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Multifactorial influences underpinning a decision on COVID-19 vaccination among healthcare workers: a qualitative analysis

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ABSTRACT

COVID-19 vaccination in healthcare workers (HCW) is essential for improved patient safety and resilience of health systems. Despite growing body of literature on the perceptions of COVID vaccines in HCWs, existing studies tend to focus on reasons for 'refusing' the vaccines, using surveys almost exclusively. To gain a more nuanced understanding, we explored multifactorial influences underpinning a decision on vaccination and suggestions for decision support to improve vaccine uptake among HCWs in the early phase of vaccination rollout. Semi-structured interviews were undertaken with thirty-three HCWs in Singapore. Transcribed data was thematically analyzed. Decisions to accept vaccines were underpinned by a desire to protect patients primarily driven by a sense of professional integrity, collective responsibility to protect others, confidence in health authorities and a desire to return to a pre-pandemic way of life. However, there were prevailing concerns with respect to the vaccines, including long-term benefits, safety and efficacy, that hampered a decision. Inadequate information and social media representation of vaccination appeared to add to negative beliefs, impeding a decision to accept while low perceived susceptibility played a moderate role in the decision to delay or decline vaccination. Participants made valuable suggestions to bolster vaccination. Our findings support an approach to improving vaccine uptake in HCWs that features routine tracking and transparent updates on vaccination status, use of institutional platforms for sharing of experience, assuring contingency management plans and tailored communications to emphasize the duty of care and positive outlook associated with vaccination.

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Introduction

Since the identification of SARS-CoV-2 in December 2019, the pathogen has rapidly spread globally, with a death toll reaching six million.¹ Apart from the loss of lives, the COVID-19 pandemic has revealed a social and economic vulnerability of our time,^{2,3} putting tremendous strains on individuals and healthcare systems as a whole.^{4,5} In response to the threat posed by the pandemic, pharmaceutical companies have developed vaccines to contain the pandemic,^{6,7} which have been subsequently authorized by the World Health Organization.⁸ Yet, the ability for vaccines to halt the pandemic is weakened by vaccine skepticism worldwide. Vaccine hesitancy refers to delaying or refusing vaccination when made available. It harms hesitant individuals and hinders the achievement of a high coverage rate that is crucial to flatten the epidemic curve.⁹

With the emergence of novel variants and breakthrough infections, vaccination and boosters continue to be one of the best defenses in combating viral spread. It is therefore critical to build confidence toward vaccines among the public and healthcare workers (HCWs) alike. Research indicates a strong association between the knowledge of and attitudes toward vaccines in HCWs and their willingness to recommend

vaccines to their patients.¹⁰ Despite ongoing efforts to encourage uptake of COVID-19 vaccines, it is not uncommon to observe HCWs' hesitancy to be vaccinated, which ranges from 4% to 72% across countries.¹¹ As healthcare workers are often considered the most reliable source of information, hesitant HCWs may strongly influence vaccine acceptance in the general population, thereby impeding the vaccination efforts.¹²

To date, a sizable number of studies have assessed HCW's perceptions of COVID-19 vaccination and some barriers to uptake. Yet, they predominantly focused on reasons for 'refusing' the COVID-19 vaccines, framed as 'hesitancy'. In addition, existing studies have almost exclusively used cross-sectional surveys for polling vaccination intentions.^{13,14} Reasons behind the decision-making for vaccination can be multifaceted and complex, while different factors may have a strong influence on vaccine acceptance. Hence, a more nuanced understanding of the factors underpinning vaccination decisions would prove valuable in designing targeted strategies to optimize future vaccination efforts. Thus, this study aimed to explore multifactorial influences that might affect a decision on COVID-19 vaccination and suggestions for decision support to improve vaccine uptake among HCWs in the early phase of vaccination rollout.

Methods

Setting

Singapore is a multi-ethnic city-state located in Southeast Asia. Although mass outbreaks in foreign worker dormitories spurred the imposition of a two-month lockdown in April 2020, the country's COVID-19 death toll remains low compared to other developed nations, with 1,287 deaths as of April 2022. In late December 2020, Singapore received its first shipment of COVID-19 vaccines, prioritizing high-risk individuals such as HCWs, nursing home residents and older adults.¹⁵ The present study was conducted between January and March 2021, when the vaccination program was rolled out for HCWs.

