1.42)	<0.01	0.63 (0.43, 0.93)	0.99 (0.52, 1.89)	0.02
Tertiary or above	1.20 (0.68, 2.13)	2.25 (0.74, 6.82)	0.54	1.44 (0.80, 2.61)	2.17 (0.72, 6.56)	0.23
<b>Comorbidities</b>						
Coronary artery disease						
No	1.0		0.13	1.0	1.0	0.03
Yes	1.65 (0.87, 3.14)	-		2.15 (1.09, 4.27)	1.59 (0.74, 3.43)	

Significant variables ( $P < 0.05$ ) from univariate regression analyses were included in multivariate regression analyses.

ORu, unadjusted odds ratios; ORm, multivariate odds ratio obtained from stepwise logistic regression.

income of HKD15,000–30,000 or HKD30,000–50,000 were less inclined to get vaccinated in the future (Table 2). The HBM-based factors that were correlated with the intention to be vaccinated included knowledge that flu vaccination is required annually, not considering side effects from flu vaccine uptake and better access to flu vaccine (Table 3).

### Discussion

In the present study, the uptake of flu vaccine among local patients with diabetes was 41.9%, which is higher than rates reported in studies conducted in Taiwan (31–35%)<sup>10</sup> and Ningbo, China (<10%).<sup>3</sup> This difference may be explained by the timing of the present study, which coincided with the outbreak

of the COVID-19 pandemic, resulting in heightened awareness of immunisation in preventing severe complications of disease. Similar findings regarding influenza vaccination during the COVID-19 pandemic were reported in a local (Hong Kong) study by Kwok et al<sup>16</sup> and in a study from Poland by Grochowska et al.<sup>15</sup> Overseas studies have concluded

**Table 3. Health Belief Model-based factors associated with flu vaccine behaviours and intentions**

	Had taken up flu vaccine during the 2020 flu season		Intend to receive flu vaccine in the coming year	
	ORu (95% CI)	ORm (95% CI)	ORu (95% CI)	ORm (95% CI)
<b>Knowledge related to flu vaccine</b>				
Flu vaccine is required every year	48.89** (25.71, 92.96)	22.68** (11.01, 46.73)	28.73** (17.58, 46.95)	15.45** (8.26, 28.91)
Perceived that flu vaccine could reduce the risk of influenza-induced complications (eg pneumonia)	4.83** (2.59, 9.02)	1.28 (0.41, 3.97)	5.30** (3.00, 9.37)	2.10 (0.78, 5.66)
Perceived that flu vaccine could reduce the risk of hospitalisation due to influenza	5.99** (3.08, 11.6)	1.90 (0.61, 5.96)	4.89** (2.80, 8.54)	0.80 (0.29, 2.24)
Perceived that flu vaccine could reduce the risk of death due to influenza	3.28** (1.93, 5.59)	1.11 (0.44, 2.77)	4.01** (2.42, 6.64)	2.02 (0.89, 4.61)
<b>Perceptions related to influenza</b>				
Patients with diabetes have higher chances of contracting influenza compared with the general public	1.99** (1.31, 3.02)	1.50 (0.86, 2.62)	2.61** (1.73, 3.92)	1.17 (0.57, 2.39)
Patients with diabetes will suffer more severe consequences after contracting influenza than the general public	1.78* (1.10, 2.88)	0.95 (0.50, 1.81)	2.42** (1.51, 3.87)	1.18 (0.64, 2.20)
Influenza will severely impact the health of patients with diabetes	3.06** (1.81, 5.17)	2.09 (0.94, 4.3)	2.89** (1.79, 4.68)	1.86 (0.85, 4.09)
<b>Perceptions related to flu vaccine</b>				
Perceived no significant side effects from flu vaccine	0.25** (0.17, 0.37)	0.46* (0.25, 0.85)	0.24** (0.16, 0.35)	0.37** (0.20, 0.66)
Perceived efficacy of flu vaccine in providing protection against influenza	26.3** (0.18, 84.79)	11.85** (2.34, 60.01)	10.49** (5.26, 20.93)	2.67 (0.96, 7.45)
<b>Cues to action</b>				
More likely to take up flu vaccine if recommended by a HCW	16.60** (7.10, 38.79)	2.56 (0.72, 9.11)	14.85** (7.49, 29.46)	2.15 (0.67, 6.91)
More likely to take up flu vaccine if suggested by family members	6.71** (3.99, 11.27)	1.82 (0.92, 3.63)	8.85** (5.41, 14.50)	1.31 (0.51, 3.39)
More likely to take up flu vaccine if it is provided in proximity to residence	6.27** (3.88, 10.13)	1.19 (0.49, 2.88)	9.14** (5.714, 14.63)	2.84* (1.20, 6.71)

\* $P < 0.05$ , \*\* $P < 0.01$ .

