COVID-19 Vaccine Acceptance and Hesitancy among Singaporean Primary Healthcare Workers

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Abstract

Background

Factors affecting COVID-19 vaccine acceptance and hesitancy among primary healthcare workers (HCW) remain poorly understood. This study aims to identify factors associated with vaccine acceptance and hesitancy among HCW.

Methods

A multi-centre online cross-sectional survey was performed across 6 primary care clinics from May to June 2021, after completion of vaccination exercise. Demographics, profession, years working in healthcare, residential status, presence of chronic medical conditions, self-perceived risk of acquiring COVID-19 and previous influenza vaccination were collected. HCW who accepted vaccine were then asked to rank their top 5 reasons for vaccine acceptance; HCW who were vaccine hesitant had to complete the 5C scale on psychological antecedents of vaccination.

Results

557 out of 1182 eligible HCW responded (47.1%). 29 were excluded due to existing contraindications. Among 557 respondents, vaccine acceptance rate was 94.9% (n=501) and 5.1% were hesitant (n=27). COVID-19 vaccine acceptance was not associated with sex, age, ethnicity, profession, number of years in healthcare, living status, presence of chronic diseases, self-perceived risk or previous influenza vaccination. The top 3 reasons for COVID-19 vaccine acceptance ranked by 501 HCW were to protect their family and friends, protect themselves from COVID-19 and due to high risk of acquiring COVID-19 because of their jobs. The 15-item questionnaire from the 5C psychological antecedents of vaccination was completed by 27 vaccine hesitant HCW. The mean scores for the components of the 5Cs were: 'Confidence' (3.96), 'Complacency' (3.23), 'Constraint' (2.85), 'Calculation' (5.79) and 'Collective responsibility' (4.12).

Conclusion

COVID-19 vaccine hesitancy is a minute issue among Singapore primary HCW, having achieved close to 95% acceptance rate with 5% hesitancy rate. Future studies can focus on other settings with higher hesitancy rates, and acceptance of booster vaccinations with the emergence of the delta COVID-19 variant.

Trial Registration

This study was approved by the National Healthcare Group (NHG) Domain Specific Review Board (DSRB), Singapore on 26th April 2021 (Reg No. 2021/00213).

Background

As of September 2021, more than 219 million individuals worldwide have been infected with Coronavirus Disease 2019 (COVID-19) with about 4.55 million deaths since its emergence in late 2019.¹ Vaccination is a key public health strategy because it has been shown to be effective in reducing risk of infection and severe disease.^{2,3} Healthcare workers (HCW) are at increased risk of exposure due to the nature of their work, and therefore achieving high vaccination rates in this group is critical. They are also the most trusted advisors; improving knowledge and confidence in vaccines have been shown to increase willingness to recommend vaccines and influence their patient's decisions.⁴ Therefore, understanding vaccine acceptance and hesitancy amongst HCW is necessary.

Vaccine hesitancy is defined by the World Health Organisation (WHO) as the delay in acceptance or refusal of vaccination despite availability.⁵ At its core, vaccine hesitancy results from the decision-making process after considering a multitude of factors which influence that decision. Frameworks such as the 3Cs model, Working Group Determinants of Vaccine Hesitancy Matrix and 5Cs psychological antecedents have been theorised in an attempt to classify these factors contributing to vaccine hesitancy.^{5,6} With the introduction of novel COVID-19 vaccines, associations for hesitancy have been described in a few systematic reviews were mixed; some noted age, sex, occupation were positive predictors for hesitancy, while previous influenza vaccination and self-perceived risk were facilitators.⁷⁻⁹ In Asia, a study have shown that the majority of HCW are willing to receive the COVID-19 vaccination, with perceived susceptibility, low potential risk of vaccine harm and pro-socialness as main drivers.¹⁰

An island city-state with a population of more than 5.7 million, Singapore encountered its first case of COVID-19 in January 2020. At the forefront of the local response to COVID-19, primary care forms the foundation of the Singapore healthcare system, provided by over 1700 private general practitioner clinics and 20 government subsidised polyclinics from 3 healthcare clusters. Primary care providers were involved in setup and operations of community isolation facilities, public health preparedness clinics (testing, management and surveillance for COVID-19 cases) and act as sites for COVID-19 vaccination.¹¹ Since December 2020, Singapore has offered HCW vaccination against COVID-19 with the Pfizer-BioNTech vaccine. It will be vital to study the perspective of primary care HCW who serve on the frontlines; thoughts and behaviours regarding the COVID-19 vaccine will definitely influence patient's vaccine decisions. Therefore, this study seeks to understand COVID-19 vaccine acceptance and hesitancy among HCW in a primary healthcare cluster in Singapore.