Participant recruitment

To recruit participants, a mass e-mail containing a recruitment poster was sent by the human resources department to all SingHealth staff, through which we invited them to take part in semi-structured interviews. Participants were asked to indicate their interest by selecting a link to a study landing page powered by Qualtrics®, a secured web-based platform provided in the e-mail. SingHealth is the largest regional healthcare system in Singapore, offering a complete range of medical care through a network of five national specialty centers, three hospitals and nine public primary care clinics.¹⁶ A total of 201 staff indicated their interest. They were purposively approached via e-mail based on the following eligibility criteria: 1) doctor, nurse, allied health professional, research staff, admin and finance staff, and ancillary staff; 2) employed full-time by the institution; and 3) proficient in English. To maximize the diversity of experiences and opinions, we strived to recruit a balanced number of participants under each professional category. Prior to interviews, written informed consent was sought via e-mail. Participants were not reimbursed for participation. This study was approved by the National University of Singapore Institutional Review Board (NUS-IRB-2020-833)

Data collection

A semi-structured interview guide was developed based on relevant literature and the study team's multidisciplinary expertise to allow prior knowledge to determine to a certain extent what we would look for (supplementary material).^{12–19} Major topics included factors influencing a decision on vaccine acceptance or hesitancy, and suggestions for improvement in vaccine uptake. The guide was pilot-tested after initial in-depth interviews and iterated several times to include more factors to be probed as data collection progressed. This inductive-deductive procedure allowed us to employ a back-and-forth process to iteratively identify newly emerged factors while confirming those factors already recognized in the extant literature. Consented individuals took part in one-to-one interviews virtually over Zoom® by two interviewers trained in qualitative research (SY and HG). Reflections and field notes were written after each interview to capture insights. Interviews lasted about 30–60 minutes.

Data analysis

All interviews were audio-recorded following consent and transcribed verbatim. Thematic data analysis was undertaken to explore underlying factors affecting vaccine uptake and their perception of how the current vaccination program can be improved.^{20,21} Two independent coders (SY and HG) reviewed the interview materials, summarized and extracted meaningful statements, and carried out open coding and axial coding using NVivo 12®. During open coding, transcripts were analyzed to develop categories of information. This allowed for subthemes to be derived from the data instead of preexisting ideas. During axial coding, common subthemes were grouped into unifying themes. The iterative process of independent coding and consensus meetings continued until no new emergent themes were identified. The codes were independently applied to all transcripts, and coding discrepancies were resolved by iterative discussions. For rigor and transparency, we anchored our methodology according to the Consolidated Criteria for Reporting Qualitative Research checklist.²²

Results

Characteristics of participants

A total of 33 HCWs participated in the one-to-one interviews. Data saturation was reached after the 29th interview, with no new themes emerging from subsequent interviews. We conducted four additional interviews beyond data saturation to ensure that point of information redundancy was achieved. **Table 1** shows the characteristics of participants, including five doctors (15.2%), five nurses (15.2%), six allied health professionals (18.1%), seven research (21.1%), five admin/finance professionals (15.2%), and five ancillary staff (15.2%). Around two-thirds were female, and 54.6% were Chinese. Mean age was 43.3 (± 13.4) years old, with slightly more than half of the participants (54.6%) aged between 31–50 years. When exploring their vaccination intention, about half of the participants (48.6%) reported their intention to receive vaccination (or already vaccinated), followed by a third (33.3%) who were still unsure at the time of the interview, coupled with a handful who refused vaccination (18.1%).

Factors related to a positive decision on vaccine uptake

Table 2 presents the factors perceived to influence a positive decision on vaccine uptake. A sense of professional integrity was the most salient theme that motivated uptake; many reported regularly working with vulnerable patients and believed that it would be essential to lower the risk of transmission by having themselves vaccinated. Participants expressed a moral obligation to adhere to the code of professional conduct that requires them to ensure the safety of their patients. Getting themselves vaccinated also meant serving as role models to encourage the general public to engage in COVID-19 vaccination. A similar but subtly different theme was a sense of collective responsibility. Some participants noted that vaccination can confer protection to people other than patients who have yet to receive it or are medically unfit. Those keen to accept the

Table 1. Characteristics of participants (n = 33).

