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Intention of nurses to accept coronavirus disease 2019 vaccination and change of intention to accept seasonal influenza vaccination during the coronavirus disease 2019 pandemic: A cross-sectional survey

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ARTICLE INFO

Article history:

Received 26 May 2020

Received in revised form 4 September 2020

Accepted 7 September 2020

Available online 10 September 2020

Keywords:

Vaccination

Vaccine acceptance

Coronavirus disease 2019

Influenza vaccines

Nurses

ABSTRACT

Background: Maintaining health of healthcare workers with vaccination is a major component of pandemic preparedness and acceptance of vaccinations is essential to its success. This study aimed to examine impact of the coronavirus disease 2019 (COVID-19) pandemic on change of influenza vaccination acceptance and identify factors associated with acceptance of potential COVID-19 vaccination.

Method: A cross-sectional self-administered anonymous questionnaire survey was conducted among nurses in Hong Kong, China during 26 February and 31 March 2020. Their previous acceptance of influenza vaccination and intentions to accept influenza and COVID-19 vaccination were collected. Their relationship with work-related and other factors were examined using multiple multinomial logistic regressions.

Results: Responses from 806 participants were retrieved. More nurses changed from vaccination refusal to hesitancy or acceptance than those changed from acceptance to vaccination hesitancy or refusal (15.5% vs 6.8% among all participants, $P < 0.001$). 40.0% participants intended to accept COVID-19 vaccination, and those in private sector (OR: 1.67, 95%CI: 1.11–2.51), with chronic conditions (OR: 1.83, 95%CI: 1.22–2.77), encountering with suspected or confirmed COVID-19 patients (OR: 1.63, 95%CI: 1.14–2.33), accepted influenza vaccination in 2019 (OR: 2.03, 95%CI: 1.47–2.81) had higher intentions to accept it. Reasons for refusal and hesitation for COVID-19 vaccination included “suspicion on efficacy, effectiveness and safety”, “believing it unnecessary”, and “no time to take it”.

Conclusion: With a low level of COVID-19 acceptance intentions and high proportion of hesitation in both influenza and COVID-19 vaccination, evidence-based planning are needed to improve the uptake of both vaccinations in advance of their implementation. Future studies are needed to explore reasons of change of influenza vaccination acceptance, look for actual behaviour patterns of COVID-19 vaccination acceptance and examine effectiveness of promotion strategies.

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1. Introduction

Coronavirus disease 2019 (COVID-19) is a novel illness caused by a pathogen named “severe acute respiratory syndrome coron-

Abbreviations: COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; WHO, World Health Organization; OR, Odds Ratio; 95% CI, 95% Confidence Interval.

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<https://doi.org/10.1016/j.vaccine.2020.09.021>

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avirus 2” (SARS-CoV-2) [1]. The World Health Organization (WHO) declared the situation of COVID-19 as pandemic on 11 March 2020 [2]. To date, there is neither SARS-CoV-2-specific medications nor vaccinations for treatment and prevention of COVID-19 [3,4]. The development of COVID-19 vaccination and its future implementation is vital to prevention and elimination of the disease [3], and the success of a vaccine relies not only on its efficacy but also the coverage of the vaccination [5]. Therefore, strategies to improve acceptance of COVID-19 vaccinations is crucial in prevention of spread of COVID-19. There is a need to identify factors which could contribute to acceptance of COVID-19 vaccination,

especially among health care workers, who are of high risk of being infected COVID-19.

