Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Introduction

Since late 2020, breakthroughs in vaccine development have been crucial for curbing the COVID-19 pandemic which as of February 2022 has caused an estimated 5.7 million deaths globally.¹ As vaccine programs continue to be rolled out, albeit at markedly differing paces worldwide,² addressing COVID-19 vaccination acceptance and uptake among high-priority groups such as healthcare workers (HCWs) remains an urgent public health challenge. High uptake of COVID-19 vaccines among HCWs, along with the wider public, is needed to achieve maximal effectiveness, especially in light of emerging variants of concern.³

There is a growing literature on factors linked to vaccination hesitancy, acceptance, and uptake in HCWs, spanning multiple methods and approaches and in particular data collected using surveys and interviews with HCWs worldwide. This breadth poses a challenge to decision-makers faced with developing supports to encourage greater uptake. As such, there is an opportunity to bring consistency across the literature using behavioural frameworks that can enable better links to be made between barriers and enablers of COVID-19 vaccination among HCWs.
strategies best suited to address them in HCW vaccination campaigns worldwide.

Framing COVID-19 vaccination uptake as a behaviour enables drawing upon decades of theory-informed empirical research aimed at understanding factors that affect what people think, feel, decide, and ultimately do. Comprehensive frameworks, such as the Theoretical Domains Framework (TDF),5–6 synthesise these factors into 14 behavioural domains (Knowledge; Skills; Social/professional role and identity; Beliefs about capabilities; Optimism; Beliefs about consequences; Reinforcement; Intentions; Goals; Memory, attention, and decision processes; Environmental context and resources; Social influences; Emotion; and Behavioural regulation) that represent over 30 theories of behaviour and behaviour change reflecting key, modifiable factors that influence behaviour. An advantage of synthesising the existing literature with such frameworks is that it is possible to: a) assess which type of barrier to getting vaccinated is appearing most and least in the literature; b) assess whether there are under-considered domains that are deserving of greater attention given their known relationship with decisions and action generally; and c) enable linkage to tools that suggest particular behaviour change techniques best suited to address particular domains. Using this behavioural lens, we conducted a rapid evidence review of factors linked to COVID-19 vaccination acceptance in HCWs and use the TDF to bring consistency across the literature.

**Objectives**

To identify key behavioural determinants of COVID-19 vaccination among HCWs and use a comprehensive theoretical framework to bring consistency across the literature.

**Methods**

**Study design**

Rapid reviews are a form of evidence synthesis that use abbreviated systematic review methods to answer pressing health questions in short time frames, often for localized decision-making purposes. Although not a replacement for a full systematic review, rapid reviews still follow the principles of robust evidence synthesis including comprehensive searches, rigorous extraction, and transparent reporting. This type of methodology has been extensively used during the COVID-19 pandemic given the need for time-sensitive evidence synthesis to inform public health policy and practice.10

**Data sources**

We conducted ongoing searches for primary studies in MEDLINE, Cochrane Register of Clinical Trials, and the Cochrane COVID-19 Study Register in accordance with a registered protocol (PROSPERO registration: CRD42021253533). The search strategy can be found in Appendix 1. We included peer-reviewed papers, preprints, and published reports of primary studies meeting our eligibility criteria below. The latest search of these databases was done on May 24, 2021. In addition, we manually searched four publicly available reports which focused on COVID-19 vaccination in Canada as part of a grey literature search.11–14

**Study inclusion/exclusion criteria**

We included studies investigating COVID-19 vaccination among HCWs (e.g., doctors, nurses, pharmacists, hospital staff; role could be self-identified) and excluded studies where general public samples only were used. Self-report measures of COVID-19 vaccination willingness/intention/hesitancy/acceptance (referred to as ‘vaccination acceptance’ hereafter) were included and vaccination acceptance had to relate to self-vaccination rather than HCWs vaccinating others as part of their clinical role. We excluded studies that only measured COVID-19 vaccination knowledge. We included studies conducted since the onset of the COVID-19 pandemic (January 2020 onwards) and we included cross-sectional, cohort and qualitative studies.

**Data extraction**

Citations from all searches were de-duplicated and entered into Abstrackr software, a free online screening tool that uses machine learning capabilities to predict the likelihood of relevance of each citation (http://abstrackr.cebm.brown.edu/). Two researchers conducted independent screening at level 1 (title and abstract) and level 2 (full-text) with discrepancies resolved via consensus meetings. Data extraction was undertaken using a standardised data extraction form which captured data on study characteristics and reported determinants of COVID-19 vaccination among HCWs. Factors affecting COVID-19 vaccination acceptance were coded to key barriers and enablers and mapped onto the TDF. A barrier/enabler was considered ‘key’ if it had been coded in ≥3 separate studies. Given the rapid review methodology, no study quality assessment was done.