Characteristics	N (%)
Age	43.3 ± 13.4
≤30	6 (18.2)
31-50	18 (54.6)
>50	9 (27.2)
Ethnicity	
Chinese	18 (54.6)
Malay	6 (18.1)
Indian	7 (21.1)
Others	2 (6.2)
Gender	
Female	22 (66.7)
Male	11 (33.3)
Profession	
Medical	5 (15.2)
Nursing	5 (15.2)
Allied Health Professional	6 (18.1)
Research	7 (21.1)
Admin/Finance	5 (15.2)
Ancillary	5 (15.2)
Education	
High school and below	9 (27.1)
College	10 (30.3)
Postgraduate	14 (42.4)
Vaccination uptake	
Intended (or vaccinated)	16 (48.6)
Unsure	11 (33.3)
Declined	6 (18.1)

vaccine also recognized the importance of economic recovery; vaccination efforts and achievement of herd immunity as drivers for reviving the national economy.

Another important theme was related to the trust in national authority that assesses vaccine safety and efficacy. Despite concerns about the accelerated pace of vaccine development, participants expressed confidence in the review of vaccines conducted by national health authorities. Overall, there was a strong sense of trust in government among participants regardless of willingness to vaccinate. Lastly, personal motives and perceptions played a role in the decision to accept vaccination. For example, some participants believed that vaccination would facilitate relaxation of restriction measures and expedite a return to normality, especially traveling. This theme was prominent among non-local healthcare staff, nearly all of whom were unable to visit their families back at home since the onset of the pandemic. When prompted, most of them cited vaccination as a prerequisite for going overseas should the travel ban be lifted. Thus, the intense feeling of longing toward seeing family members enabled their decision to get vaccinated. These HCWs generally felt privileged to have priority access to the vaccine.

Factors related to a decision to delay or decline vaccination

Table 3 presents the factors perceived to impede a decision on vaccine uptake. A frequently mentioned hindrance was related to key aspects of the vaccines, such as safety and efficacy. This

Table 2. Factors related to a positive decision on vaccine uptake.

Theme	Subtheme	Illustrative quotes
Professional integrity and obligation	Desire to protect patients	<p>“Because I am at the frontline, and a lot of my patients are oncology patients, their immunity is compromised. So, we have to be fair to them.” 66 Female, Admin/Finance</p> <p>“Even if I am not a direct frontline staff, there will inevitably be some contact with either patients or other healthcare workers. Even though I am [still] working from home right now, occasionally, I go back to the office. [Hence], there is a risk of spreading it to other patients or even my family. So, I really cannot understand why there are people who refuse vaccination voluntarily.” 39 Male, Research</p>
	Wanting to be a good example to the public to encourage vaccination	<p>“Also, to be a role model to the public. If we as healthcare workers are not considering the vaccine, then how can we expect the public to get the vaccine?” 30 Female, Research</p> <p>“Because I work in the healthcare, the more I have to take it and show to the public that it is actually safe and effective.” 66 Female, Admin/Finance</p>
Sense of collective responsibility	Vaccination was seen to confer protection to others	<p>“A bit more of a societal duty toward the betterment of all. Because I can be part of a much bigger picture, and a lot of people are involved around the world obviously, so I thought it was a morally right thing to do.” 52 Male, Medical</p> <p>“I live with my parents, but not their turn yet to have the vaccination. So, by getting vaccinated, I am sure I will be protected, and the protection extends indirectly to them too.” 28 Female, Research</p>
	Vaccination is perceived as a driver for economic recovery through herd immunity	<p>“I think it is safer for every person who wants to continue to work. It is still better prevention than mask-wearing and social distancing. Only through vaccination, the economy will recover. If most of us are not vaccinated, do not ever hope for the recovery of economic activities when we are still segregated at the workplace.” 68 Female, Nursing</p> <p>“The economy is so badly hit by COVID-19. As long as we do not get herd immunity, the market and border will remain closed. So, for every person who refuses to take the vaccine, effectively they are opting for slower economic growth.” 39 Male, Research</p>
Confidence and trust in authority and vaccine	The belief that regulatory authorities did a good job to assess vaccine safety and effectiveness	<p>“Although the development of COVID-19 vaccine is faster compared to the development of vaccines in the past, I was confident that our health authorities had done the due diligence of researching the pros and cons of each vaccine. So, I believe that it is safe and also effective.” 34 Male, Medical</p> <p>“I feel that in Singapore, the regulatory authority is stringent. Anything that comes to our shores goes through very stringent testing before our government approves of it, likewise to the approved vaccines too.” 50 Female, Nursing</p>

(Continued)

Table 2. (Continued).

