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REVIEW ARTICLE

Hesitancy to COVID-19 Vaccine Among Healthcare Workers: A Scoping Review

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ABSTRACT

Vaccine hesitancy is a global concern and a significant barrier to vaccine uptake. Healthcare workers (HCWs) are more likely to contract COVID-19 and are the most trusted source of patient vaccine-related information. This scoping review summarized the rates of hesitancy against COVID-19 vaccine and booster dose among HCWs. We also explored the determinants of COVID-19 vaccine hesitancy and acceptance. The review method was described according to the PRISMA extension for scoping reviews. Literature search from PubMed, Google Scholar, Scopus, and EBSCOhost was conducted for studies published from January 2020 to August 2022. Themes were generated using inductive and deductive methods to identify the determinants for hesitancy and acceptance of COVID-19 vaccine. Overall, a total of 157 articles were included in this review. The hesitancy rate varied before the COVID-19 vaccination rollout ranging from 3.8% to 79.0%, while the hesitancy rate was 1.1%-73.3% in studies conducted after the vaccination rollout. Six themes were generated for hesitancy and seven themes for acceptance of COVID-19 vaccines. The themes identified for vaccine hesitancy and acceptance were trust issues in vaccines or authority; vulnerability to COVID-19 infection and its complications; information and misinformation; personal and past vaccine experience; religious and ethical; and socio-demographic and work factors. Professional integrity was the additional theme for vaccine acceptance. Safety and

effectiveness issues, trust, perceived risk of infection, and misinformation were among the common factors. It is recommended that the government develops strategies, guidelines, or more transparent information about the vaccines to improve the acceptance of COVID-19 vaccinations.

INTRODUCTION

The outbreak of the new coronavirus disease 2019 (COVID-19) has been declared a worldwide pandemic by World Health Organization (WHO) on 11 March 2020 (Cucinotta & Vanelli, 2020). The pandemic's catastrophic consequences underscore the urgent need for an effective vaccine. Vaccine hesitancy, defined as the delay in acceptance or refusal of vaccination despite availability, is a growing concern worldwide (Dubé et al., 2014). HCWs are at high risk of infection as their job requires close personal exposure to infected patients, which may contribute to the spread of the disease (Luo et al., 2021). When HCWs contract COVID-19, it reduces the workforce and further impacts the healthcare system significantly (Kwok et al., 2021). The WHO emphasizes that HCWs can be crucial to effective vaccination programs, as they can promote vaccinations and serve as role models for the general population (Avakian et al., 2022). Therefore, it is crucial to boost HCWs' confidence in vaccines and involve them in addressing vaccine hesitancy among patients.

The COVID-19 vaccines remain the best option for protection, although their efficacy varies by different strains of the virus (Haque & Pant, 2022). Recent literature has reported that the vaccination provides stronger, long-lasting protection against serious hospital outcomes and death than against symptomatic and asymptomatic illness (Hall et al., 2022). The emergence of new variants, new information, new policies, newly reported vaccine risks, and changes in policies have contributed to COVID-19 vaccine hesitancy (Larson et al., 2022). All these changes are amplified by the digital media platforms, leading to vulnerability of the hesitancy status over time (Larson et al., 2022). Therefore, continuous monitoring of HCWs' vaccine perceptions is pertinent to successful vaccination program and safeguards the healthcare system. Rapidly growing literature regarding COVID-19 vaccine hesitancy and acceptance in HCWs globally underscores the need to update the community and government on these issues.

To our knowledge, 13 reviews and meta-analyses (up until August 2022) had been conducted on COVID-19 vaccine hesitancy or acceptance among HCWs, with most searches completed by July 2021. Peterson et al. conducted a literature search in April 2022 but did not specify the number of studies. (Peterson et al., 2022). A review by Willems et al. reported on 22 cross-sectional studies and four qualitative studies, that did not specify the description of the continent or booster hesitancy rates (Willems et al., 2022). The highest number of studies reported about this issue was on 75 studies conducted through a literature search up to May 2021 (Crawshaw et al., 2022). A systematic review by Galanis et al. has highlighted that the acceptance rate of the COVID-19 vaccine among HCWs was 63.5%, which linked to factors like male gender, older age, white ethnicity, physician profession, higher education, comorbidities, previous flu vaccination, stronger vaccine confidence, positive attitude toward COVID-19 vaccine, fear about COVID-19, individual perceived risk about COVID-19, and contact with COVID-19 patients (Galanis et al., 2021).

We noted numerous studies have been done since 2021 that mandate an update on the topic. Furthermore, we pointed out that the attitude to the vaccine may fluctuate based on several factors that have not been discussed in previous reviews such as the period during vaccine rollout and towards the booster dose. As a result, we aim to conduct a scoping review to identify and summarize the COVID-19 vaccine and booster hesitancy

rates, as well as factors that could contribute to COVID-19 vaccine hesitancy or acceptance among HCWs worldwide. This review will help the health authorities and policymakers understand the hesitancy factors and strategy to improve acceptance of COVID-19 vaccination to enhance the vaccination uptake and future emerging vaccines.

We identify several objectives for this scoping review as follows:

- To map out the descriptions of the COVID-19 vaccine and booster hesitancy among HCWs in terms of types of studies, year of study, studies conducted during or before vaccine rollout, types of HCWs, and hesitancy rate.
- To explore the themes regarding determinants for hesitancy and acceptance of COVID-19 vaccines.

METHODS

The review method was described according to the PRISMA ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews) (Tricco et al., 2018). This scoping review was performed following the methodological framework proposed by Peters et al. 2022 (Peters et al., 2021).