**Results**

**Study characteristics**

From 19,591 records, a total of 74 studies met our inclusion criteria15–88 (see Appendix 2 for PRISMA flow diagram). Appendix 3 provides an overview of each study. Fifty-five were published peer-reviewed papers, 16 were preprints, and two were published reports. Fifty-nine of 74 studies collected data in the period since COVID-19 vaccine approval (November 2020 onwards). Seventy-one of 74 studies used cross-sectional survey designs, two were qualitative studies,21,36 and one was a cohort study.43 Twenty-three of 74 studies were conducted exclusively in North America. Fifty-one studies were conducted outside of North America: Europe (France,33,63, Germany,41,42,59 Greece and Cyprus,68 Greece,52,62 Italy,25,26,50 Poland,45,76 Slovenia,75 Turkey,14,41,46,84,87 and UK15,53); Asia (China,3,7,21,38, Hong Kong,82 India,1,25,50 Pakistan,69 Taiwan34,41,46,84,87, and Vietnam35); South America (Colombia35); Central America (Mexico22); Africa (Cameroon,30, Democratic Republic of Congo,30, Egypt,26,37,71 Ghana30 and Uganda35); Middle East (Iraq,37 Israel,27,88 Lebanon,35, Palestine30,47 and Saudi Arabia35,96,77) and multiple countries.

Fifty-one of 74 studies recruited general HCWs samples of which seven recruited mixed samples that included HCWs as well as participants from the general public and/or patients.13,35,43,47,56,58,73 Twenty-three of 74 studies recruited specific professions/specialties: medical students,30,51,71 skilled nursing facility staff,30 dental professionals/students,25,88 paediatricians,24 intensive care staff,32 physicians,34 nurses,34 non-physicians,34,70 nursing home/assisted living staff,19 continuing care workers,19 pharmacy professionals,19 personal support workers,78 nurses/trainee nurses,30,49,53,64,82 ophthalmology residents,45 emergency medical services personnel,23 doctor and nurses.73

**Rates of COVID-19 acceptance among HCWs**

Almost two-thirds of responding HCWs were willing to accept a COVID-19 vaccine (number of studies (k) = 72; median = 64%; interquartile range (IQR) = 50–78%). Among North American studies, the median average of responding HCWs willing to accept a COVID-19 vaccine was also 64% (k = 21; IQR = 56–80%). In rest-of-the-world studies, 62% of responding HCWs were willing to accept...
a vaccine for COVID-19 \((k = 51, \text{IQR} = 49\text{–}77\%\))
among studies conducted in the period since COVID-19 vaccine approval (November 2020 onwards), \(64\% (k = 57; \text{IQR} = 53\text{–}80\%\)
responding HCWs were willing to accept a COVID-19 vaccine.

**Behavioural determinants of COVID-19 vaccination acceptance among HCWs**

Eight (of a possible 14) TDF domains appear to be important determinants of COVID-19 vaccine acceptance among HCWs (Fig. 1):

- **Knowledge** \([k = 9]\):
  - Environmental context and resources \([k = 10]\)
  - Social influences \([k = 22]\)
  - Behaviours about consequences \([k = 29]\)
  - Behaviours about capabilities \([k = 3]\)
  - Social/professional role and identity \([k = 41]\)
  - Reinforcement \([k = 56]\)
  - Emotion \([k = 85]\)

  compared to data focusing on COVID-19 vaccination in the general public, similar barriers to and enablers of COVID-19 vaccination in HCWs were identified. Domains that do not seem to be important determinants of COVID-19 vaccination among HCWs include: Skills, Behavioural regulation, Memory, attention and decision processes, Goals, and Optimism. Figs. 2 and 3 depict the 20 most frequent key barriers and enablers (coded in \(\geq 3\) studies), respectively.

**TDF domains represented within the literature**

- **Knowledge**: A lack of knowledge about COVID-19 vaccines was cited as a barrier in nine studies.\(^{30,48,50,54,64,71,78,83,85}\) One study tested the relationship statistically between HCW knowledge and vaccination acceptance, where HCWs with ‘high’ knowledge about COVID-19 vaccines had 1.86 times greater odds of accepting a COVID-19 vaccine vs those with ‘low’ knowledge.\(^{44}\) A qualitative study highlighted that ‘complex information, conflicting and changing guidance, overwhelming amounts of material, and poor provision of information in other languages contributed to a lack of trust, confusion, and ultimately vaccine hesitancy’ \((p8)^{13}\).