There were plenty of research studying factors associated or influenced acceptance of vaccinations among health care workers. A systematic review [6] on factors influencing uptake of influenza vaccination of health care workers found that they were more likely to accept H1N1 vaccination if they perceived the vaccine is safe and effective in preventing infection of self and others, and perceived the H1N1 pandemic was severe. It was also found in a study among nurses that concern about contracting avian influenza and perceived lack of control over avian influenza infection contributed to higher uptake rate of relevant vaccine [7]. Previous seasonal influenza vaccination was another strong predictor to acceptance of H1N1 vaccination among health care workers across different countries and regions during the H1N1 pandemic [6,8,9]. Among these studies, factors at work of health care workers during the pandemic, including whether working in a high-risk setting and whether encountered with suspected or confirmed patients, were reported in relative fewer studies. One study in Hong Kong found that community nurses had lower uptake rate of H1N1 vaccination than hospital nurse during H1N1 pandemic [10]. Another study reported that exposure to H1N1 patients did not affect acceptance of vaccination among nurses [11]. These work-related factors should receive greater attentions in COVID-19 pandemic, as healthcare workers might have different perception over infection risk and disease severity when they are exposed in a high-risk environment of COVID-19 compared with H1N1 and seasonal influenza.

Meanwhile, influenza vaccination is a cost-effective way in reducing the influenza-like illness and its societal costs [12,13]. In Hong Kong, free seasonal influenza vaccinations are provided to healthcare workers in public sector through their hospitals/organizations by the government annually between October and November, but not all of healthcare workers in private sector can receive free influenza vaccine [14,15]. The health care workers can easily register themselves in an online platform set up by their own hospital for influenza vaccine appointment. Influenza and COVID-19 shared similar mode of transmission and clinical characteristics [16]. There is a potential that the COVID-19 pandemic could affect the uptake rate of seasonal influenza vaccination, with evidence in previous epidemics or pandemics of infectious diseases showing their impact on acceptance of this vaccination. Studies have reported a wide range of uptake rate of seasonal influenza vaccination among non-high-risk group, from 5.8% to 45.1% [13,17], and among health care worker, from 9% to 92% [6]. It was found in a population-based study in Beijing, China [18] that uptake rate of influenza vaccination increased in 2009/2010 season but reduced in 2010/2011 to the same level before 2009 H1N1 pandemic in 2008/2009. A cohort study in France observed, however, a moderate negative effect of 2009/2010 pandemic on acceptance of vaccination among urban population [19]. Another study in Hong Kong showed that there was no difference in willingness of health care workers to accept influenza vaccination at two different WHO alert level [8]. However, the potential impact of COVID-19 pandemic on acceptance of influenza vaccination is unknown.

Maintaining health of health care worker during the pandemic has been recognized as a major component of pandemic preparedness [20]. However, there is a lack knowledge on the intentions to accept COVID-19 vaccinations when it is available and change of acceptance influenza vaccinations as well as their relationship with previous vaccination behaviours and work-related factors, which is essential to the design and implementation of potential vaccination guidelines and policies as well as preparedness of the healthcare system during the pandemic. Therefore, this study aims to examine the impact of COVID-19 pandemic on acceptance of influ-

enza vaccination, and to identify the factors associated with intentions to accept COVID-19 vaccination and the reasons to refuse or have hesitation on this vaccination.

2. Materials and methods

A cross-sectional online survey was conducted among nurses in Hong Kong during 26 February and 31 March 2020 to obtain acceptance of influenza vaccination before COVID-19 pandemic and intentions to accept influenza and COVID-19 vaccination during the pandemic. This survey has been reviewed and approved by the Survey and Behavioural Research Ethics Committee of The Chinese University of Hong Kong.

2.1. Sample recruitment and data collection

The nurses working in either public or private service provision and in any of inpatient, outpatient or outreach service in community setting were eligible to this study. Those who were working as administrators, in academic institutions, or in other positions that did not provide direct care to patients and those who were retired were excluded from the study sample. All registered members of the Association of Hong Kong Nursing Staff ($n = 16,500$), the labor union of nurses in Hong Kong, were approached and invited to this study using their email contacts. The self-administered questionnaire was distributed to the nurses in an internet-based link along with an invitation email. An information sheet about the study was included at the beginning of the questionnaire, followed by an electronic consent form. The participants who agreed to join the study filled in the questionnaire on their own electronic devices. A reminder for participation into the survey was sent two weeks after the first invitation email. Comparison of sample characteristics was made with statistics of nurse population in Hong Kong to look for potential selection bias.