Theme	Subtheme	Illustrative quotes
Personal motives and perceptions	Desire to travel and return to normality	<p><i>"I am a Malaysian staff. I have been unable to travel back home since last year. From my personal point of view, if I get vaccinated, I will have the pass that allows me to go home."</i> 46 Female, AHP</p> <p><i>"We have to do a lot of safety measures at the moment like now we have to do daily temperature, and we have to report it diligently. It is a bit annoying at times. So, I am hoping that with more people getting vaccinated, perhaps such restrictions can be relaxed."</i> 35 Female, Research</p>
	Personal susceptibility of COVID-19 infections perceived to be high	<p><i>"I live with my wife, who is also a healthcare worker. Both of us work in the Emergency Department. We have a very high risk of getting COVID-19. Hence vaccination will definitely lower our risk."</i> 34 Male, Medical</p> <p><i>"The perceived risk of getting infected in the course of my work as well as from day-to-day interactions with various people prompted me to get vaccinated."</i> 35 Male, AHP</p>
	Feeling privileged to have priority access to vaccine	<p><i>"I am an overseas trained nurse, seeing how the pandemic is being managed in my country makes me feel very privileged to be one of the firsts to receive the vaccine."</i> 27 Female, Nurse</p> <p><i>"The vaccines are so precious as the access is so limited. Since I have access to it first, I will definitely go."</i> 49 Female, Nursing</p>

Table 3. Factors related to a decision to delay or decline vaccination.

Theme	Subtheme	Illustrative quotes
Concerns regarding key aspects of vaccine	Perception that safety and side effects are not assured	<p><i>"I think it is the safety issue that is stopping me from getting the jab. You know, some people have claimed that they have got allergic reaction or even death from anaphylactic shock."</i> 41 Female, Medical</p> <p><i>"I think it is the side effects that are deterring me. I am concerned about cytokine storms. I read some of the research trials, whereby a few of the participants had to amputate part of their limbs due to cytokine storm."</i> 31 Female, AHP</p>
	The belief that long-term benefits of vaccines are questionable	<p><i>"I had concerns about the duration for which it could protect against. Will the level of protection just decrease after six months or one year? If so, is there really a need for vaccination?"</i> 35 Male, Research</p> <p><i>"With new strains emerging, I am not confident that the vaccine can protect us from all these. If so, why should I risk my health for uncertain things?"</i> 43 Female, Admin/Finance</p>
	Disinclined to accept particular vaccine technology or brand	<p><i>"The mRNA technology is very new, it is not clinically tested on official trials yet, and most importantly, most insurances do not cover debilitating effects arising from novel technology."</i> 33 Female, AHP</p> <p><i>"In some parts of the world, they have introduced vaccines with efficacy that is around 50–60%. So, I am quite brand specific. I will only take the vaccine manufactured in a certain country."</i> 62 Male, AHP</p>
	Novelty of the vaccine is seen as unconvincing, which prompts the desire to let others receive it first	<p><i>"I think because the vaccine is relatively new. During early January and February [2021], a lot of people hear a lot of things, but they do not have any encounters with anyone who has undergone the vaccination. At that time, the feeling is that it may sound good, but I want to hold on first and see if everything is okay before going ahead,"</i> 46 Female, AHP</p> <p><i>"When the vaccine was first available to me, I chose not to go first because there was limited data. I want to observe what happened to those people who take the vaccine first."</i> 30 Female, Research</p>
	Fast-tracked vaccine development is considered unreliable	<p><i>"At this point in time, there was not really much information, and the vaccine was rolled out very fast compared to previous vaccines that needed to undergo many trials before release. So, there is a concern about the vaccine validity. I am not sure it is being pushed out for the sake of money or riding the COVID-19 hype."</i> 28 Female, Research</p> <p><i>"Because the vaccination was developed very quickly, I am not sure whether it was properly tested or not."</i> 65 Male, Ancillary</p>
Inadequate information and misinformation	Apprehension over adverse events being amplified by negative stories on social media	<p><i>"I am scared because of the news [vaccine related ADR] reported on social media, like 'oh no, this person developed this reaction'."</i> 32 Male, AHP</p> <p><i>"There have been concerns about a few incidents of anaphylaxis or other unintended adverse effects. There is a surgeon in the US who developed brain aneurysms post-vaccination, so people who read about these horror stories feel discouraged including myself."</i> 58 Female, Medical</p>
	Fear of harm on fertility and childbearing	<p><i>"Will it affect ladies who are planning to get pregnant? Some of us are not very sure at the moment as we do have a plan to start a family."</i> 35 Female, Nurse</p> <p><i>"Those who are trying for kids are a bit wary of the vaccine. They are not sure if the vaccine affects their baby should they get pregnant."</i> 29 Female, Nurse</p>