  - **Environmentally context and resources**: Access to and trust in reputable information sources about COVID-19 and COVID-19 vaccines was seen as an enabler to vaccine acceptance in six studies.\(^{21,25,26,38,80,86}\) Moreover, one study found that financial support such as paid sick leave during the pandemic was associated with vaccine acceptance among HCWs.\(^{24}\) In terms of barriers, one study found that a lack of availability and accessibility of COVID-19 vaccines was linked to lower vaccine acceptance among HCWs.\(^{45}\)

  - **Social influences**: Ten studies found mistrust towards governments and public health bodies was associated with lower vaccination acceptance.\(^{16,30,35,36,51,64,68,70,80,85}\) At a more local level, two studies found that trust in how hospital management had handled the pandemic was linked to lower vaccine acceptance.\(^{44,68}\)

  - **Beliefs about consequences**: This domain was one of the most frequently identified across studies and related specifically to beliefs related to vaccine safety, efficacy, and necessity. In 30 studies, safety concerns centered on the risk of possible adverse events \(\text{e}g., \text{side effects}\).\(^{80,82,85}\)

  - **Concerns about the speed at which COVID-19 vaccines had been developed was seen in 10 studies.\(^{19,24,25,35,46,57,70,74,83}\) Twelve studies found that HCWs questioned the efficacy of COVID-19 vaccines.\(^{30,35,37,46,64,69,75,77,78,79}\) Moreover, beliefs about the necessity of COVID-19 vaccines \(\text{e}g., \text{not feeling at risk because they feel in good health}\) were also found to be associated with lower vaccination acceptance in six studies.\(^{24,30,46,71,82}\)

  - **Emotion**: General fear about COVID-19 was associated with higher vaccination acceptance in five studies.\(^{33,37,41,64,76}\)

  - **Beliefs about capabilities**: Three studies found that confidence in overcoming any challenges or difficulties in getting vaccinated was associated with higher acceptance in three studies.\(^{70,73,86}\)

  - **Social/professional role and identity**: One consistent finding was that vaccination acceptance was lower in non-physicians such as nurses.\(^{21,22,27,28,35,54,58,60,62,63,65,68,70,72,75,81,84,90}\) It may be that certain HCW groups have specific needs and concerns that...
| TDF domain                              | Definition                                                                                             | Barriers                                                                                                           | Enablers                                                                                           |
|----------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Knowledge                              | What do HCWs know & how does that influence what they do? Do they have the procedural knowledge?  
  (i.e., knowing how to do something) | Insufficient knowledge about COVID-19 vaccines\(^{1,25,4,5,8,42,57,74,82,84}\) and  
  COVID-19 vaccines\(^{1,25,4,5,8,42,57,74,82,84}\) (number of studies \(k = 9\)) |                                                                                                                   | Access to and trust in reputable scientific/non-  
  scientific information sources about COVID-19  
  and COVID-19 vaccines (e.g., cues to action)  
  \((k = 6)^{1,26,24,25,37,28}\)  
  Receiving financial support during the  
  pandemic (e.g., paid sick days) \((k = 1)^{23}\)  
  Trust in how hospital management has handled  
  the pandemic \((k = 2)^{31,67}\)                                                                 |
| Environmental context and resources    | What in HCWs environment influence what they do and how they influence?                                | Limited availability and accessibility of COVID-19 vaccines \((k = 1)^{84}\)                                          |                                                                                                                   |                                                                                                                   |
| Social influences                      | What do others do? What do others think of what HCWs do or what they should do?  
  Who are they and how does that influence what they do? | State/government/public health agency/media mistrust \((k = 10)^{1,2,5,3,5,29,84}\)  
  Negative influences of social contacts,\(^{30,40}\)  
  family members,\(^{10,40}\)  
  and political figures\(^{24}\) in relation to vaccine acceptance\(^{20}\) \((k = 5\)) |                                                                                                                   |                                                                                                                   |
| Beliefs about consequences             | What are the good and bad things that can happen from what HCWs do and how does that influence  
  whether they’ll do it in the future?                                                                 | Concerns about vaccine safety (e.g., side-effects) \((k = 30)^{15,16,21,23,30,34,35,36,39,41,44,47,74,76,78,81,84}\)  
  \(\ldots 84\)  
  Beliefs about COVID-19 vaccine efficacy  
  \((k = 10)^{18,14,16,47,50,53,68,74,78,81,89}\)  
  and efficacy against variants of concern specifically\(^{10}\) (\(k = 12\))  
  Concerns about rushed vaccine development  
  \((k = 10)^{1,2,5,24,28,34,45,46,56,57,65,72,82}\)  
  Beliefs that vaccine not necessary (e.g., feel in  
  good health, already protected) \((k = 6)^{35,24,41,49,60,68,70,72,75,81,84}\)  
  Belief that getting vaccinated will protect family  
  specifically \((k = 5)^{21,24,39,50,51}\)  
  Belief that getting vaccinated will protect  
  patients specifically \((k = 3)^{25,50,53}\) | Concerns about being infected by COVID-19 (e.g., perceived susceptibility to COVID-19  
  and its severity) \((k = 10)^{15,26,1,5,16,46,44,71,72,80}\)  
  Positive attitudes and confidence towards COVID-19 vaccines (e.g., perceived benefit)  
  \((k = 6)^{15,24,39,41,49,60}\)  
  Belief that getting vaccinated will protect family specifically \((k = 5)^{21,24,39,50,51}\)  
  Belief that getting vaccinated will protect  
  patients specifically \((k = 3)^{25,50,53}\) |                                                                                                                   |
| Social/professional role and identity  | How does their role/responsibility (in various settings) influence whether they do or not?  
  How does who they are as a HCW influence  
  whether they do something or not? Is the  
  behaviour something they are supposed to do  
  or is someone else responsible? | Vaccine acceptance lower among nursing professionals vs physicians\(^{16,20,22,25}\)  
  \(\ldots 66,70,71,73,78,79,81\)  
  \(\ldots 84\)  
  or dietary, housekeeping, and administrative staff\(^{16}\) \((k = 22)\) | Working directly patients generally\(^{44,48,74}\) and  
  with COVID-19 patients specifically\(^{39,27,28,29,82}\) \((k = 8)\)  
  When getting vaccinated seen as a  
  professional\(^{1,16}\) or collective/prosocial  
  responsibility\(^{1,25}\) \((k = 3)\)  
  Belief that vaccination for COVID-19 should be  
  mandatory for HCWs \((k = 3)^{42,52,56}\)  
  Pharmacists who are managers/owners were  
  more likely to accept a vaccine than pharmacy  
  technicians \((k = 1)^{91}\)  
  An increase in the unemployment rate within  
  the dental sector coincides with a rise in  
  willingness for a COVID-19 vaccine \((k = 1)^{98}\)  
  Paediatric physicians more likely to accept free  
  80% effective vaccine vs physicians in  
  administrative roles \((k = 1)^{77}\)  
  Being a pharmacy student vs medicine student  
  was a significant predictor of COVID-19 vaccine  
  acceptance \((k = 1)^{71}\)  
  Historical seasonal influenza vaccination  
  \((k = 25)^{1,15,3,16,24,25,37,39,34,41,46,49,51,52,53,63}\)  
  Members of families/close social network  
  having been infected with COVID-19  
  \((k = 2)^{71}\)  
  Engaging with COVID-19 infection behaviours  
  (i.e., personal protective behaviour) throughout  
  the pandemic \((k = 1)^{77}\) |                                                                                                                   |                                                                                                                   |
How do they feel (affect) about what they do and do those feelings influence what they do? Emotion