2.2. Measurements and variables

The questionnaire which was developed based on the literature review and our previous research experience, consisted of three sections: (1) vaccination-related intentions and behaviours [10], (2) work-related factors [21], and (3) demographics. For the vaccination-related intentions and behaviors, the participants were asked for information about (1) whether or not they accepted seasonal influenza vaccination in the past year, (2) whether or not they intended to accept seasonal influenza vaccination this year and (3) whether intended to accept COVID-19 vaccination when it is available. The responses for question 1 were recorded as binary variable: “accepted” and “did not accepted”, and question 2 and 3 were recorded as “intend to accept”, “not intend to accept” and “undecided”. For those who did not intend or not decide to accept COVID-19 vaccination, the reasons of no such intention was asked in a multiple-choice question subsequently, with 4 options: “do not trust the effectiveness and safety of the new vaccine”, “do not think it necessary”, “no time to take it”, and “others, please specify” with an open-ended question.

Items about work-related factors included the service setting they were working in (high-risk and non-high-risk setting), whether working in public or private service provision, whether encountered any suspected or confirmed COVID-19. High-risk service setting stands for isolation wards, intensive care units, surveillance units, accident and emergency department and surgery department, while non-high-risk setting stands for the rest inpatient departments, general physician and specialist outpatient department and clinics, and outreach service team to community. In addition, their perception of likelihood of being infected with

COVID-19 was recorded by a five-point Likert scale: “definitely not likely”, “probably not likely”, “possibly”, “probably” and “definitely”. As mentioned earlier, nurses working in public sector receive free influenza vaccination, while those in private sector may not necessarily receive free vaccine, so this factor was included as it might affect acceptance of both COVID-19 and influenza vaccination. Service setting and whether encountering COVID-19 patients stand for work-related risk of being infected, which has not been sufficiently studied under COVID-19 pandemic; therefore, their association with vaccination acceptance were explored in this study. Perceived likelihood of being infected as a subjective measurement of infection risk was often included as a covariate in studies related to vaccination acceptance [6,13]. The background information including whether being diagnosed any chronic condition and basic demographics was collected as well. Chronic condition, which was found to be related to influenza vaccination acceptance [13], indicates potential severity of COVID-19 if infected [22] and was included as a covariate in this study.

2.3. Statistical analysis

Data processing and analyses were conducted using Stata 14.0. The data on demographics, chronic condition, perceived likelihood of infection, work-related factors and vaccination acceptance and intention were described and reported. For intention of influenza vaccination acceptance, two-way cross-tabulated analysis was performed between previous acceptance of influenza vaccination and intentions to accept influenza vaccination this year to explore the impact of COVID-19 pandemic on acceptance of influenza vaccination using paired sample Wilcoxon test.

For intention of COVID-19 vaccination acceptance, association between this intentions and previous acceptance of influenza vaccination, work-related factors and perceived likelihood of infection

was examined in multiple multinomial logistic regression with adjustment of age, gender and chronic conditions. Due to small subgroup sample size, the category “definitely not” of perceived likelihood of being infected with COVID-19 was re-grouped with “probably not” into one category “not likely”, while “definitely” was re-grouped with “probably” into “likely” in the multiple regression. Difference between reasons of no intention and reasons of no decision on COVID-19 vaccination acceptance was also examined using Chi-square test.

3. Results

3.1. Sample characteristics

There were a total of 856 nurses who completed the online questionnaire. The response rate was 5.2% among all active members of Association of Hong Kong Nursing staff. Of them, 17 were retired and 33 were working in administrative or academic positions, who were excluded from the analysis. Among the remaining 806 nurses who are eligible to the study (Table 1), 87.5% were female. There were 21.6% nurses aged 18–29, 31.1% aged 30–39, 27.1% aged 40–49 and 20.2% aged 50 or above. For health status, 22.3% of them reported to have chronic conditions. Regarding work-related characteristics, 24.2% of them worked in private sector of service provision, 25.1% of them worked in high-risk setting while 74.9% worked in non-high-risk setting. There were over half of them (54.2%) have encountered suspected or confirmed COVID-19 patients at work. Moreover, 47.9% of them thought they would “possibly” be infected with COVID-19 and 36.5% thought they would “probably not” be infected, while only 1.2% thought they would “definitely” be infected. Characteristics of this sample were matched to nurse population in Hong Kong, where median age was 42.0 years, 86.6% of nurse population were female, and 21.1%

Table 1
Intentions of acceptance of COVID-19 vaccination by different characteristics of participants.