Significant variables ( $P < 0.05$ ) from univariate regression analyses were included in multivariate regression analyses.

HCW, healthcare worker; ORu, unadjusted odds ratios; ORm, multivariate odds ratio obtained from stepwise logistic regression.

that changes in risk perception and better adherence to good public health practices during a pandemic outbreak are reasons for improved vaccination adherence and incentive.<sup>14–16</sup>

### Sociodemographic characteristics

First, in patients with diabetes, age  $\geq 65$  years was positively associated with both vaccine adherence and intention to be vaccinated in the future, a finding that corroborates results reported in both local and overseas studies.<sup>3,8,10,13</sup> In the present study, flu vaccine uptake was highest (55%) in the group aged  $\geq 65$  years. Despite subsidies being available under the Vaccination Subsidy Scheme since 2018 for people aged 50–64 years to receive flu vaccine in enrolled private clinics, the present study revealed the rate of flu vaccine uptake among patients with diabetes aged  $< 65$  years was suboptimal

### Box 1. New knowledge added by this study and its clinical implications

#### New knowledge added by this study

Study participants with a secondary school education level and higher household income were less likely to have received flu vaccine and reported a lower likelihood to receive future vaccination

In contrast to previous literature, perceived benefits of flu vaccine and healthcare workers' recommendations were not established as significant predictors for flu vaccine uptake in this study

#### Clinical implications

To promote flu vaccine uptake among young individuals with diabetes (age  $< 65$  years), we should:

- expand eligibility for young individuals with diabetes to receive flu vaccine in general outpatient clinics.
- establish an interactive online platform to promote the safety and efficacy of vaccination
- improve access to vaccine-related services through collaborations with local communities

More local studies are warranted to explore the root cause for low vaccination adherence and intention to receive future vaccinations among unvaccinated individuals who were aware of the benefits of flu vaccine

(20%). Low perceived risks of influenza disease and a lack of awareness of the need for vaccination have been postulated as explanations for the significantly lower flu vaccine coverage for younger patients with diabetes aged 40–64 years.<sup>2</sup> In addition, because younger patients with full-time jobs often have less free time, we suggest expanding the eligibility for vaccination in GOPC so these individuals have the opportunity to be vaccinated when they attend their regular follow-up.

Second, study participants with a secondary school education level and higher household income were less likely to have received the flu vaccine and had lower intentions to receive vaccinations in the future (Box 1). Although Tan et al<sup>11</sup> and Domnich et al<sup>14</sup> correlated lower income with vaccine hesitancy, most other studies<sup>2,3,8,9,13</sup> of vaccination behaviour failed to demonstrate income as a predictor for vaccine uptake. Our results may reflect increased exposure to social media among those with higher education levels or higher household income,<sup>12</sup> with vaccination misinformation pervasive throughout social media resulting in medical mistrust. This group of individuals often has easy access to health information on social media, where misinformation about vaccination is more likely to be shared than articles with accurate content.<sup>20</sup> Studies have found vaccine-resistant individuals are more likely to receive information from social media channels rather than health and government authorities,<sup>21</sup> because information on social media channels is conveyed using understandable terminology rather than medical jargon. In promoting vaccine awareness, public health authorities should ensure that the information delivered is comprehensible and accessible to the general public.

Our study also revealed female sex as a factor associated with willingness to receive the flu vaccine. In the literature, there are differences in the reported associations between sex and vaccination uptake. For example, in Asian studies, females have a higher rate of vaccination uptake.<sup>2,8,10</sup> You et al showed that women were more likely to use outpatient healthcare services than men.<sup>22</sup> However,

studies from Western countries have reported the opposite results.<sup>4,14</sup> Further research is needed to determine whether sex association varies across different countries or ethnicities.

### HBM-based factors

Consistent with both local and overseas studies,<sup>3,5,8,9,13</sup> knowledge that the flu vaccine needs to be administered annually was the most significant factor correlated with both flu vaccine uptake and the intention to receive flu vaccine in the coming year. In addition, respondents who were not concerned about side effects from flu vaccine uptake, those who perceived flu vaccine as being efficacious and those with better access to flu vaccine were more willing to take up vaccination in the future. Conversely, although not illustrated in multivariate analyses, a substantial proportion of our study population remained unvaccinated despite being aware of the benefits of flu vaccine. More local studies are warranted to explore the root cause for low vaccination adherence and intentions to receive future vaccinations.