(Continued)

Table 3. (Continued).

Theme	Subtheme	Illustrative quotes
Limited benefits and utility of vaccination due to personal situation	Not considering oneself vulnerable to infection due to the nature of work	<i>"Not all the staff in the lab are handling COVID-19 sample, I am one of them. Hence, I feel I do not see the need to go for vaccination."</i> 33 Female, AHP <i>"We really don't need it [vaccine] because we are backend staff, and we don't really see the need to be vaccinated first when we are not facing patients."</i> 49 Female, Nurse
	Personal health conditions perceived incompatible with vaccination	<i>"I have a lot of medicine as I had a stroke before. I am taking blood thinner too, so I do not think I am qualified for the vaccination."</i> 65 Male, Ancillary <i>"Actually, I developed hives when I received one of the flu vaccines. So, I am wary of getting the jab for fear of another allergic reaction."</i> 33 Female, AHP <i>"I asked the doctor if I am still eligible for the vaccination as I am allergic to nuts. However, I was not given any definite answers."</i> 23 Female, Nurse

belief was more salient among those who were unsure or did not intend to accept the vaccine, who rationalized that possible safety issues and limited long-term benefits were offset by protection the vaccine can offer against COVID-19. One participant questioned the necessity to expose oneself to the unknown risk of vaccination when its capability of protecting inoculated individuals against mutated strains was not well established. This belief was mainly grounded in the speed of vaccine production and perceived lack of sufficient clinical evidence. Interestingly, an individual preference over the brand and vaccine technology seemed to strongly influence uptake. Many participants preferred a particular vaccine technology and expressed a willingness to delay inoculation until their preference was made available. The novelty of the vaccine prompted a wait-and-see attitude, with some deliberately waiting for more people to be vaccinated first before gaining the confidence to do so.

Inadequate information and misinformation were another critical theme. Reluctance to accept vaccines was often influenced by negative stories and unfortunate incidents propagated by mainstream and social media. Specific information on risks related to childbearing was perceived to be limited and inadequate, which was of particular concern to female HCWs who planned on pregnancy. On the other hand, some participants viewed the vaccination as having limited utility for them due to personal situations such as underlying health conditions and the nature of their work. Participants with a history of allergies felt uncomfortable to be inoculated, citing fear of adverse allergic events. However, it should be noted that although a small proportion of participants with an allergic history did express a keen interest to be vaccinated, official guidelines were felt to lack clarity regarding their specific risks, thus hampering a decision to be vaccinated. Not directly working with vulnerable patients was cited by some participants that influenced their reticence to vaccinate. These participants generally reflected uncertainty about the personal benefits of being vaccinated.

Improving vaccine acceptance and uptake

Participants made valuable suggestions to enhance vaccine uptake (Table 4). First, improving a system of collection and dissemination of vaccination-related information was seen to promote reflective communication. For example, routine tracking and transparent updates on vaccination were expected to aid

HCWs to consider their intention for vaccination and motivate uptake. This could be achieved by a regular administration of post-vaccination surveys to enable individuals to see aggregated vaccination status and vaccine-related incidents. Other participants suggested the creation of an institution-based single platform where HCWs could share post-vaccination experiences with other HCWs. They believed that such a platform would benefit those who were hesitant or ambivalent, and at the same time, would prevent the spread of unverified stories shared via social media. It was commonly viewed that an improved system of information dissemination may not only assist the institution to have a clearer understanding of adverse events experienced by the staff, but it may also accelerate the release of prompt advisories should unusual events occur.