Eligibility criteria

Studies that met the following criteria were included. The inclusion criteria were:

1. Population: HCWs were defined as all individuals employed or studying in a healthcare setting, including physicians, nurses, and allied HCWs, as well as ancillary staff (e.g., healthcare administration and support staff).
2. Study design: cross-sectional, survey, cohort, qualitative.
3. Outcomes: studies examined attitudes/ hesitancy/acceptance of COVID-19 vaccination and analyzed related factors.
4. Language: English

The exclusion criteria were:

1. Population: the public or health-based students
2. Study design: an interventional study, review, systematic review and meta-analysis or scoping review
3. Outcomes: studies did not assess the COVID-19 vaccine attitude or related factors
4. Others: retraction, not peer-reviewed

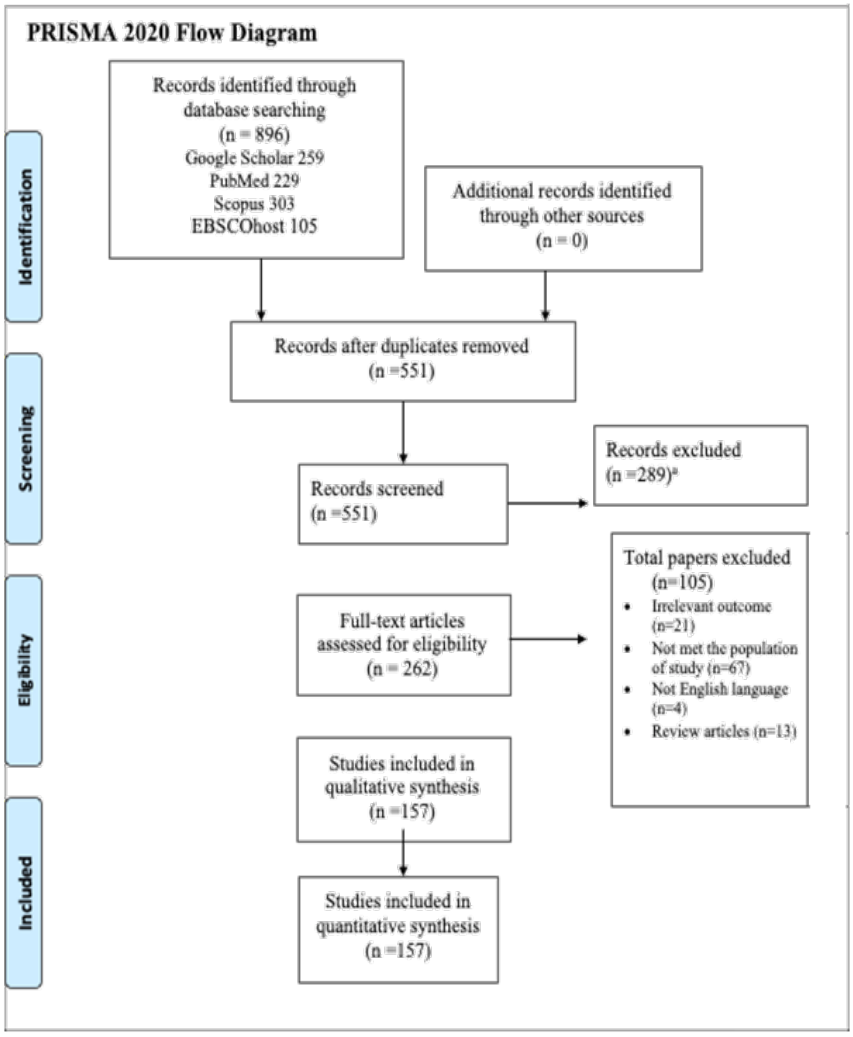
Search strategy

Four English databases (PubMed, Google Scholar, Scopus, and EBSCOhost) were comprehensively retrieved for relevant literature published from January 1, 2020 to August 25, 2022. Various combinations of topical terms were utilized as key phrases; COVID-19 or SARS-CoV-2 or 2019-nCoV AND healthcare workers or healthcare personnel or physicians or nurse AND vaccines or vaccination or immunization AND hesitancy or attitude or acceptance. The search strategy keyword was shown in Supplementary 1. Original articles written in English performed strictly among HCWs of both genders and containing sufficient data of interest were considered. Studies not reporting the rate of vaccine acceptance/hesitancy toward COVID-19 vaccination among HCWs were not included. Information on the author, publication year, country, data collection date, sample size, the population involved, vaccine availability, acceptance/hesitancy and prevalence rate towards COVID-19 vaccine, and associated factors were collected from studies of interest. "Hesitancy rate" was calculated considering both negative and uncertain answers showing refusal to be vaccinated (e.g., "probably no", "unlikely", or "somewhat disagree"). In that study which reported only vaccine acceptance rates, the vaccine hesitancy rates were calculated using the formula: (100%-vaccine acceptance rate%).

A two-step study selection was used in this review. The first exclusion by title and abstract was made by using the inclusion/exclusion criteria, by the author (NYY), then another researcher (AAK) retrieved the full text for further screening to determine whether studies to be included or excluded. Any divergences in screening results were resolved by discussion between reviewers and, if necessary, consulting a senior reviewer to reach a consensus. Endnote software was used to import search results from all databases and remove duplicates. After duplicate removal, the researchers screened titles, abstracts, and full text of the results independently. The differences were resolved through joint discussions or consultations with a third party.