Method

Study population and setting

The study involved HCW from 6 polyclinics who are part of a healthcare cluster in the western region of Singapore. A cross-sectional study design was chosen as it has been proven to effectively and efficiently sample vaccine acceptance and hesitancy rates across different timepoints. For 4 weeks, between 12th May and 8th June 2021, a structured anonymous self-administered questionnaire was sent via electronic

mail to all 1182 HCW, which included doctors, nurses, allied health professionals, operations and administrative personnel. Participation was voluntary. This questionnaire measured actual vaccine acceptance or refusal rather than mere intention, as it was introduced 4 months after the commencement of the staff vaccination exercise. To increase participation rate, 2 additional reminders were sent on the last week of data collection. Informed consent was implied upon voluntary submission of questionnaire.

Survey questionnaire

We collected demographic characteristics, profession, number of years working in healthcare, residential status, presence of chronic medical conditions, self-perceived risk of acquiring COVID-19 and previous influenza vaccination. HCW were invited to categorise their vaccination status as 'completed 2 doses', 'completed 1 dose', 'keen, awaiting vaccination', or 'not keen or unable to be vaccinated'. HCW who indicated the affirmative in the first 3 categories were asked to rank their top 5 reasons for taking the vaccination. Survey questions were based on input and discussion of co-authors with expertise in qualitative research, infectious disease and vaccine hesitancy, after cross referencing with available systematic reviews.⁷⁻¹⁰ Those who selected 'not keen or unable to be vaccinated' were asked to select their reasons for not taking the vaccine, their current sentiments and answer the 5C scale on psychological antecedents of vaccination, a validated 15-item questionnaire which include areas such as confidence, complacency, constraints, calculation and collective responsibility.¹² This framework was selected as the model was easy to implement, reliable and reproducible. The authors believed that this model was the most suitable for HCW as it focused less on knowledge and accessibility to vaccines, superior compared to other scales to explain variance of self-reported vaccine behaviours and tested by a study done among Kuwaiti HCW.¹³

For content validation, 5 domain experts on vaccinations within primary care gave feedback to examine the extent to which the question items on the questionnaire were representative of the entire domain the questionnaire seeks to measure. They were excluded from the main study. The questionnaire was revamped and underwent face validation to determine if targeted respondents understood the question items; this is done through recruitment of 10 HCW from different departments to read the informed consent form and perform the questionnaire, and were also excluded from the main study. Their feedback was used to create the final version of the questionnaire, appended in Annex below.

The guidance for indications and contraindications to COVID-19 vaccine varied throughout the course of the year. According to the prevailing Ministry of Health (MOH) of Singapore guidelines on 31st May 2021, patients with severe cutaneous adverse reactions, active cancer on treatment, allergies and anaphylaxis to non-vaccine triggers, pregnant or breastfeeding were allowed to proceed with COVID-19 vaccination. After the change, all HCW (n = 29) who were previously contraindicated and excluded from this study were eligible to be vaccinated.

Ethical considerations

The study, analysis and publication of results was approved by the NHG Domain Specific Review Board (DSRB). Consent was presumed when participants participated through the act of answering and submitting the questionnaire.

Statistical analysis

All analyses were conducted using IBM SPSS Statistics Version 22.0. Variables in this analysis included age, sex, ethnicity, profession, years in healthcare, living status, presence of chronic diseases, perceived risk of acquiring COVID-19 and its exposure, influenza vaccination status, factors associated with vaccine acceptance and hesitancy. HCW were regrouped into the following 4 categories based on their nature of their work: nursing, allied health, administrative and medical. Variables associated with vaccine acceptance and hesitancy were assessed through Pearson's chi-squared test to provide *p* values. For all statistically significant results, we performed a forced-entry multivariate logistic regression introducing all covariates with a *p*-value < 0.05 to identify covariates independently associated with acceptance or hesitancy of the COVID-19 vaccine to provide crude odds ratio (OR) and 95% confidence intervals (C.I.). The top reasons ranked by HCW for vaccine acceptance were also analysed to look for associations. HCW who were not keen or unable to be vaccinated were asked to fill in a 7-point Likert scale for all 15 questions of the 5C scale on the 5 psychological antecedents of vaccination. This was converted to a score (Strongly disagree $\diamond$ 0, Neutral $\diamond$ 4, strongly agree $\diamond$ 7), averaged and tabulated across the 5 areas of the 5C scale. The exceptions were confidence and collective responsibility, for which the scores were reversed. Due to the small group of these HCW, the Likert scale was regrouped into 3 categories: disagree, neutral, agree, for easier analysis.