Recommendations from healthcare professionals have been established as strong determinants of flu vaccine uptake in both local (Hong Kong) and overseas studies.<sup>2–5,8–10,23,24</sup> However, in the present study, this factor was not significant in multivariate regression analysis. One explanation for this observation is consultation time constraints. According to data from the World Bank, the doctor-to-patient ratio per 1000 population in overseas countries supporting the importance of doctor recommendations was 3.5,<sup>23</sup> compared with 2 in Hong Kong.<sup>25</sup> Heavy patient load, translating to an average consultation time of six minutes per patient in GOPCs in Hong Kong, might be one of the factors limiting informed discussion regarding flu vaccine during clinical consultations. A local study revealed that 85% of adults aged  $> 65$  years said they had not received information regarding vaccination during a consultation.<sup>8</sup> This aligned with a previous study, which showed connections between patients' mistrust and physicians' interpersonal communication skills, including limited time during routine visits

and poor delivery of information during consultations.<sup>26</sup> In addition, vaccine hesitancy among healthcare workers needs to be addressed. In Australia, healthcare workers have reported their barriers to vaccination include vaccine ineffectiveness, that staff may not be at risk of influenza and adverse effects of immunisation.<sup>27</sup> Similarly, with a high prevalence of vaccine hesitancy among healthcare professionals in Hong Kong,<sup>28</sup> we postulate that recommendations made by those who do not believe in the benefits of vaccination will not sound as convincing as those who do.

### Proposed public health measures to promote flu vaccine uptake

Based on our study findings, we recommend emphasising the need for annual flu vaccination as preventive care in existing diabetes patient education programs. Personal reminder systems, such as text messages, can be implemented, with studies finding that these systems increase the flu vaccine immunisation rate by 29%.<sup>29</sup>

In Australia, since the introduction in 2010 of national funding of annual flu vaccines for those aged <65 years who are at higher risk of infection, including those with diabetes, vaccination coverage has increased from 29.8% in 2008<sup>30</sup> to 49.2% in 2013.<sup>31</sup> In Hong Kong, only those aged ≥65 years are eligible for free vaccination at a GOPC under the current government vaccination program. This program should be extended to all those with diabetes to encourage young patients with diabetes to receive flu vaccine when attending follow-up.

Because in the present study consideration of side effects after flu vaccine uptake was associated with vaccination adherence, interventions aimed at educating patients with diabetes as to the safety and efficacy of vaccination are an effective clinical strategy. To target the working population, who are invariably connected to their personal digital devices, it is imperative to incorporate media-based awareness campaigns, such as interactive online platforms for experts to provide answers to individual inquiries using language that is more easily understood.

A successful policy described by Isenor et al engaged local pharmacists as providers of flu vaccine.<sup>32</sup> In addition, a local study showed that a substantial proportion of those who had heard of flu vaccine considered that easier access would facilitate flu vaccine uptake in the future.<sup>8</sup> Access to flu vaccine, especially for younger individuals with diabetes, who are often occupied with work and family, can be improved through collaboration with community daycare centres operated by non-governmental organisations, taking advantage of their extended operating hours and convenient locations. Learning from the local experience of setting up community vaccination centres for COVID-19, mobile flu shot clinics could be set up at district health centres or local daycare centres to increase the awareness of and adherence to flu vaccination.

To reduce vaccine hesitancy among doctors, up-to-date information on the efficacy and benefits of flu vaccine should be promoted via regular seminars and circulars. Doctors can be cued through electronic reminders when a patient with diabetes has not yet received flu vaccine and then explore whether the patient has any concerns regarding flu vaccine using pamphlets provided.

### Study limitations

The results of this study may not be generalisable to other clinic settings because our study was a single-centre study. There might also be self-selection bias because those who consented to take part in the study may have had a more positive attitude towards vaccination. In addition, the existing government subsidised program for flu vaccination among adults aged 50–64 years may affect patients' attitude towards how much they were willing to pay for flu vaccine.

### Conclusion

In the present study, the rate of vaccination uptake among patients with diabetes in Hong Kong was 42%, which is suboptimal according to the WHO recommendations.<sup>7</sup> Based on our findings, examples of interventions to promote vaccination include expanding eligibility for young

patients with diabetes to receive free flu vaccination in GOPCs, setting up online platforms to clear barriers to vaccination, working jointly with local communities to enhance accessibility to vaccine-related services and holding regular seminars for doctors to provide them with up-to-date information regarding the benefits of flu vaccine to reduce vaccine hesitancy.

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Competing interests: None.

Funding: None.

Provenance and peer review: Not commissioned, externally peer reviewed.

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### Acknowledgements

The authors thank Professor Martin Wong (JC School of Public Health and Primary Care, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong) and Dr Li Hei Lim (Department of Family Medicine and Primary Care, Sai Wan Ho GOPC, Hong Kong) for providing invaluable comments on the manuscript, and Dr James Siu Ki Lau (Department of Accident and Emergency, Ruttonjee Hospital, Hong Kong) and Dr Stephanie Yu (Department of Accident and Emergency, Ruttonjee Hospital, Hong Kong) for critical appraisal of the manuscript. The authors also thank the nursing and supporting staff from the Sai Wan Ho GOPC for helping with the distribution and collection of questionnaires.

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