Charting the data

A standardized set of data extraction items guided by our research question were developed and piloted at the protocol stage to extract key data from the included studies. Data extractions were performed by author AAK and checked by another author (NYY). Variables were extracted for the following key groupings: Title, article language, the author of article, publication date, publication year, country of studies, data collection period, sample size, study design, HCWs population, characteristics of participants, study tools, vaccine rollout, hesitancy or acceptance rate, booster hesitancy rate and determinants of hesitancy or acceptance.



[a] Did not evaluate COVID-19 vaccine-related hesitancy or acceptance among HCWs.

Figure 1: Flowchart of retrieval articles.

Data synthesis and analysis

Microsoft excel and word were used for the data extraction. Then these data were imported into NVIVO 12.0 and were coded according to the study objectives. Inductive and deductive methods were performed by AAK to get the themes and subthemes for the determinants of vaccine hesitancy or acceptance. Next, all the themes extracted from the papers were reviewed by the NYY. Both authors came to a consensus about the themes identified.

RESULTS

Our initial literature search yielded 896 articles from four databases (Figure 1). After removing duplications, 551 studies remained and were screened for titles and abstracts. Next, 289 articles were identified that fall in the category of unrelated and ineligible articles. The excluded publications consisted of 21 irrelevant outcomes, 67 studies that were not in the population of interest, 13 review articles, and four non-English full texts. As a result, the number of studies included was 157 publications.

Table 1 shows the descriptive characteristics of the studies. There were a total of 157 studies, with 147 cross-sectional studies (Supplementary 2) and ten qualitative or mixed-method studies (Supplementary 3). Most of the studies were conducted in 2021 (54.8%). Out of the 147 cross-sectional studies, 134 were studies on primary dose and 13 were studies including booster dose.

Survey characteristics

Forty-nine studies were conducted mostly before the COVID-19 vaccine's rollout, thus these studies analyzed people's attitudes and intentions about future COVID-19 immunizations based on the assumption that the vaccine would be accessible. Ninety-eight cross-sectional studies and 10 qualitative surveys were completed after the COVID-19 vaccine was available. Thirteen out of 98 cross-sectional studies conducted after vaccine rollout further studied the intention for booster doses among HCWs. Five cross-sectional studies involved collaborating with many countries, with the maximum number involving 91 countries (Askarian et al., 2022). The sample size for cross-sectional studies ranged from 108 to 85216 participants. There were various variances in the sample group, but most studies included physicians, nurses, or both. Clinical officers, lab technologists, allied health workers, administrative, and support employees were all included in the sample population of several studies.

COVID-19 hesitancy rates before and after vaccine rollout

Data on the COVID-19 vaccine hesitancy rate were retrieved from 147 cross-sectional studies. Based on our findings, 49 studies were conducted before the COVID-19 vaccination rollout and 98 studies were conducted during the vaccination campaign. The hesitancy rate varied before the COVID-19 vaccination rollout ranging from 3.8% to 79.0%, while the hesitancy rate was 1.1%-73.3% in studies conducted during the vaccination program rollout. Among highly hesitant countries included Egypt (74.0%-79.0%), Taiwan (76.4%), Congo (72.3%), and Cyprus (70.0%). In contrast, vaccine hesitancy was low in Italy (1.1%), followed by the United States (1.5%), Uganda (2.3%), and the Asia-Pacific region (3.8%).

Determinants and reasons associated with hesitancy to take the COVID-19 vaccine

We identified six themes and further sub-categorized them into 23 contextual determinants or reasons for COVID-19 vaccine hesitancy (Table 2). The themes were categorized into; trust issues in vaccines or authority, vulnerability to COVID-19 infection and its complications; information and misinformation; personal and past vaccine experience; religious and ethical; sociodemographic and work factors. Vaccine safety and efficacy seemed to be the most common factors found in many studies (Table 2). Concerns on the effect of the vaccine on

pregnancy, breastfeeding, and fertility were found in several studies (Fotiadis et al., 2021; Quiroga et al., 2021; Townsel et al., 2021; Xu et al., 2021). The socio-demographic factors for vaccine hesitancy revealed that females, younger age group, lower education level, and non-medical or clinical based paramedics were more likely to be hesitant. Most qualitative studies explored the attitudes and perceptions toward COVID-19 vaccines, with safety concerns and potential adverse effects being the most discussed aspects (supplementary data 3).

Table 1: Descriptive characteristics of the studies

Variables	Number of studies
Year of Study conducted	
2020	60
2021	86
2022	11
Continents of study	
America	34
Europe	36
Asia	58
Africa	23
Australia	1
>1 continent	5
Types of HCWs	
General	140
Physicians	4
Nurses	9
Pharmacists	3
Clinical Radiographers	1
Sample size	
<1000	88
1000-2000	31
2000-5000	25
5000-10000	7
>10000	6
Studies before vaccine rollout	49
Studies during vaccine roll-out (including booster dose)	108

Determinants and reasons associated with acceptance to take the COVID-19 vaccine

The themes for acceptance were almost the same for the hesitancy determinants but it had one different theme that was not found in the hesitancy factor (Table 3). This theme was professional integrity which included only one subtheme which was moral and work responsibility. A qualitative study and a few cross-sectional surveys identified this issue for HCWs' acceptance of the vaccine (Adejumo et al., 2021; Cuschieri & Grech, 2021; Kuter et al., 2021; Woodhead et al., 2021). Those HCWs who had a history of acceptance with the recommended vaccine, perceived higher susceptibility to infection, and having occupational risk are factors identified. Male, older age group, higher education level, having higher income, front liners and higher working experience are the socio-demographic characteristic of this group of HCWs.