Results

Basic demographics

Out of 1182 eligible HCW, 557 respondents completed the survey with a response rate of 47.1%. 29 (5.2%) were excluded due to absolute contraindications to COVID-19 vaccination (pregnant or planning for pregnancy and previous history of anaphylaxis). Of the remaining 528 respondents, 450 (85.2%) were fully vaccinated, 28 (5.3%) had completed 1 dose, 23 (4.4%) were keen and awaiting vaccination, and 27 (5.1%) were not keen to be vaccinated (Figure 1). Social demographic information can be found in Table 1. Most respondents (*n* = 463, 87.7%) were female and of Chinese ethnicity (*n* = 378, 71.6%). Their occupation spanned the entire spectrum of primary care, including nurses (*n* = 203, 38.4%), allied health professionals (*n* = 142, 26.9%), administrative personnel (*n* = 128, 24.2%) and doctors (*n* = 55, 10.4%). A third (33.3%) of HCW have worked less than 5 years in healthcare, and almost half (47.6%) worked 6-15 years.

From Table 2, 472 (89.4%) of HCW lives with others. 102 (19.3%) HCW have chronic diseases or previous surgeries, of which 10 (9.8%) declared that they were not keen to vaccinate due to their conditions or medications. 424 (80.3%) felt that they were at higher risk of acquiring COVID-19 from their jobs. Majority (*n* = 313, 59.3%) had come into contact with suspected or confirmed COVID-19 patients, and were

involved in COVID-19 operations or duties (n = 295, 55.9%). Among them, 96.3% (n = 284) were confident on the effectiveness of personal protective equipment. In terms of other vaccinations, 92.2% (n = 487) had received the influenza vaccination in the past year.

Table 1
– Socio-demographics of respondents on COVID-19 vaccine acceptance

Variables	Respondents (%)	COVID-19 vaccine acceptance		
		Acceptance (%) (n = 501)	Hesitancy (%) (n = 27)	P value
Sex				
Female	463 (87.7)	437 (94.4)	26 (5.6)	0.162
Male	65 (12.3)	64 (98.5)	1 (1.5)	
Age group				
21-25 years old	50 (9.5)	50 (100)	0 (0)	0.267
26-34 years old	190 (36.0)	178 (93.7)	12 (6.3)	
35-44 years old	138 (26.1)	131 (94.9)	7 (5.1)	
45-54 years old	98 (18.6)	91 (92.9)	7 (7.1)	
≥55 years old	52 (9.8)	51 (98.1)	1 (1.9)	
Ethnicity				
Chinese	378 (71.6)	357 (94.4)	21 (5.6)	0.732
Malay	78 (14.8)	75 (96.2)	3 (3.8)	
Indian	43 (8.1)	42 (97.7)	1 (2.3)	
Others	29 (5.5)	27 (93.1)	2 (6.9)	
Profession				
Nursing	203 (38.4)	188 (92.6)	15 (7.4)	0.117
Allied Health*	142 (26.9)	137 (96.5)	5 (3.5)	
Administrative ⁺	128 (24.2)	121 (94.5)	7 (5.5)	
Medical [#]	55 (10.4)	55 (100)	0 (0)	
Number of years working in healthcare				
≤5 years	176 (33.3)	166 (94.3)	10 (5.7)	0.439
6-10 years	136 (25.8)	130 (95.6)	6 (4.4)	
11-15 years	115 (21.8)	111 (96.5)	4 (3.5)	
16-20 years	44 (8.3)	39 (88.6)	5 (11.4)	

Variables	Respondents (%)	COVID-19 vaccine acceptance	
21-25 years	32 (6.1)	30 (93.8)	2 (6.3)
26-30 years	13 (2.5)	13 (100)	0 (0)
≥31 years	12 (2.3)	12 (100)	0 (0)
<p>*Category includes care coordinators, dieticians, financial counsellors, medical social workers, pharmacists, physiotherapists, podiatrists and radiographers</p> <p>+category includes operation executives, call centre operators, patient care and service associates, IT support and temperature screening assistants</p> <p>#Category includes medical officers, residents, family physicians and dentists</p>			