A robust institutional support system was perceived as important in promoting vaccine acceptance. A recurring suggestion was to grant paid vaccination leave to staff. At the time of the study, the vaccination protocol required HCWs to resume work immediately following the vaccination since the vaccination exercise was conducted during working hours. However, participants who had been vaccinated reported an experience of discomfort, ranging from aching at the injection site to low-grade fever and swollen lymph nodes. A participating medical doctor stationed at the staff clinic similarly observed a marked increase in staff seeking consultation for minor adverse events following vaccination. Hence, giving time off or a vaccination leave benefit was expected to yield improved vaccine uptake and staff wellbeing. Another subtheme was assuring contingency management plans in situations of unexpected complications resulting from the vaccination, such as extended insurance coverage. Participants noted that this gesture would encourage vaccine uptake among individuals who were initially discouraged due to possible costs entailed by vaccination-related adverse events. A tailored educational campaign to foster understanding of vaccination rather than using a one-size-fits-all approach to vaccine promotion was suggested by some participants as a way to enhance vaccination uptake.

Discussion

HCWs identified multifactorial influences affecting their deliberations over whether to accept or not COVID-19 vaccines, which may have important implications for driving the success of the vaccination program. The decision was not a simple

Table 4. Improving vaccine acceptance and uptake.

Theme	Subtheme	Illustrative quotes
Improving a system of information collection and dissemination	Providing routine and transparent updates on vaccination to understand the vaccination status	<p>"I think it is good to have a post-vaccination survey, whereby the institution can ask the staff who have taken the vaccine for some comments such as side effects experienced after vaccination. Such data should be collated and tabulated, then send it to all the staff so they can be more informed of what are some of the possible side effects that other people also experience." 33 Female, AHP</p> <p>"The institution can publish, let's say, numerical data on how many people have gone for vaccination, and then how many people are experiencing minor side effects like chills and fever arising from vaccination, and then how many people are having severe allergic reactions. Provision of such information more transparently to the staff will boost their confidence in you, especially if the percentage of severe reaction is really very low." 41 Female, Medical</p>
	Creating an institutional platform to share post-vaccination experiences among staff to preempt unverified stories	<p>"It is helpful to ask staff who have gone for vaccination to share their experience with the rest; the idea is to assure others: Look at these people who have gone for vaccination, and they are fine. Of course, you don't get people who say: Oh, nothing happened to me, I'm perfectly fine. That is not really telling the truth. But somebody telling others that: Yes, the injection site is sore, the soreness goes on for maybe 12 hours, and if I take paracetamol, then the next day, life goes on. So, it has to be practical things that people can relate to. That's important." 67 Female, Ancillary</p> <p>"As of now, when vaccinated staff encountered unpleasant experience during or after vaccination, they have no ways to feedback it directly to the institution. When such communication channels were not provided, they will turn to people around them, then those who have not gone [for vaccination] would be even more discouraged. On the other hand, it also helps the hospital to release advisories should peculiar incidents were reported" 49 Female, Nursing</p>
Institutional support for staff pre- and post-vaccination	Granting paid leave post-vaccination	<p>"A lot of them presented themselves at the staff clinic due to minor adverse events from vaccines. We can explore granting one to two days of undocumented sick leave to staff who have received their vaccination so they could simply rest at home." 34 Male, Medical</p> <p>"I feel that the institution has to recognize that there are people who are going to experience [vaccination-related] adverse effects. So, they will have to take medical leave. What I have heard in the news is that there are certain companies such as [a local bank], although they have not rolled out vaccination program for their staff what they are doing is that for all staff who are going to be vaccinated, they are entitled up to 2 days of unrecorded leave. You do not even have to see a doctor to get the leave." 35 Male, Research</p>
	Assuring contingency management plans in situations of unexpected adverse events	<p>"I think hospital can provide extended insurance coverage, in case of side effects, the staff will be insured for any treatments or diagnostics test related to the vaccination. This measure might encourage more people to go for vaccination, especially if they are worried about the cost arising from vaccination side effects" 33 Female, AHP</p> <p>"Setting up a hotline or a vaccine clinic within the institution, whereby staff can call or walk-in, if they experience any side effects or if they have any queries or uncertainties prior vaccination. It will be beneficial instead of staff going around searching for information, which might not be verified in the first place." 30 Female, Research</p>
	Developing educational materials tailored to literacy levels	<p>"Within the institution, there exists a group of people who might not grasp clinical concepts readily; some could even be illiterate. Hence, there is an urgency to reconsider the dissemination of information. We do not want to miss out on any group. I think education materials specifically targeting this group might help to encourage uptake, instead of bombarding them with medical terms which they do not understand, and they cannot relate eventually." 68 Female, Nursing</p> <p>"We can give pamphlets to educate the staff about the vaccines that they are receiving. I think information should be tailored to the different groups so it can be understood and internalized easily." 34 Male, Ancillary</p>