Job satisfaction was associated with higher self-efficacy/conﬁdence in overcoming any vaccine acceptance (κ = 1) challenges or difﬁculties in getting vaccinated and Beliefs about capabilities Do HCWs think they can (are they conﬁdent (κ = 3) that they can) and how does that influence whether they do it or not? What increases or decreases their conﬁdence?

Discussion

Our rapid evidence review used an established behavioural framework to bring consistency across the rapidly expanding literature on COVID-19 vaccine acceptance among HCWs to identify modiﬁable factors to increase vaccine uptake. Based on evidence from 74 studies published up to May 2021, we found almost two-thirds of responding HCWs were willing to accept a COVID-19 vaccine. Across studies, we identiﬁed eight (of a possible 14) domains of TDF, and 20 key barriers and enablers which may have implications for interventions seeking to promote COVID-19 vaccine uptake among HCWs. The most frequently coded TDF domains were Beliefs about consequences, Social/professional role and identity, and Reinforcement, which were broadly operationalized as concerns about the vaccine itself, HCWs in non-physician roles, and previous seasonal vaccine uptake, respectively.

HCWs frequently citing concerns about COVID-19 vaccine safety supports ﬁndings from the broader vaccination literature. Although this is undoubtedly a key barrier to vaccination (COVID-19 or otherwise), its frequency can be partially explained by narrow study designs focusing solely on HCW attitudes towards vaccination. As such, although some behavioural domains did not yet emerge as factors associated with COVID-19 vaccine acceptance in HCWs (TDF domains: Skills, Behavioural regulation, Memory, attention and decision processes, Goals, and Optimism), there may be opportunity for considering a greater breath of possible barriers and enablers which could be guided by frameworks such as the TDF. Only one study in our sample had used the TDF to inform their survey design, which resulted in key insights into barriers and enablers to vaccination acceptance among Canadian HCWs, many of which extended what is known.

Addressing key barriers and enablers for HCWs should involve multiple approaches at multiple levels; therefore, a one-size-fits-all approach is unlikely to address the range of barriers and enablers expressed by HCWs. In Table 2, we provide a non-exhaustive list of recommendations based on general principles from behavioural science which may help form the basis for behaviour-focused interventions to increase COVID-19 vaccination among HCWs.