Hesitancy to COVID-19 vaccine booster dose

A total of 13 studies were conducted to assess the hesitancy or acceptance of HCWs for the COVID-19 vaccine booster dose. The hesitancy rates for booster doses were ranged from 13.0% - 58.8%. The determinants for hesitancy to COVID-19 vaccine booster dose were almost similar to the determinants for hesitancy to the primary dose. Lower education level, younger age, concern about safety and side effects of the vaccine, and lack of information were all factors associated with hesitancy for COVID-19 vaccine booster dose. There were particularly some factors that were different from the factors associated with hesitancy to COVID-19 primary dose. These included post-vaccination adverse reactions that may cause work absenteeism, having received the Moderna vaccine (Chrissian et al., 2022), and increased fear of a second booster dose/new COVID-19 vaccine (Galanis, Vraka, et al., 2022). A study in Singapore found that if the HCWs were

Table 2: Themes for hesitancy factors to COVID-19 vaccines among HCWs.

Theme 1: Trust issues in vaccines or authority	
Concern about the safety and efficacy of the vaccines	(Adejumo et al., 2021; Amin & Palter, 2021; Aoun et al., 2021; Arslanca et al., 2021; Aurilio et al., 2021; Avakian et al., 2022; Baghdadi et al., 2021; Baynouna Al ketbi et al., 2021; Browne et al., 2021; Castañeda-Vasquez et al., 2021; Chrissian et al., 2022; Chudasama et al., 2022; Costantino et al., 2022; Cuschieri & Grech, 2021; Dara et al., 2021; Di Valerio et al., 2021; Dzieciolowska et al., 2021; Elharake et al., 2021; Fakonti et al., 2021; Haddaden et al., 2021; Hoffman et al., 2022; Hulen et al., 2022; Ilori et al., 2022; Kaufman et al., 2022; Kim et al., 2021; Manby et al., 2022; Mehta et al., 2022; Nasr et al., 2021; Ofei-Dodoo et al., 2021; Oliver et al., 2022; Otiti-Sengeri et al., 2022; Parente et al., 2021; Razzaghi et al., 2022; E. D. Robinson et al., 2021; Schrading et al., 2021; Shekhar et al., 2021; Unroe et al., 2021; Vignier et al., 2021; Yoon et al., 2022; Zaidi et al., 2021; Zaitoon et al., 2021; Zheng et al., 2021)
Concern about the effect of COVID-19 vaccines on fertility, pregnancy, or breastfeeding	(Aw et al., 2022; Dara et al., 2021; Fotiadis et al., 2021; Galanis, Moisoglou, et al., 2022; Ofei-Dodoo et al., 2021; Perez et al., 2022; Quiroga et al., 2021; Townsel et al., 2021; Xu et al., 2021; Yoon et al., 2022; Zheng et al., 2021)
Lack of trust in authorities such as health authorities, pharmaceuticals, or government	(Adejumo et al., 2021; Aemro et al., 2021; Al-Sanafi & Sallam, 2021; Alhassan et al., 2021; Alle & Oumer, 2021; Baynouna Al ketbi et al., 2021; Botwe et al., 2021; Dubov et al., 2021; Elharake et al., 2021; Famuyiro et al., 2021; Gadoth et al., 2021; Gogoi et al., 2022; Christopher Holzmann-Littig et al., 2021; Hulen et al., 2022; Qunaibi et al., 2021; Verger et al., 2021; Vignier et al., 2021; Woodhead et al., 2021; Yoon et al., 2022; Youssef et al., 2022; Zaidi et al., 2021; Zürcher et al., 2021)
Personal preference for a particular vaccine	(Al-Sanafi & Sallam, 2021; Dzieciolowska et al., 2021; Hulen et al., 2022; Quiroga et al., 2021; Sirikalyanpaiboon et al., 2021)
Theme 2: Vulnerability to infection and its complications	
Confidence in natural immunity or their immune system to protect them from COVID-19 infection	(Aemro et al., 2021; Amin & Palter, 2021; Bauernfeind et al., 2021; Castañeda-Vasquez et al., 2021; Chudasama et al., 2022; Costantino et al., 2022; Dubov et al., 2021; Galanis, Moisoglou, et al., 2022; Kara Esen et al., 2021; Kociolek et al., 2021; Mehta et al., 2022; Ofei-Dodoo et al., 2021; Pacella-LaBarbara et al., 2021; Qunaibi et al., 2021; Shehata et al., 2021; J. Wang et al., 2020; Yendewa et al., 2022; Zaitoon et al., 2021)
Perceived low risk of getting COVID-19 infection	(Aemro et al., 2021; Bauernfeind et al., 2021; Fotiadis et al., 2021; Pacella-LaBarbara et al., 2021; Sirikalyanpaiboon et al., 2021; Zürcher et al., 2021)
Confidence in complementary medi-cine	(Castañeda-Vasquez et al., 2021; Zaidi et al., 2021)
Fear of contracting COVID-19 infec-tion through the vaccine	(Barry et al., 2021; Chew et al., 2021; Kuter et al., 2021)
Theme 3: Information and misinformation	
Perceived inadequate knowledge about the vaccines	(Aemro et al., 2021; Alle & Oumer, 2021; Angelo et al., 2021; Aoun et al., 2021; Avakian et al., 2022; Baniak et al., 2021; Bauernfeind et al., 2021; Baynouna Al ketbi et al., 2021; Browne et al., 2021; Cuschieri & Grech, 2021; Di Gennaro et al., 2021; Dubov et al., 2021; Dzieciolowska et al., 2021; Gadoth et al., 2021; Christopher Holzmann-Littig et al., 2021; Kuter et al., 2021; Otiti-Sengeri et al., 2022)