Table 2
– Factors associated with COVID-19 vaccine acceptance

Variables	Respondents (%)	COVID-19 vaccine acceptance		
		Acceptance (%) (n = 501)	Hesitancy (%) (n = 27)	<i>P</i> value
<i>Living status</i>				
Living with others	472 (89.4)	446 (94.5)	26 (5.5)	0.232
Living alone	56 (10.6)	55 (98.2)	1 (1.8)	
<i>Chronic diseases or previous surgeries</i>				
Yes	102 (19.3)	95 (93.1)	7 (6.9)	0.372
No	426 (80.7)	406 (95.3)	20 (4.7)	
<i>Perceived high risk of getting COVID-19 from job</i>				
Yes	424 (80.3)	406 (95.8)	18 (4.2)	0.067
No	104 (19.7)	95 (91.3)	9 (8.7)	
<i>Contact with suspected or confirmed COVID-19 patients</i>				
Yes	313 (59.3)	299 (95.5)	14 (4.5)	0.420
No	215 (40.7)	202 (94.0)	13 (6.0)	
<i>Involved in clinic, dormitory or isolation facility COVID-19 duties</i>				
Yes	295 (55.9)	280 (94.9)	15 (5.1)	0.973
No	233 (44.1)	221 (94.8)	12 (5.2)	
<i>Influenza vaccination in past 1 year</i>				
Yes	487 (92.2)	462 (94.9)	25 (5.1)	0.943
No	41 (7.8)	39 (95.1)	2 (4.9)	

Variables associated with COVID-19 vaccine acceptance

COVID-19 vaccine acceptance was not associated with sex, age, ethnicity, profession or number of years in healthcare (Table 1). There were no associations between COVID-19 vaccine acceptance and living status, presence of chronic diseases, self-perceived risk of getting COVID-19, contact with suspected or confirmed COVID-19 patients, being involved in COVID-19 operations and duties, perceived effectiveness of personal protective equipment or previous influenza vaccination (Table 2).

According to Figure 2, the cumulative top 3 reasons for COVID-19 vaccine acceptance ranked by HCW were 'protect my family and friends from COVID-19', 'protect myself from COVID-19' and 'high risk of

getting COVID-19 because of my job' (standard deviations as depicted). Each of these 3 reasons were chosen by more than 50% of HCW when asked to rank their top 5 reasons for vaccine acceptance.

Factors contributing to COVID-19 vaccine hesitancy

The 15-item questionnaire adapted from the 5C psychological antecedents of vaccination was completed by 27 vaccine hesitant HCW and illustrated in Figure 3. The individual and mean scores for the components of the 5Cs, 'Confidence' (3.96), 'Complacency' (3.23), 'Constraint' (2.85), 'Calculation' (5.79) and 'Collective responsibility' (4.12) were tabulated. Low 'Complacency' and 'Constraint' scores represented that HCW were not complacent, and does not feel constrained to access to vaccination. Questions pertaining to 'Calculation' acquired the highest mean scores with no HCW choosing disagree to any of the 3 statements.

Discussion

Improving COVID-19 vaccination rates can certainly hasten the end of the pandemic. To date, few studies have investigated vaccine acceptance specifically among HCW, and most published on intention rather than actual uptake rate. As this was a cross-sectional study conducted in May 2021, vaccine uptake can differ at various timepoints, complicated by changes in vaccine guidance, local infection rates and influenced by legislation on social restrictions. According to internal data in September 2021, the primary healthcare cluster has achieved 90% full vaccination rate. However, the most significant limitation of our study is that 52.9% of HCW did not answer the questionnaire; the true hesitancy rate is likely higher than 5.1% as non-respondents are more likely to be hesitant. This is despite the fact that HCW were given ample time of 4 months from start of vaccination campaign with various opportunities and reminders to complete their vaccinations. Being a cross-sectional survey, we are unable to infer a causal relationship; a convenience sampling may yield potentially biased estimates. While the options for factors affecting vaccine acceptance were varied, there were no framework or methods to identify additional factors that may be unique to COVID-19 and this population. A qualitative study may be able to broaden the factors and uncover inherent reasons affecting vaccine hesitancy.

This study is also among the first to explore reasons for vaccine acceptance among HCW, allowing others to develop key strategies in targeting such factors to improve acceptance. Our study yielded no association between COVID-19 vaccine acceptance and socio-demographic factors, profession, self-perceived risk or presence of chronic diseases. We suspected this was due to well-educated HCW stemming from a developed, multicultural society with strong governmental influence. However, our results showed otherwise; the reasons quoted as most important reasons were to protect themselves, family and friends from COVID-19 and self-perceived high risk due to their jobs (Figure 2). They prioritised personal reasons over other reasons like altruistic factors (protect patients from COVID-19) or external pressures (governmental, institutional, family or peer support). HCW are not only usually the first to receive vaccinations, they also act as role models to the public, therefore their reasons for vaccine acceptance must be strongly considered as this can help inform future vaccination strategies.