	Intentions to accept COVID-19 vaccination			Total N(%)
	Intended to accept N(%)	Not intended to accept N(%)	Undecided N(%)	
Age				
18–29	73 (22.7)	26 (18.8)	75 (21.7)	174 (21.6)
30–39	116 (36.0)	40 (29.0)	95 (27.5)	251 (31.1)
40–49	78 (24.2)	44 (31.9)	96 (27.8)	218 (27.1)
50+	55 (17.1)	28 (20.3)	80 (23.1)	163 (20.2)
Gender				
Female	260 (80.8)	126 (91.3)	319 (92.2)	705 (87.5)
Male	62 (19.3)	12 (8.7)	27 (7.8)	101 (12.5)
Having chronic conditions				
No	239 (74.2)	108 (78.3)	279 (80.6)	626 (77.7)
Yes	83 (25.8)	30 (21.7)	67 (19.4)	180 (22.3)
Public or private				
Public	242 (75.2)	98 (71.0)	271 (78.3)	611 (75.8)
Private	80 (24.8)	40 (29.0)	75 (21.7)	195 (24.2)
Work setting				
Non-high risk	242 (75.2)	106 (76.8)	256 (74.0)	604 (74.9)
High-risk	80 (24.8)	32 (23.2)	90 (26.0)	202 (25.1)
Encountered with confirmed/suspected COVID-19 patients				
No	132 (41.0)	64 (46.4)	173 (50.0)	369 (45.8)
Yes	190 (59.0)	74 (53.6)	173 (50.0)	437 (54.2)
Acceptance of influenza vaccination in 2019				
No	120 (37.3)	118 (85.5)	185 (53.5)	423 (52.5)
Yes	202 (62.7)	20 (14.5)	161 (46.5)	383 (47.5)
Perceived likelihood of being infected COVID-19				
Definitely not	8 (2.5)	11 (8.0)	10 (2.9)	29 (3.6)
Probably not	113 (35.1)	46 (33.3)	135 (39.0)	294 (36.5)
Possibly	158 (49.1)	69 (50.0)	159 (46.0)	386 (47.9)
Probably	38 (11.8)	10 (7.3)	39 (11.3)	87 (10.8)
Definitely	5 (1.6)	2 (1.5)	3 (0.9)	10 (1.2)
Total	322 (100.0)	138 (100.0)	346 (100.0)	806 (100.0)

worked in private sector excluding those in administrative position, according to the latest statistics from Department of Health [23].

3.2. Impact of COVID-19 pandemic on acceptance of influenza vaccination

The impact of the COVID-19 pandemic on acceptance of seasonal influenza vaccination was assessed by the difference between acceptance of influenza vaccination last year (2019) and the intention to accept influenza vaccination this year (2020) of each individual. A similar acceptance rate of seasonal influenza between 2019 (n = 383, 47.5%) and 2020 (n = 360, 44.7%) was observed (Table 2). There were 37.0% of them who neither accepted influenza vaccination in 2019 nor intended to accept it in 2020, and 40.7% of them who accepted or intended to accept this vaccination in both 2019 and 2020. Considering the COVID-19 pandemic as an exposure, the outcome measure (influenza vaccination acceptance) are matched between exposed group (the year 2020) and non-exposed group (the year 2019). For those who accepted the influenza vaccination in 2019 (n = 383), a total of 55 nurses became unfavorable response with not intend to accept (n = 21, 2.6% among all participants) or not decided to accept it (n = 34,

4.2% among all participants) in 2020. For those who did not accept the influenza vaccination in 2019 (n = 423), 125 nurses became favorable response with 32 (4.0% among all participants) intended to accept the vaccine and 93 (11.5% among all participants) undecided about the vaccination in 2020. More nurses changed from “did not accept” the vaccination to “undecided” or “intended to accept” than those changed from “accepted” to “undecided” or “not intended to accept”, and the paired sample Wilcoxon test found this difference statistically significant (15.5% vs 6.8% among all participants, P < 0.001).