Apprehension of social media negative stories	(Al-Sanafi & Sallam, 2021; Aw et al., 2022; Di Gennaro et al., 2021; Elkhayat et al., 2022; Christopher Holzmann-Littig et al., 2021)
Negative influence from surroundings such as family members, friends, or personal doctor	(Elkhayat et al., 2022; Christopher Holzmann-Littig et al., 2021)
Theme 4: Personal and past vaccine experience	
History of hesitancy with recommend-ed vaccines	(Adeniyi et al., 2021; Bauernfeind et al., 2021; Cuschieri & Grech, 2021; Famuyiro et al., 2021; Fotiadis et al., 2021; Christopher Holzmann-Littig et al., 2021; Kara Esen et al., 2021; Kim et al., 2021; Oliver et al., 2022; Qunaibi et al., 2021; Shallal et al., 2021)
Fear of injection	(Baghdadi et al., 2021; Ye et al., 2021)
Cost issue	(Adejumo et al., 2021; Parente et al., 2021)
Theme 5: Religious and ethical	
Spiritual and religious belief	(Alhassan et al., 2021; Elharake et al., 2021; Woodhead et al., 2021)
Disagree with mandatory vaccine	(Woodhead et al., 2021)
Theme 6: Sociodemographic and work factor	
Female	(Afzal et al., 2022; Al-Sanafi & Sallam, 2021; Askarian et al., 2022; Aw et al., 2022; Barry et al., 2021; Bauernfeind et al., 2021; Ciardi et al., 2021; Digregorio et al., 2022; El-Sokkary et al., 2021; Famuyiro et al., 2021; Grochowska et al., 2021; Janssen et al., 2021; Khamis et al., 2022; Kim et al., 2021; Kociolek et al., 2021; Li et al., 2021; Pacella-LaBarbara et al., 2021; Papini et al., 2022; Qunaibi et al., 2021; Shehata et al., 2021; Sun et al., 2021; M. W. Wang et al., 2021; Yilma et al., 2022; Zürcher et al., 2021)
Lower education	(Afzal et al., 2022; Al-Sanafi & Sallam, 2021; Askarian et al., 2022; Chrissian et al., 2022; Janssen et al., 2021; Li et al., 2021; Pal et al., 2021)
Younger age	(Aemro et al., 2021; Afzal et al., 2022; Aw et al., 2022; Bauern-feind et al., 2021; Browne et al., 2021; Chrissian et al., 2022; Ciardi et al., 2021; Digregorio et al., 2022; Gadoth et al., 2021; Hoffman et al., 2022; Janssen et al., 2021; Kara Esen et al., 2021; Kim et al., 2021; Mehta et al., 2022; Pal et al., 2021; Puertas et al., 2022; Qunaibi et al., 2021; Turbat et al., 2022)
Higher income	(Castañeda-Vasquez et al., 2021; Li et al., 2021; M. W. Wang et al., 2021; Zigron et al., 2021)
Presence of co-morbidity	(Chew et al., 2021; Dara et al., 2021; Suo et al., 2021)
Working in rural areas	(Shehata et al., 2021)
Non-medical or clinical based para-medics	(Abdulle et al., 2022; Afzal et al., 2022; Bauernfeind et al., 2021; Cuschieri & Grech, 2021; Gadoth et al., 2021; Gag-neux-Brunon et al., 2021; Kara Esen et al., 2021; Kim et al., 2021; Lataifeh et al., 2022; Li et al., 2021; Martin et al., 2021; Papini et al., 2022; Puertas et al., 2022; Razzaghi et al., 2022; Schrading et al., 2021; Shallal et al., 2021; Townsel et al., 2021; Turbat et al., 2022; Vignier et al., 2021)

Table 3: Themes for acceptance factors for COVID-19 vaccines among HCWs.