There was some evidence indicating that knowledge was associated with vaccination acceptance among HCWs. Knowledge, or lack thereof, is often seen as a key barrier to behaviour change which is reﬂected in the abundance of strategies and programs that focus solely on education and providing information. Although knowledge is undoubtedly important, it is usually insufﬁcient as a stand-alone strategy; therefore, additional evidence-based, modiﬁable barriers must also be considered. Despite Memory, attention and decision processes being part of the TDF, no studies attempted to measure decision-making. However, it is likely that future studies collecting data on both vaccination acceptance and uptake may delve deeper into the actual decision process (e.g., framing effects and memory), which may also tap into other domains such as Beliefs about consequences (e.g., how HCWs
weighed up beliefs about vaccine necessity vs concerns about possible adverse effects).

Given that COVID-19 vaccines have been rolling out since late 2020, there is an opportunity to assess whether the same factors associated with vaccine acceptance (intention) are also associated with actual vaccination uptake (behaviour). This will provide insight into the extent vaccine intention predicts behaviour in HCWs, and whether postintentional factors are at play. Evidence
Table 2
Identified barriers to and enablers of COVID-19 vaccination acceptance among healthcare workers (HCWs) along with recommendations based on behavioural science principles.

| Theoretical Domains Framework (TDF) domain                  | Barriers and enablers identified                                                                                           | Recommendations based on behavioural science principles                                                                 |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| **Barriers**                                                |                                                                                                                          |                                                                                                                          |
| Knowledge                                                  | Gaps in knowledge about COVID-19 vaccines (number of studies $k = 9$)                                                      | Address knowledge gaps through educational campaigns tailored to different groups of HCWs, disseminated from trusted sources that likely differ for different groups of HCWs; one-size-fits-all knowledge dissemination unlikely to reach those who may benefit most. |
| Social Influences                                           | Mistrust in government/public health response to COVID-19 ($k = 10$)                                                     | Help rebuild trust through transparent communication about COVID-19 vaccination and community engagement and cultural understanding, especially HCWs from equity-seeking groups. Acknowledging past harms against racialized groups validates feelings of mistrust and aims to rebuild trust by addressing inequities. |
| Beliefs about consequences                                  | Concerns about COVID-19 vaccine safety ($k = 30$)                                                                       | Reassure and be transparent about vaccine risks using trusted sources and communication modalities that go beyond numerical risk and benefit data. |
|                                                            | Concerns about COVID-19 vaccine development ($k = 10$)                                                                  | Reiterate how it was possible to develop and approve COVID-19 vaccines relatively rapidly while maintaining all the same checks and balances to ensure a rigorous vaccine development process. |
|                                                            | Concerns about COVID-19 vaccine efficacy ($k = 12$)                                                                     | Ensure that the effectiveness of vaccines against COVID-19 and its variants of concern are clear and continue to be updated as evidence accrues. Communicate efficacy using evidenced benefit communication approaches that do not only rely on numeracy. Clarify benefits (where known) across outcomes of importance including infection, severity, side effects, hospitalization and/or death. |
|                                                            | Concerns about COVID-19 vaccine necessity ($k = 6$)                                                                     | Reassure the need for vaccines, emphasizing the protection of oneself and others to build towards community immunity. |
| Social/professional role and identity                       | COVID-19 vaccine acceptance rates differing among HCWs (e.g., nurses vs physicians) ($k = 22$)                          | One-size-fits-all approaches are unlikely to generalize across different groups of HCWs. Working within professional circles (both formal and informal) and leveraging trusted members of each group may help to address their needs and concerns. |
| **Enablers**                                                |                                                                                                                          |                                                                                                                          |
| Environmental context and resources                         | Having access to and trust in reputable information sources ($k = 6$)                                                   | Identify and make available reputable and trustworthy sources of information sources more accessible to help counter misinformation about COVID-19 vaccines. |
| Beliefs about consequences                                  | Concerns about becoming infected with COVID-19 ($k = 10$)                                                              | Reiterate the seriousness of being infected by COVID-19 and potential longer-term consequences (e.g., ‘long-covid’). Emphasize the benefit of vaccines, both from a medical standpoint (e.g., drawing on the benefit of previous vaccines for infectious diseases (e.g., polio)) and personal/social standpoint (e.g., returning to ‘normal’, seeing family without restrictions). |
|                                                            | Positive attitudes/high perceived benefit of COVID-19 vaccines ($k = 6$)                                                | Leverage the prosocial nature of vaccination which will help protect others. |
|                                                            | Belief that COVID-19 vaccines will help protect family ($k = 5$)                                                        | Leverage the prosocial nature of vaccination which will help protect others in a work context. |
|                                                            | Belief that COVID-19 vaccines will help protect patients ($k = 3$)                                                       |                                                                                                                          |