3.3. Factors associated with intentions to accept COVID-19 vaccination

Of response, 40.0% nurses had intention to accept COVID-19 vaccination. In the multiple multinomial regression (Table 3), on one hand, male (adjusted odds ratio (OR): 2.78, 95% confidence interval (95% CI): 1.69–4.58), those with chronic disease (adjusted OR: 1.83, 95%CI: 1.22–2.77), working in private service provision (adjusted OR: 1.67, 95%CI: 1.11–2.51), encountering with suspected or confirmed COVID-19 patients (adjusted OR: 1.63, 95% CI: 1.14–2.33) and those who accepted seasonal influenza vaccination in 2019 (adjusted OR: 2.03, 95%CI: 1.47–2.81) were more likely to have intentions to accept COVID-19 vaccination when it

Table 2
Acceptance of influenza vaccination in 2019 and intentions to accept influenza vaccination in 2020.

		Intentions during pandemic (2020)			Total	P value ¹
		Not accept	Undecided	Accept		
Acceptance before pandemic (2019)	Did not accept	298 (37.0%) ²	93 (11.5%)	32 (4.0%)	423 (52.5%)	<0.001
	Accepted	21 (2.6%)	34 (4.2%)	328 (40.7%)		
Total		319 (39.58%)	127 (15.8%)	360 (44.7%)	806 (100.0%)	

Note: 1. This P value comes from paired sample Wilcoxon test.

2. The percentage in all the parentheses are percentage of the number of participants in the cell among total number of participants (i.e. 806 participants).

Table 3
Factors associated with intentions to accept COVID-19 vaccination when it is available.

("Undecided" as reference)	Intended to accept COVID-19 vaccination		Not intended to accept COVID-19 vaccination	
	Adjusted OR	95%CI	Adjusted OR	95%CI
Age				
18–29	Reference		Reference	
30–39	1.18	(0.76, 1.84)	1.22	(0.67, 2.23)
40–49	0.72	(0.45, 1.16)	1.52	(0.82, 2.80)
50+	0.61	(0.36, 1.03)	1.12	(0.56, 2.24)
Gender				
Female	Reference		Reference	
Male	2.78*	(1.69, 4.58)	1.25	(0.60, 2.61)
Having chronic conditions				
No	Reference		Reference	
Yes	1.83*	(1.22, 2.77)	1.30	(0.76, 2.22)
Public or private				
Public	Reference		Reference	
Private	1.67*	(1.11, 2.51)	1.54	(0.92, 2.57)
Work setting				
Non-high risk	Reference		Reference	
High-risk	0.84	(0.57, 1.22)	0.89	(0.54, 1.45)
Encountered with confirmed/suspected COVID-19 patients				
No	Reference		Reference	
Yes	1.63*	(1.14, 2.33)	1.32	(0.83, 2.10)
Acceptance of influenza vaccination in 2019				
No	Reference		Reference	
Yes	2.03*	(1.47, 2.81)	0.19*	(0.11, 0.32)
Perceived likelihood of being infected COVID-19				
Not likely	Reference		Reference	
Possibly	1.00	(0.70, 1.42)	1.18	(0.75, 1.85)
Likely	1.05	(0.62, 1.77)	0.70	(0.33, 1.48)

* P < 0.05.

Table 4
Reasons for no intention or no decision of accepting COVID-19 vaccination when it is available.