Theme 1: Trust issues in vaccines or authority	
Confidence in the safety and efficacy of the vaccines	(Abdulle et al., 2022; Adeniyi et al., 2021; Aemro et al., 2021; Alhassan et al., 2021; Aoun et al., 2021; Arslanca et al., 2021; Baghdadi et al., 2021; Baniak et al., 2021; Bauernfeind et al., 2021; Botwe et al., 2021; Browne et al., 2021; Castañeda-Vasquez et al., 2021; Chew et al., 2021; Costantino et al., 2022; Cuschieri & Grech, 2021; Dara et al., 2021; Di Gennaro et al., 2021; Elharake et al., 2021; Fakonti et al., 2021; Famuyiro et al., 2021; Fares et al., 2021; Fotiadis et al., 2021; Gadoth et al., 2021; Gagneux-Brunon et al., 2021; Galanis, Moisoglou, et al., 2022; Grochowska et al., 2021; Kim et al., 2021; Kuter et al., 2021; Laiyemo et al., 2022; Ledda et al., 2021; Mehta et al., 2022; Oduwole et al., 2021; Otiti-Sengeri et al., 2022; Parente et al., 2021; Puertas et al., 2022; Robbins et al., 2021; E. D. Robinson et al., 2021; Shekhar et al., 2021; Sirikalyanpaiboon et al., 2021; Sun et al., 2021; Verger et al., 2021; Xu et al., 2021; Yassin et al., 2022; Youssef et al., 2022; Zaitoon et al., 2021; Zigron et al., 2021; Zürcher et al., 2021)
Trust in authorities such as health au-thorities, pharmaceuticals, and gov-ernment	(Khalis et al., 2021; Kim et al., 2021; Malik et al., 2021; Maraqa et al., 2021; Puertas et al., 2022; Shallal et al., 2021; M. W. Wang et al., 2021; Youssef et al., 2022)
Theme 2: Vulnerability to COVID-19 infection and its complications	
High perceived susceptibility to infec-tion and occupational risk	(Adejumo et al., 2021; Angelo et al., 2021; Dzieciolowska et al., 2021; Elkhayat et al., 2022; Gagneux-Brunon et al., 2021; Ilori et al., 2022; Khalis et al., 2021; Kukreti et al., 2021; Li et al., 2021; Nasr et al., 2021; Noushad et al., 2021; Noushad et al., 2022; Otiti-Sengeri et al., 2022; Pacella-LaBarbara et al., 2021; Parente et al., 2021; Patelarou et al., 2021; Paudel et al., 2021; Shehata et al., 2021; Sirikalyanpaiboon et al., 2021; Štěpánek et al., 2021; Vignier et al., 2021; Yassin et al., 2022; Ye et al., 2021)
Protecting self and families	(S. W. C. Koh et al., 2022; Kuter et al., 2021; Nasr et al., 2021; Oliver et al., 2022; Sun et al., 2021; Yassin et al., 2022)
Self and family history of COVID in-fection	(Afifi et al., 2022; Aurilio et al., 2021; Bauernfeind et al., 2021; Boche et al., 2022; Fotiadis et al., 2021)
Theme 3: Information and misinformation	
Perceived adequate knowledge about the vaccines	(Abdulle et al., 2022; Afifi et al., 2022; Avakian et al., 2022; Baniak et al., 2021; Ciardi et al., 2021; Dara et al., 2021; Elkhayat et al., 2022; Fotiadis et al., 2021; Galanis, Moisoglou, et al., 2022; Kaufman et al., 2022; Khalis et al., 2021; Lataifeh et al., 2022; Maraqa et al., 2021; Nasr et al., 2021; Noushad et al., 2021; Patelarou et al., 2021; Sirikalyanpaiboon et al., 2021; Sun et al., 2021; Youssef et al., 2022; Zigron et al., 2021)
Media positive information	(Kim et al., 2021)
Gather information about vaccines from health authorities	(Barry et al., 2021; Sirikalyanpaiboon et al., 2021; Ye et al., 2021)
Theme 4: Personal and past vaccine experience	
History of acceptance with recom-mended vaccines	(Aurilio et al., 2021; Avakian et al., 2022; Bauernfeind et al., 2021; Costantino et al., 2022; Elkhayat et al., 2022; Fotiadis et al., 2021; Maraqa et al., 2021; Patelarou et al., 2021; Saddik et al., 2021; Štěpánek et al., 2021; Ye et al., 2021; Youssef et al., 2022; Zaitoon et al., 2021)

Getting back to normality	(Chew et al., 2021; Kuter et al., 2021; Noushad et al., 2022; Ofei-Dodoo et al., 2021; Woodhead et al., 2021; Yoon et al., 2022)
Theme 5: Religious or political issues	
Compatible with religious belief	(Oduwole et al., 2021; Wiysonge et al., 2022)
Political or policy influence (incen-tives, policies)	(Baynouna Al ketbi et al., 2021; Dubov et al., 2021)
Theme 6: Professional integrity	
Moral or work responsibility	(Adejumo et al., 2021; Aoun et al., 2021; Cuschieri & Grech, 2021; Digregorio et al., 2022; Gadoth et al., 2021; Hulen et al., 2022; S. W. C. Koh et al., 2022; Kukreti et al., 2021; Kuter et al., 2021; Ofei-Dodoo et al., 2021; Pacella-LaBarbara et al., 2021; Razzaghi et al., 2022; Saddik et al., 2021; Štěpánek et al., 2021; Wiysonge et al., 2022; Woodhead et al., 2021)
Theme 7: Sociodemographic and work factors	
Male	(Afifi et al., 2022; Aoun et al., 2021; Baynouna Al ketbi et al., 2021; Briko et al., 2022; Dzieciolowska et al., 2021; Elharake et al., 2021; Elkhayat et al., 2022; Gagneux-Brunon et al., 2021; Kaufman et al., 2022; Kuter et al., 2021; Maraqa et al., 2021; Noushad et al., 2022; Nzaji et al., 2020; Parente et al., 2021; Patelarou et al., 2021; Paudel et al., 2021; Saddik et al., 2021; Štěpánek et al., 2021; Unroe et al., 2021; Youssef et al., 2022)
Higher education level	(Adejumo et al., 2021; Dubov et al., 2021; Fotiadis et al., 2021; Kuter et al., 2021; Nohl, Afflerbach, et al., 2021; Parente et al., 2021; Paudel et al., 2021; E. D. Robinson et al., 2021; Shallal et al., 2021; Shekhar et al., 2021; J. Wang et al., 2021; Xu et al., 2021)
Older age	(Alle & Oumer, 2021; Baynouna Al ketbi et al., 2021; Briko et al., 2022; Dzieciolowska et al., 2021; Fossen et al., 2021; Gagneux-Brunon et al., 2021; Kaufman et al., 2022; Kuter et al., 2021; Nohl, Afflerbach, et al., 2021; Noushad et al., 2021; Noushad et al., 2022; Shaw et al., 2021; Shekhar et al., 2021; Sirikalyanpaiboon et al., 2021; Štěpánek et al., 2021; Unroe et al., 2021; Wiysonge et al., 2022; Ye et al., 2021; Zaitoon et al., 2021; Zürcher et al., 2021)
Higher income	(Dubov et al., 2021; Paudel et al., 2021; Shekhar et al., 2021)
Presence of co-morbidity	(Angelo et al., 2021; Dara et al., 2021; Elkhayat et al., 2022; K. Wang et al., 2020)
Living in major cities or working in tertiary centers	(Elkhayat et al., 2022; Kaufman et al., 2022; Malik et al., 2021)
Working as front liners	(Adejumo et al., 2021; Aw et al., 2021; Briko et al., 2022; El-Sokkary et al., 2021; Fossen et al., 2021; Malik et al., 2021; Nohl, Ben Abdallah, et al., 2021; Ye et al., 2021; Youssef et al., 2022)
Longer duration of service in health	(Adejumo et al., 2021; Baghdadi et al., 2021; Baniak et al., 2021; Fakonti et al., 2021; Fotiadis et al., 2021)