(continued on next page)
Table 2 (continued)

| Theoretical Domains Framework (TDF) domain | Barriers and enablers identified | Recommendations based on behavioural science principle |
|-------------------------------------------|---------------------------------|------------------------------------------------------|
| Beliefs about capabilities                 |                                |                                                      |
| Fear about being infected with COVID-19   |                                | Highlight personal protective behaviors that reduce risk of contracting COVID-19. |
| Psychological distress symptoms (stress, depression, anxiety) |               | Acknowledge that some psychological disorder-thinking may influence personal protective behaviors such as vaccination (although there must be caution with this). |
| Working directly with COVID-19             |                                |                                                      |
| Social/professional role and identity      |                                |                                                      |
| Emotion                                   |                                |                                                      |
| Fear of being infected with COVID-19       |                                | Encourage confidence in the safety and effectiveness of the vaccine, and similar others being vaccinated to help model and build confidence. |
| Reinforcement                             |                                |                                                      |
| Historical seasonal influenza vaccination  |                                | Leverage successful interventions to increase seasonal influenza vaccination which may be applicable to COVID-19. |

from other behavioural literatures suggests a gap between intention and action and approaches for bridging this gap offer opportunities for ensuring individuals who do develop strong intentions and acceptance for the COVID-19 vaccine translate their strong intention into actual vaccination.92

Although we have made recommendations based on past learnings from behavioural science (Table 2), there is an opportunity to supplement these principle-based learnings with data from past vaccination campaign interventions94 and interventions and/or trials that have been conducted during the COVID-19 pandemic which, unfortunately, have been scarce. A recent systematic review by Schumacher and colleagues identified intervention studies seeking to increase influenza vaccination coverage in HCWs. Among 30 studies, a range of education and promotion (e.g., educational sessions), incentivization (e.g., free vaccination), organisational (e.g., on-site vaccination), and policy (e.g., mandatory vaccination policy) strategies were used with mandatory vaccination policies achieving the highest overall vaccination coverage.94 Despite being a topic of some controversy, several countries including England, Australia, France, and Germany have decided to implement mandatory COVID-19 vaccines for HCWs with other countries likely to follow suit.95

There is also a need for more research to be conducted with HCWs from equity-seeking groups to help better inform how best to support greater vaccination. Assessing barriers and enablers to vaccine acceptance that equity-seeking groups experience may provide valuable insights into factors driving observed disparities, especially when considered alongside the key barriers and enablers to better support each group.96–97

Limitations

Our study has several limitations. First, our rapid review methodology did not allow for a study quality assessment to be done, which means that we are unable to make a judgement of the quality of the evidence being synthesised. Second, given our desire to ensure that emerging data were captured, we included preprints that had not yet been peer-reviewed. Third, 15 of 74 papers included were conducted before COVID-19 vaccines had been approved (November 2020); therefore, questioning about COVID-19 vaccination would have been hypothetical. However, similar determinants of vaccines were found across all studies, which suggests that opinions about hypothetic vs actual vaccines were broadly consistent in our sample. Fourth, our last search was done in May 2021, meaning that recent studies in this topic area are absent.

Conclusion

Our rapid review identified several behavioural determinants of COVID-19 vaccine acceptance among HCWs which could help inform vaccination messaging, campaigns, programs, and policy to support HCWs globally. This review should help decision-makers to navigate this complex area which requires an evidence-based approach to increase COVID-19 vaccine uptake. We have demonstrated utility in applying behavioural frameworks such as the TDF to help bring coherence to an emerging literature. An advantage of synthesising the existing literature with such frameworks is three-fold: first, it helps to identify key determinants represented in the literature; second, it allows one to consider if there are under-considered determinants deserving of greater attention; and third, it enables linkage between behavioural determinants and behaviour change techniques.5 Given the paucity of theory-informed research in our sample, we encourage the use of such frameworks to help inform the development of surveys and
interview guides to ensure that the widest set of potential determinants to vaccination are explored.

Author statements

Acknowledgements

This project was funded by the Public Health Agency of Canada and the Rhode Island Department of Health. The opinions, results, and conclusions are those of the authors and are independent of the funder. No endorsement by the Public Health Agency of Canada or the Rhode Island Department of Health is intended or should be inferred. The authors declare no conflicts of interest. Ethical approval was not required given that our study design was a rapid evidence review.

Ethical approval

None sought.

Funding

None declared.

Competing interests

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2022.06.003.