	Intentions to accept COVID-19 vaccination when it is available		Total	P value ¹
	Not accept	Undecided		
Suspicion on efficacy, effectiveness or safety				
No	40 (29.4)	71 (21.2)	111 (23.6)	0.057
Yes	96 (70.6)	264 (78.8)	360 (76.4)	
Believing COVID-19 vaccination is unnecessary				
No	98 (72.1)	288 (86.0)	386 (81.9)	<0.001*
Yes	38 (27.9)	47 (14.0)	85 (18.1)	
No time to take the COVID-19 vaccination				
No	130 (95.6)	330 (98.5)	460 (97.7)	0.057
Yes	6 (4.4)	5 (1.5)	11 (2.3)	
Total	136 (100)	335 (100)	471 (100.0)	

Note: 1. These are P values of Chi-square test.

* P < 0.05.

is available, rather than having no decisions on COVID-19 vaccination. On the other hand, nurses who accepted influenza vaccination in 2019 were also less likely to refuse COVID-19 vaccination this year (adjusted OR: 0.19, 95%CI: 0.11–0.32), using those who had no decisions on COVID-19 vaccination as reference.

3.4. Reasons for no intentions or no decisions on COVID-19 vaccination acceptance

There were 3 major reasons collected for no intentions or no decisions to accept COVID-19 vaccination: (1) suspicion on efficacy, effectiveness or safety of the new vaccine (76.43%), (2) believing COVID-19 vaccination is necessary (18.05%), and (3) no time to take it (2.34%) (Table 4). The difference on the reasons was further explored between those who did not intend to accept COVID-19 vaccination and those who did not have decisions on the vaccination acceptance. It was found that nurses who did not decide to accept influenza vaccination were less likely to believe the COVID-19 vaccination is unnecessary (14.0% vs 27.9% for those who did not intend to accept, P < 0.001), and more likely to have suspicion on efficacy, effectiveness or safety of the new vaccine, despite the difference was not significant (78.8% vs 70.6% for those who did not accept, P = 0.057).

4. Discussion

This study was conducted during the pandemic of COVID-19. By the end of this survey (31 March 2020), there were 715 cumulative COVID-19 cases confirmed in Hong Kong. During the survey period, number of daily confirmed cases was increasing to the highest number of 65 cases on 27 March [24]. Despite the evolving situation of the pandemic, a low level of intentions to accept COVID-19 vaccination as well as a high proportion of unsureness of decisions on acceptance of this vaccination was found in the survey, which might be partially due to zero COVID-19 cases among healthcare workers reported by 11 March 2020. This might be one of the reasons why some of the survey participants felt unnecessary to accept the vaccine. However, the effectiveness of vaccination on disease prevention in real world highly relies on the coverage or uptake rate of the vaccine [5,25]. Herd effect of vaccine, referring to indirect protection of unvaccinated persons, has been found in vaccine of pneumococcus, influenza and many of other infectious diseases, but the effect can be reduced or no herd effect because of low uptake rate [26]. For example, herd effect appears to occur when uptake rate of influenza type b vaccine reaches 50% [26], compared with around 40% for both seasonal influenza and COVID-19 vaccination found in this study. With an increasing number of confirmed cases among healthcare workers

in July and August 2020 [27–29], promotion for a potential COVID-19 vaccine among healthcare workers becomes more important.

In addition, absence and unsureness of decision in vaccination acceptance in the survey reflects hesitation about vaccination, and the potential refusal and delay [30–32] on the vaccination may still affect coverage of the vaccine or its immunization rate [32], although they might also accept the vaccination eventually. Its impact could be as crucial as directly refusing vaccination under the pandemic. For seasonal influenza vaccination, there was a shift of acceptance of influenza vaccination of nurses to having hesitation on this vaccination, especially for those did not accept vaccination before. Despite a potential positive impact of the pandemic on influenza vaccination observed in the study, immediate attention is still needed on the strategies to further encourage those having hesitations on vaccinations to accept both COVID-19 and influenza vaccination.

4.1. Change of intention to accept influenza vaccination and potential reasons

The overall acceptance of influenza vaccination was similar between 2019 and 2020, which is similar to the findings from a study during 2009 H1N1 pandemic that no difference found in H5N1 vaccination acceptance at two WHO alert level [8]. More nurses changed from refusal to hesitation and acceptance on vaccination, which could be potentially led by encountering with suspected or confirmed COVID-19 patients, according to supplementary analysis (Table S2, Supplementary file 1). This kind of contact might provide a reminder of people's susceptibility when facing infectious disease and increase the perceived likelihood of being infected airborne diseases other than COVID-19, including influenza. This change in intention suggested that there could potentially be more people to accept influenza vaccination this year, so the vaccine supply, relevant policy and guideline of vaccination should be prepared for this.