binary response; rather, it was a weighing up process reflecting expectations, values and drawbacks arising from vaccination as well as taking into account their relative significance.

Similar to prior literature, we found that despite general acknowledgment of the importance of vaccination, there were prevailing concerns related to the vaccine, such as safety, long-term benefits and rigor of vaccine development, which acted as a barrier to a decision on vaccine acceptance.^{23–25} Inadequate

information, coupled with negative stories and false claims on social media, also seemed to fuel suspicions and prompt some HCWs to delay or decline vaccination. A systematic review attributed media as the main contributor to the confusion of vaccine safety by reporting inaccurate information and amplifying vaccine side effects.²⁶ The issue of media representation becomes critical when misinformation goes against the flow of evidence-based information. With the media becoming

a source of contradictory information, media speculation, especially during a public health emergency, should be addressed promptly to curb the spread of anti-vaccine sentiments. Paradoxically, it may be increasingly difficult for individuals to value the benefits conferred by mass vaccination when the number of community cases remains low.²⁷ Research suggests that complacency is remarkably elevated in places with low caseloads, where the risk of vaccination may appear higher than that of a vaccine-preventable disease, thereby rendering vaccination less essential.²⁸ Indeed, due to relatively low caseloads, some of our participants did not consider themselves vulnerable to COVID-19 infections and hence did not see the need to be vaccinated. This sentiment illustrates the salience of contextual influences on decision-making, and how HCWs conceptualize the risk is also important to decisions on vaccine uptake.^{29,30}

On the other hand, we identified several influences that could motivate a decision on vaccine uptake. Duty of care and ensuring patient safety were the key driver for a decision to accept vaccination. Bound by professional contract, many HCWs felt compelled to be inoculated as they believed this would reduce risk to vulnerable patients. This finding resonates with previous studies that found an association between a desire to protect patients and willingness to be vaccinated.^{31,32} Thus, the emphasis on the protective effects of vaccines on self and patients should form an important key message for vaccination promotion programs in healthcare and hospital settings. Another prominent theme was the personal desire to return to normality; participants indicated their willingness to get vaccinated in the hope of ending the pandemic and getting back to the pre-pandemic way of life. As countries begin to ease their border control and lift travel restrictions, vaccination is widely regarded as a prerequisite before traveling.³³ Therefore, future communication strategies aiming to increase vaccination and boosters should consider carefully framing messages around positive outlooks associated with vaccination to cultivate a more positive response to vaccination.

In light of multifaceted influences, a crucial issue that remains to be addressed is how to foster acceptance of vaccines and booster shots given the emergence of breakthrough infections and new variants. Literature suggests that vaccination intention in HCWs could be improved should they be well informed of the vaccine science.^{34,35} However, we found that a lack of dedicated information channels on vaccination unwittingly allowed the spread of unverified claims among HCWs, undermining their confidence in the vaccine. To address HCWs' concerns and doubts, an institution-led platform was suggested by participants to enhance accessibility to vaccine-related information. In Switzerland, a government-owned vaccination information platform, namely INFOVAC, was launched to empower HCWs to obtain accurate information from verified sources and increase knowledge. Since its implementation, the Swiss healthcare system has seen increased utilization of vaccination services.^{36,37} Therefore, setting up a legitimate platform would enable healthcare institutions to actively counter unverified information circulating within the workplace while serving as an avenue for HCWs to report or inquire about vaccine-related information. In addition to the

provision of informed reassurance, extended institutional support could facilitate HCWs' decision-making. In an effort to promote vaccination, the World Health Organization rolled out a no-fault compensation program operating on an international scale. The program offered eligible individuals who experienced injuries due to the inherent risk of vaccination a fast, fair, and transparent compensation, without the need of the injured party to prove negligence or fault by the vaccine provider or health system.³⁸ Learning from such experiences, relevant health authorities could partner with insurance agencies to improve staff welfare post-vaccination, such as extending insurance coverage for adverse events. Such strategies may help to build the confidence of HCWs toward vaccination.