References

1. Johns Hopkins University. COVID-19 dashboard. 2021. https://coronavirus.jhu.edu/map.html. [Accessed 27 July 2021].
2. Kavanagh MM, Gostin LO, Sunder M. Vaccine doses to address global vaccine inequity and end the COVID-19 pandemic. JAMA 2021;326:219–20. https://doi.org/10.1001/jama.2021.10823.
3. Lopez Bernal J, Andrews N, Gower C, Gallagher E, Simmons R, Thelwall S, et al. Evergreen rapid review on COVID-19 vaccine uptake among health care workers and general population using health belief model. J Eval Clin Pract 2021. https://doi.org/10.1111/jep.13581.
4. Al-Metwalli RZ, Al-Jumaili AA, Al-Alag ZA, Sorofman B. Exploring the acceptance of COVID-19 vaccine among healthcare workers and general population using a cross-sectional survey from a MERS-CoV experienced nation. medRxiv 2020.2012.09.20246447. https://doi.org/10.1101/2020.12.09.20246447.
5. Bauernfeind S, Hitzenbichler F, Huppertz G, Zeman F, Koller M, Schmidt B, et al. Brief report: attitudes towards Covid-19 vaccination among hospital employees in a tertiary care university hospital in Germany in December 2020. Infection May 2021;20. https://doi.org/10.1007/s10152-021-02622-9.
6. Berry SD, Johnson KS, Myles L, Herndon L, Montoya A, Fashaw S, et al. Lessons learned from frontline skilled nursing facility staff regarding COVID-19 vaccine hesitancy. J Am Geriatr Soc 2021. https://doi.org/10.1111/jgs.17116.
7. Castañeda-Vazquez DE, Ruiz-Padilla JP, Botello-Hernandez E. Vaccine hesitancy against SARS-CoV-2 in health personnel of northeastern Mexico and its determinants. J Occup Environ Med 2021. Publish Ahead of Print. https://journals.lww.com/joem/Fulltext/9000/Vaccine_Hesitancy_against_SARS_CoV_2_in_Health.97527.aspx.
8. Chew NWS, Cheong C, Kong G, Phua K, Kiang N, Tan BYQ, et al. An Asia-Pacific study on healthcare workers’ perceptions of, and willingness to receive, the COVID-19 vaccine. Int J Infect Dis 2021;106:52–60. https://doi.org/10.1016/j.ijid.2021.03.069.
9. Desveaux L, Savage RD, Tadrous M, Kithulegoda N, Thai K, Stall NM, et al. Briefs associated with savings of non-physician healthcare workers to receive the COVID-19 vaccine in Ontario, Canada. medRxiv 2021.
10. Di Gennaro F, Murri R, Segala PV, Cerruti L, Abulle A, Saracino A, et al. Attitudes towards anti-SARS-CoV-2 vaccination among healthcare workers: results from a national survey in Italy. Viruses 2021;13.10.3390/v13030371.
11. Di Giannetto F, Murri R, Segala PV, Cerruti L, Abulle A, Saracino A, et al. Attitudes towards anti-SARS-CoV-2 vaccination among healthcare workers: results from a national survey in Italy. Viruses 2021;13.10.3390/v13030371.
12. Di Giannetto F, Murri R, Segala PV, Cerruti L, Abulle A, Saracino A, et al. Attitudes towards anti-SARS-CoV-2 vaccination among healthcare workers: results from a national survey in Italy. Viruses 2021;13.10.3390/v13030371.
13. Fares S, Elmymer MM, Mohamed SS, Elsayed R. COVID-19 vaccination perception and attitude among healthcare workers in Egypt. J Prim Care Community Health.2021;12.10.3390/jpcch.2021.1131334. https://doi.org/10.1177/2150127211031334.
14. Foouge JT, Noubom B, Kenfack B, Dongmo NT, Tabue M, Megodeu L, et al. Poor knowledge of COVID-19 and unfavourable perception of the response to the pandemic by healthcare workers at the Bafoussam Regional Hospital (West Region - Cameroon). medRxiv 2020. https://doi.org/10.1101/2020.08.20.20178970.2020.08.20.20178970.
15. Fu C. Acceptance and preference for COVID-19 vaccine in healthcare workers (HCWs). medRxiv 2020. https://doi.org/10.1101/2020.09.04.20060103.2020.09.04.20060103.
16. Gadhok A, Halfbrook M, Martin-Blais R, Gray A, Tobin NH, Ferbas KG, et al. Assessment of COVID-19 vaccine acceptance among healthcare workers in Los Angeles. medRxiv 2020. https://doi.org/10.1101/2020.11.18.20234468.2020.11.18.20234468.
17. Gagneux-Brunon A, Detoc M, Bruel S, Tardy B, Rozaire O, Frappe P, et al. Intention to get vaccinations against COVID-19 in French healthcare workers during the first pandemic wave: a cross-sectional survey. J Hosp Infect 2021;108:168–73. https://doi.org/10.1016/j.jhin.2021.10.020.
18. Gonnella E, Soysal A, Atcic S, Engin M, Yesilbas O, Kasap T, et al. Pediatrians’ COVID-19 experiences and views on the willingness to receive COVID-19 vaccines: a cross-sectional survey in Turkey. Hum Vaccines Immunother 2021;1–8. https://doi.org/10.1080/21645515.2021.1896319.
19. Grumbach K, Judson T, Desai M, Jain V, Linden C, Doernberg SB, et al. Association of race/ethnicity with likelihood of COVID-19 vaccine uptake among healthcare workers and the general population in the san francisco bay area. JAMA Intern Med Published Online First March 2021;30. https://doi.org/10.1001/jamainternalmed.2021.1445.
20. Harrison J, Berry S, Mor V, Gifford D. “Somebody like me:” understanding COVID-19 vaccine hesitancy among staff in skilled nursing facilities. J Am Med Dir Assoc March 2021. https://doi.org/10.1016/j.jamda.2021.03.012, published online first: 20.
83. Yigit M, Ozkaya-Parlakay A, Senel E. Evaluation of COVID-19 vaccine acceptance of healthcare providers in a tertiary Pediatric hospital. Hum Vaccines Immunother 2021:1–5. https://doi.org/10.1080/21645515.2021.1918523.