It was found in the supplementary analysis (Table S3, Supplementary file 1) that younger nurses and those worked in high-risk setting and perceived higher likelihood of being infected COVID-19 were likely to change from acceptance of influenza vaccination to hesitation. It might be because those facing higher risk of being infected COVID-19 were reluctant to consider vaccination for other diseases. However, the results did not fully explain why some of those who accepted influenza vaccination last year did not intend or decide to accept it this year. In previous studies, it was found that the reasons of influenza vaccination refusal, including “vaccine will not work”, “not safe”, “not likely to catch flu” or “no spare time” [8,18], which is similar to the major concerns on

the efficacy, effectiveness, safety as well as necessity of COVID-19 vaccines. While higher proportion of participants had doubts on necessity of H1N1 (around 50%) compared with COVID-19 vaccine (18.1% in this study), much lower proportion reported concerns on efficacy and safety on H1N1 vaccine (<25%) compared with COVID-19 vaccine (76.4% in this study) [8,18]. Studies [6,30,33,34] also showed that misleading media reports on prevention strategies and media-related anti-vaccine conspiracy theories, which are exposed to people more frequently during the pandemic, play a role in reducing confidence of vaccination of general public and health care workers. Studies also showed that controversies and conflicts of interests between experts and relevant companies could discourage the vaccination behavior [19,35,36]. Nevertheless, the reason of influenza vaccination refusal of people who previously accepted it and potential strategy to address the problem should be further explored by more studies.

4.2. Intention to accept COVID-19 vaccination and its implications

Regarding the intention to accept COVID-19 vaccination, the previous influenza vaccination behaviour was found to be a strong predictor to this intention. Similar result was found in previous studies that previous acceptance of vaccination had a strong association with acceptance of seasonal influenza vaccination and H1N1 vaccination [8,36]. It suggested vaccination acceptance is a habit of an individual [37], and this habit may apply to vaccine of different diseases with similar mode of transmission and clinical characteristics. In addition, encountering with suspected or confirmed COVID-19 patients and having chronic conditions also contributed to higher intentions to accept COVID-19 vaccination, which showed higher risk of infection and higher perceived severity after being infected COVID-19 were also factors affecting the intention of vaccination.

The association between previous influenza acceptance and intentions to accept COVID-19 vaccination indicated that promotion of influenza vaccination could be beneficial in improving uptake of COVID-19 or other pandemic vaccination, and could be incorporated as part of preparedness plan for health care workers. The promotion strategies for those who had hesitations on influenza vaccinations and those who intended to refuse it should be different. More nurses who had hesitation on vaccination inclined to be worried about efficacy, effectiveness and safety of potential COVID-19 vaccines, as there was little relevant information during development of the vaccines. Therefore, the finding suggested that one of future strategies for government to promote COVID-19 vaccination could be dissemination of information and evidence of the new vaccine's efficacy and safety to those with hesitations, and it could be more efficient by implementing this strategy through contact information of people accepted influenza vaccination in previous years or at the place where people accept influenza vaccination this year to increase coverage of COVID-19 vaccine [38]. Meanwhile, nurses and other health care workers who have chronic diseases and having encountered confirmed or suspected COVID-19 patients should be identified as a priority group by the government to accept COVID-19 vaccinations when it is available due to greater intentions to accept this vaccination. Government should consider to include healthcare workers in private sector into free COVID-19 vaccination program as well, as they expressed a greater intention to accept this vaccine in the survey and private sector takes 70% of all outpatient services in Hong Kong [39], which is likely to be the first contact point of undiagnosed COVID-19 patients. Hospital administrators could also spend more efforts in vaccination promotion to healthcare workers working in high-risk setting and those would have chance to rotate working in high-risk setting, as they did not report a greater intention than others to receive the vaccine while they are exposed to greater risk.