Vaccine hesitancy may vary over time as additional information about risks and safety become more widely available. 'Calculation' recorded the highest mean scores among all the domains under the 5C psychological antecedents of vaccination, as 24 out of 27 wanted fully understand the COVID-19 vaccine before making their decision (Figure 3). This was expected to be the greatest factor as HCW had access to the most knowledge and understanding to the severity and repercussions of the infection. The Kuwaiti study who also used the 5C psychological antecedents revealed that high scores in 'Confidence', 'Constraints', 'Calculations' and 'Collective Responsibility' were significantly associated with vaccine acceptance.¹³ We were unable to compare this with our study as we only applied the 5C psychological antecedents to HCW who were hesitant. The sample size for vaccine hesitant group (n = 27) is too small for any significant analysis. HCW were also the first residents in Singapore prioritised to receive the novel COVID-19 vaccine since mid-January 2021. Based on the theory of Diffusion of Innovation,¹⁴ we suspect that the hesitant group may accept vaccination over time, as vaccination campaigns ramped up nationwide. Hesitancy may be sensitive to time-varying infection, government restrictions and mortality rate of the ongoing pandemic. This is also accelerated by nationwide government-led efforts in promoting vaccinations through all media forms.

Conclusion

In conclusion, it is reassuring that COVID-19 vaccine hesitancy is a minute issue among Singapore primary HCW, having achieved close to 95% acceptance rate with 5% hesitancy rate. HCW bridge the gap between health care authorities and patients and have a disproportionate influence on patients' vaccine decisions. Therefore, high vaccination rates correlate positively with their willingness to recommend COVID-19 vaccination to their patients, and strategies that work for HCW can certainly be extrapolated to the community.¹⁵ Vaccine hesitancy wanes with time; this is evident from high 'Calculation' scores to what HCW value, as they closely consider and weigh benefits and risks before making an informed decision. This has not impeded or affect their decision for vaccination. Further cross-sectional studies can be conducted at different timepoints to evaluate perspectives of non-respondents and triangulate with studies done in other countries to paint a complete global picture pertaining to hesitancy. The 5C scale should potentially be applied to other settings with higher hesitancy rates to achieve significant results. As COVID-19 continues to spread throughout the world, it will be interesting to also study acceptance and hesitancy rates with emergence of the delta variant and rollout of booster vaccinations.

Abbreviations

COVID-19 - Coronavirus Disease 2019

HCW - healthcare workers

NHG - National Healthcare Group

DSRB - Domain Specific Review Board

Declarations

- Ethics approval and consent to participate – Approved by National Healthcare Group (NHG) Domain Specific Review Board (DSRB). Informed consent was obtained from all participants. All methods were performed in accordance with the relevant guidelines and regulations.
- Consent for publication – Completed
- Availability of data and materials – The datasets generated and/or analysed during the current study are not publicly available due to confidentiality agreement signed by the participants but are available from the corresponding author on reasonable request
- Competing interests – The authors declare that they have no competing interests
- Funding – No funding was provided
- Authors' contributions
 - SWCK – Conceptualisation, Methodology, Investigation, Formal analysis, Writing (Original draft), Visualisation, Project Administration
 - YL – Conceptualisation, Methodology, Formal analysis, Writing (Review & Editing)
 - VWKL – Conceptualisation, Methodology, Formal analysis, Writing (Review & Editing), Supervision
 - SJL – Methodology, Formal analysis, Writing (Review & Editing)
 - YHC – Investigation, Formal analysis, Data curation
 - DY – Conceptualisation, Methodology, Supervision, Administration
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Figures

Figure 1

Study inclusion and exclusion

Figure 2

The cumulative top 3 reasons for COVID-19 vaccine acceptance ranked by HCW were 'protect my family and friends from COVID-19', 'protect myself from COVID-19' and 'high risk of getting COVID-19 because of my job' (standard deviations as depicted). Each of these 3 reasons were chosen by more than 50% of HCW when asked to rank their top 5 reasons for vaccine acceptance.

Figure 3

The 15-item questionnaire adapted from the 5C psychological antecedents of vaccination was completed by 27 vaccine hesitant HCW and illustrated in Figure 3.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [COVID19vaccinehesitancyquestionnairev1.5uaa200421unvaccinated.pdf](#)
- [COVID19vaccinehesitancyquestionnairev1.5uaa200421vaccinated.pdf](#)