84. Youseff D, Abbas LA, Berry A, Youseff J, Hassam H. Determinants of acceptance of coronavirus disease-2019 (COVID-19) vaccine among Lebanese health care workers using health belief model. Res Sq May 2021;v1. https://doi.org/10.21203/rs.3.rs-284775/v1.

85. Yu Y, Lau JTP, She R, Chen X, Li L, Li L, et al. Prevalence and associated factors of intention of COVID-19 vaccination among healthcare workers in China: application of the Health Belief Model. Hum Vaccines Immunother 2021;1–9. https://doi.org/10.1080/21645515.2021.1899327.

86. Yurttas B, Poyraz BC, Sut N, Ozdede A, Oztas M, Uğurlu S, et al. Willingness to get the COVID-19 vaccine among patients with rheumatic diseases, healthcare workers and general population in Turkey: a web-based survey. Rheumatol Int 2021;41:1105–14. https://doi.org/10.1007/s00296-021-04841-3.

87. Zigron A, Dror AA, Morozov NG, Shani T, Haj Khalil T, Eisenbach N, et al. COVID-19 vaccine acceptance among dental professionals based on employment status during the pandemic. Front Med 2021;8:13. https://doi.org/10.3389/fmed.2021.618403.

88. Crawshaw J, Konnyu K, Castillo G, van Allen Z, Trehan N, Gauvin FP, et al. Factors affecting COVID-19 vaccination acceptance and uptake among the general public: a living behavioural science evidence synthesis (v5, Aug 31st, 2021). https://www.researchgate.net/profile/Jacob-Crawshaw/publication/354531157_Gen_Pub_Vaccination_Living_Behavioural_Science_Evidence_Synthesis_v5_Aug_31/links/613f4f7c90130b1e19d67ec6/Gen-Pub-Vaccination-Living-Behavioural-Science-Evidence-Synthesis-v5-Aug-31.pdf. [Accessed 10 October 2021].

89. Castillo G, Ondimbe-Eyoh S, Crawshaw J, Smith M, Trehan N, Gauvin FP, et al. Factors affecting COVID-19 vaccination in Black communities in Canada: a behavioural analysis. 2021. https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.5—black-communities-and-vaccine-confidence.pdf?sfvrsn=80fee5c5-5. [Accessed 24 December 2021].

90. Castillo G, O’Gorman CM, Crawshaw J, Smith M, Trehan N, Gauvin FP, et al. Factors affecting COVID-19 vaccination among people experiencing homelessness and precarious housing in Canada: a behavioural analysis. 2021. https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.5—vaccine-confidence-among-homeless-and-housing-precarious-populations.pdf?sfvrsn=3034e6b5_5. [Accessed 24 December 2021].

91. Pesseau J, Desveaux L, Allen U. Behavioural science principles for supporting COVID-19 vaccine confidence and uptake among Ontario health care workers. Sci Rises Ost COVID-19 Sci Advise Table 2021;2:12.

92. Jacobson Vann JC, Jacobson RM, Coyne-Beasley T, Asafu-Adjei JK, Szilagyi P. Patient reminder and recall interventions to improve immunization rates. Cochrane Database Sys Rev Published Online First 2018. https://doi.org/10.1002/14651858.CD003941.pub3.

93. Schumacher S, Salamanca-Garcia J, Cornely OA, Mellinghoff SC. Increasing influenza vaccination coverage in healthcare workers: a review on campaign strategies and their effect. Infection 2021;49:387–99. https://doi.org/10.1007/s15010-020-01559-5.

94. Reuters. Countries making COVID-19 vaccines mandatory. Reuters. 2021. https://www.reuters.com/business/healthcare-pharmaceuticals/countries-making-covid-19-vaccines-mandatory-2021-08-16/. [Accessed 22 December 2021].

95. Castillo G, Ndumbe-Eyoh S, Crawshaw J, Smith M, Trehan N, Gauvin FP, et al. Factors affecting COVID-19 vaccination among Indigenous peoples in Canada: a behavioural analysis. 2021. https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.5—indigenous-peoples-and-vaccine-confidence.pdf?sfvrsn=97976116_5. [Accessed 24 December 2021].