Since the first vaccination programs was rolled out, extensive efforts have been made by the authorities and healthcare institutions to address the concerns raised and improve overall vaccine uptake. On a national scale, the authority introduced the Vaccinated Travel Lanes (VTLs) as an incentive that promotes vaccination uptake.³⁹ Under such arrangement, fully vaccinated individuals were allowed two-way quarantine free travel between Singapore and a predefined list of countries. This arrangement was well received by foreign healthcare staffs yearning for going back home. Within healthcare institution, a dedicated COVID-19 vaccine team comprising infectious disease physicians and nurses was commissioned to provide individualized consultation to staff who expressed concerns about the compatibility of the vaccine with their personal health conditions. The institution also implemented a new pharmacy walk-in consultation for hospital staff to verify any COVID vaccine-related claims with the pharmacists.

In hindsight, what we found with the interviews appeared to have evolved over the course of the pandemic. As additional information about vaccine safety and adverse events became more available, views regarding COVID vaccines may have changed over time. Those who were initially hesitant toward the vaccine might have embraced vaccination once they were convinced that vaccines are safe and effective. For example, a local study reported that after nine months of vaccination campaigns, sentiment of vaccine mistrust among staff had been steadily abated with internal vaccinations database showing 90% full vaccination rate in primary healthcare cluster.⁴⁰ This could be attributed to the concerted efforts from hospital leadership and policy makers, disseminating messages about the protective impact of vaccines and providing current evidence on vaccine efficacy against variants of concerns.⁴⁰ These actions may have altered the initial perceptions of HCWs thereby encouraging vaccine uptake, as vaccination would be seen as an altruistic act in safeguarding their own health and that of their patients.

This study provided valuable insights into the development of measures to improve vaccine acceptance among HCWs. As this study was conducted at the very initial stage when COVID vaccination was first rolled out, with priority given to HCWs, we were able to capture initial hesitations and concerns surrounding the new vaccines. During this period, vaccination was on a strictly voluntary basis. Thus, responses from participants were believed to be largely candid as no sanctions were imposed should they choose not to be vaccinated. However, as

the country began to open up progressively and with improved understanding of the vaccine's safety and efficacy, the authority gradually implemented mandatory workforce vaccination measures.⁴¹ Future research could usefully explore the changing perceptions of vaccination in response to policy measures. Our findings may also inform future policy strategies to build confidence in new vaccines in HCWs and support the rollout of vaccination programs in the event of future vaccine development against pandemics. Despite the strengths, this study has a few limitations. Our sample was derived from the list of HCWs who indicated a willingness to participate in the study by online invitation. The voluntary nature of participation may reflect potential selection bias, where HCWs who participated may have more inclinations toward vaccination compared to those who did not participate. Another limitation is recognizing that findings represent a snapshot of the early phase of vaccination rollout for HCWs. As additional information about safety and risks becomes more available, views regarding the COVID vaccine may change over time.

Conclusion

Our study provides important insights related to the multifactorial influences on vaccination acceptance and future COVID-19 vaccination uptake in HCWs. Given the varying rates of efficacy across COVID-19 vaccines and the need for ongoing booster vaccination, the approach to improve vaccine uptake among HCWs may benefit from a multi-pronged strategy that features routine tracking and transparent updates on vaccination status, use of institutional platforms for sharing of experiences, extended support for staff welfare post-vaccination and tailored communications to emphasize professional integrity and positive outlook associated with vaccination. Our findings also may shed light on policies aimed at enhancing acceptance of vaccines more generally among HCWs.

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Author contribution

SY: methodology, data curation, formal analysis, writing—original draft; HG: methodology, data curation, formal analysis, writing—review & editing; DM, SS, EL, SSWL, JGHL, TC, NG: writing—review & editing; MO: conceptualization, writing—review & editing. All authors approved the final version of the manuscript.

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