reluctant for the first dose, they were likely to be hesitant for the booster dose. However, in the same study, they reiterated that the HCW were less booster hesitant compared to the first dose (Sky Wei Chee Koh et al., 2022).

DISCUSSION

This review utilized the most current and comprehensive reviews of the literature on COVID-19 vaccine hesitancy and acceptance among HCWs globally, including 157 articles up to August 2022. A scoping review comprised 147 cross-sectional and ten qualitative or mixed-method studies. The proportion of HCWs intending to be vaccinated against COVID-19 varies widely across countries or regions, influenced by different demographics, beliefs, and other contextual factors (Aw et al., 2021). We identified six themes for hesitancy and seven for acceptance. The most common theme for hesitancy and acceptance was trust issues in vaccines or authority. Under this theme, concern about the safety and efficacy of the vaccines including concerns about the effect of the vaccines on pregnancy, lactation, or fertility was noted in many studies.

Overall, the COVID-19 vaccine hesitancy rate of HCWs before the vaccine's rollout was higher compared to during or after the vaccine campaign, which was 35.6% compared to 27.3% in mean. In this review, Egypt and Taiwan showed higher hesitancy rates up to 79.0% and 74.0% respectively before the COVID-19 vaccine was made available in the country (Fares et al., 2021; Kukreti et al., 2021). HCWs expressed mainly concerns about the fast-tracked development of a vaccine, a lack of enough clinical trials, and fear of side effects of vaccine (Fares et al., 2021). The acceptance of the vaccine was low also due to the safe status of COVID-19 infection as there were no community outbreaks during the study in Taiwan and therefore, the perception of infection with COVID-19 was low (Kukreti et al., 2021). The effect of time should be considered to rationalize the high hesitancy rate among HCWs in the early period.

COVID-19 vaccine willingness can vary substantially with time, experience with actual vaccine administration, and the ongoing pandemic's time-varying morbidity and mortality values (Sallam, 2021). A longitudinal study among HCWs in Los Angeles found that attitudes toward COVID-19 vaccines had improved and vaccine uptake intent had nearly doubled in the second survey after the vaccination campaign had been running for some time. It was believed as a result of increased communication about vaccine candidates, an increase in public confidence in leadership that oversees vaccine messaging, regulation, and supply, an increase in the number of cases and fatalities, evidence of the high efficacy and safety of COVID-19 vaccines and reports from others in their communities who had successfully vaccinated (Halbrook et al., 2022).

When the COVID-19 vaccine was made available, some countries still reported a high hesitancy rate. The two highest hesitancy rates recorded were 73.3% and 66.7%, respectively, from studies among Arabian HCWs and these studies shared almost similar factors which were fear of the side effects, not adequate time to verify the vaccine's safety, doubtful of the credibility of the producing company, and distrust of the healthcare policy applied by the government (Qunaibi et al., 2021). Another earlier study of Arab countries among the public showed that the low levels of COVID-19 vaccination uptake willingness despite the burden of COVID-19 was severe, due to the low trust in the government, low levels of education, and worse conspiracy beliefs (Sallam et al., 2021). The effects on public health could be imminent if these conspiracy theories are not refuted with fact-checking and evidence-based scientific knowledge.

Our analyses identified that confidence or concern in safety and efficacy of the COVID-19 vaccines, and trust in authorities

were the main top determinants for the attitude of HCWs toward the vaccines. These include factors on concerns about the short-term or long-term side effects, vaccine development velocity, and lack of trust in the information provided by the authorities. Among the fears were an allergic reaction, effect on the unborn child or breastfeeding baby, and long-term carcinogenic effects (Haddaden et al., 2021; Mehta et al., 2022; Ofei-Dodoo et al., 2021). Some of the HCWs delayed their vaccination, preferred to observe the effect on other people, and wait to review more data and gather more information before deciding on themselves (Peterson et al., 2022). On the other hand, the effectiveness and safety of the vaccines had an impact on the choice to adopt COVID-19 vaccination (Norhayati et al., 2021). An early study of the acceptance of a potential COVID-19 vaccine increased as the hypothetical effects of the vaccine increased (Alqudeimat et al., 2021).

The issue pertaining to trust in authorities are the vaccine development, approval process, pharmaceutical industry, conspiracy theories, and health politics (C. Holzmann-Littig et al., 2021). The same findings are noted globally either in the USA, the middle east, Africa, and European countries (Alhassan et al., 2021; Elharake et al., 2021; Verger et al., 2021). Lack of trust in the pharmaceutical companies or concerns about government-controlled of pharmaceutical companies in the epidemic raising vaccine hesitancy (Adejumo et al., 2021). Due to worries and memories of incidents involving inadequate unethical research practices, scepticism and eventually, they did not trust that vaccine development is salient (Woodhead et al., 2021). They believe that a short development period will affect vaccine efficacy and are concerned about the long-term side effects of the vaccine injection, leading then to doubt about the vaccine's ability to counter SARS-CoV-2 attack.