Moreover, as those who intended to refuse COVID-19 vaccination tended to believe the vaccination is not necessary, promotion for these people should focus on the risk of being infected and the benefit of being immunized. Promotions and education on maintaining adequate non-pharmaceutical preventions in the future should also be implemented among them. The effectiveness of these promotion strategies can be evaluated in future research.

5. Strength and limitations

To our knowledge, there was no published research found in studying the willingness, intention or compliance of health care workers in accepting COVID-19 vaccination when it is available. This study provides information on the potential impact of COVID-19 pandemic on acceptance of influenza vaccination, and identified factors associated with acceptance of potential COVID-19 vaccination. The finding can be applied to health care workers as comparable results were found in previous studies for this population. They are facing higher risk of being infected COVID-19 during the pandemic than general public, so there should be planning of vaccination promotion in advance of implementation of the vaccines, even though the COVID-19 vaccines have not been available. This study can be used to inform such planning and strategies.

The limitations of this study should be considered in interpreting the findings. First, there could be potential selection bias in the study sample. Although all active nurses at the Association of Hong Kong Nursing Staff were approached for the survey, the response rate of the survey was low. Nevertheless, the number of participants was able to achieve pre-set sample size for this survey (Supplementary file 1). The low response rate showed the email invitation and online questionnaire might not be a best way for recruitment. In future study, survey method can be improved by mailing of the questionnaire and distribution of the questionnaire through hospitals or organizations that they are working in to achieve higher response rate. Due to low response rate, the participants might have more concerns about the pandemic situation than those who did not participate. Therefore, the acceptance rate of COVID-19 vaccination might be even lower than what has been found in this study. Despite this, this study was able to recruit adequate number of nurses from both public and private sector and in different work settings, and median age and the ratios of female/male nurses and public/private sector were matched to statistics of nurse population in Hong Kong. In addition, this paper focused on the working setting, thus years of participants working in nursing practice was not collected. Its association with COVID-19 vaccination uptake can be studied in future research. Another limitation was that the intentions of acceptance were used to compare with previous acceptance behaviours, and there might be gaps between intentions and actual acceptance behaviors. Further studies can be conducted to retrospectively compare the behaviours of vaccination during or after the pandemic with pre-pandemic behaviours.

6. Conclusion

It is important to design an evidence-based strategy to promote the uptake of vaccination for health care workers, for it not only protect the health care workers, who is facing high risk of infection, but also reduce transmission of the disease to their family and community. With a low level of COVID-19 acceptance intentions and high proportion of hesitation in acceptance of influenza and COVID-19 vaccination, attentions and efforts are needed in the future to improve the uptake rate of both vaccinations. Evidence-based planning for vaccination strategies for health care workers should be considered in advance of implementation of the vaccinations. Future studies are needed to explore reasons of change of

influenza vaccination acceptance, look for pattern of actual behaviour of COVID-19 vaccination acceptance and examine the effectiveness of promotion strategies.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors would like to thank for Mr. Jack CH Lau, Ms. Amy YK Wong and Mr. Peter SY Yau for their support in creating the online survey platform and monitoring the quality of data collection.

Authorship statement

All authors attest they meet the ICMJE criteria for authorship.

Authors' contributions

This study was designed by KW, ELYW, KFH, AWLC and EKY. ELYW and AWLC led the data collection. The data processing and analysis was conducted by KW. The manuscript was prepared by KW and ELYW. All authors contributed in editing and final approval of the manuscript.

Funding

No funding received for this study.

Ethics approval and consent to participate

This study was approved by the Survey & Behavioural Research Ethics Committee of The Chinese University of Hong Kong. Informed consent was obtained from the participants before the questionnaire survey.

Data statement

Data used in this study cannot be made publicly available for ethical reasons. Public availability of data would compromise confidentiality and privacy of participants.

Appendix A. Supplementary material

Sample size estimation and factors associated with intentions to accept influenza vaccination. Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2020.09.021>.

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