COVID-19 vaccine hesitancy was found to be higher in females than the male which is in line with other reviews (Caiazzo & Stimpfel, 2022; E. Robinson et al., 2021). Females expressed more concerns about vaccine safety and negative feelings toward vaccination were significantly higher among those attempting pregnancy, pregnant and lactating (Perez et al., 2022). In another study, pregnant ladies were six times more likely to delay their COVID-19 vaccination and twice as likely to refuse the vaccine (Townsel et al., 2021). Female has been also found to have lower vaccination rates in other vaccinations such as influenza and pandemic influenza vaccinations (Chor et al., 2009; Paudel et al., 2021). Males had better health-seeking behaviours and appreciation of advice about COVID-19 vaccines (Elkhayat et al., 2022). The association between younger HCWs and COVID-19 hesitancy may be due to increased public attention on prioritized vaccination among the elderly while on the other hand, older individuals perceived higher risk of serious illness and a greater likelihood of the presence of medical co-morbidities (Aw et al., 2021).

Perceived lack of information about the vaccines, apprehension over social media negative stories, and negative influence from others were factors derived from the theme of information and misinformation. The spread of misinformation regarding vaccines on social media had become a major driving factor in declining the recommendation by the government for vaccination (Nohl, Ben Abdallah, et al., 2021) According to a study, two-thirds of HCWs depend on television, internet, and friends who choose to refuse the vaccine (Elkhayat et al., 2022). These summarises the importance of social media as a primary source of information nowadays. Anti-vaccination groups employed all propaganda techniques on social media such as pressing issues on vaccine safety and inefficacy and blaming pharmaceutical companies for working illegally to produce vaccines in bulk (Sobkowicz & Sobkowicz, 2021).

We also identified that perceived

vulnerability to COVID-19 infection was a major factor. Perceived low risk for infection or confidence in natural immunity or their immune system were among the contextual factors. HCWs were hesitant to take the shot due to the belief that they were already naturally immune because they had contracted the disease at least once before (Shehata et al., 2021). Some of hesitant HCWs were confidence and preferred complementary and alternative medicines (CAM) use to protect them from COVID-19 infection (Castañeda-Vasquez et al., 2021). Examples of CAM used for COVID-19 prophylaxis include vitamins, minerals, herbal medicine, yoga and other dietary supplements. (Bulatova et al., 2022). On the other hand, those HCWs who perceived that they were at higher risk of contracting the infection would be more likely to be vaccinated (Pacella-LaBarbara et al., 2021; Yoon et al., 2022). Many studies have also shown that the high perceived susceptibility to infection increased the HCWs' intention for vaccination to protect themselves, their families, and patients (Kuter et al., 2021). Thus, it is not surprising that those working as front liners were more likely to accept the vaccines (S. W. C. Koh et al., 2022).

The emergence of SARS-CoV-2 mutants, waning immunity, and breakthrough infections prompted the use of booster doses of the COVID-19 vaccine to fight against the pandemic. In this review, the hesitance of the primary dose of the COVID-19 vaccine may predict the delay of booster doses of the vaccine. In a few observational studies, HCWs who were hesitant toward the first dose were three to five times more likely to be hesitant toward the booster doses (Sky Wei Chee Koh et al., 2022; Paul & Fancourt, 2022). The hesitancy to receive booster doses may also reflect a general hesitancy to receive other forms of vaccination (Pal et al., 2021).

Authentic information and tools to manage adverse events motivate vaccination. Misinformation causes vaccination hesitancy, which requires education of eligible vaccine recipients, according to previous studies (Muric et al., 2021; J. Wang et al., 2021). The significance of education aimed at HCWs has been underlined in studies of other vaccines (Song et al., 2006). Since the HCW vaccination coverage rate was suboptimal in other vaccines, some countries have implemented mandatory vaccination policies among HCWs for vaccine-preventable diseases (Maltezou et al., 2019). The USA had widely adopted a mandatory influenza vaccination campaign for HCWs in healthcare facilities with excellent results (uptake rate of >90%) (Black et al., 2018). This results in some counties implementing mandate COVID-19 vaccination for HCWs as well as public servants.

This review has limitations. First, our review excluded non-English published papers and may miss some relevant articles. Second, most included studies were cross-sectional studies with variable sampling methods, possibly explaining differing hesitancy rates even within a single country. Third, these studies mainly focus on vaccination intentions, which do not predict future vaccine uptake. Further studies should investigate the actual vaccine uptake, as intentions do not necessarily translate into action. Finally, some potential determinants of vaccine hesitancy were not mentioned due to data constraints.

CONCLUSION

We conclude that there were six themes for hesitancy and seven themes for acceptance of COVID-19 vaccines. Safety and effectiveness issues, trust, perceived risk of infection, and misinformation were among the common factors. The hesitancy rates varied across countries, gender, job position, education level, and economic status. Vaccine testing must adhere to worldwide best practices and remain unbiased by politics, religion, or race. Accurate information should be disseminated to build HCWs' confidence, as their encouragement is vital for patient vaccination. Knowing the reasons for vaccine hesitancy and acceptance

can guide and aid in the implementation of education and policy-level initiatives to improve future immunization programs.

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CONFLICT INTEREST

The authors do not have any conflict of interest to declare.

SUPPLEMENTARY DATA

Supplementary 1
Supplementary 2
Supplementary 3

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