Factors affecting COVID-19 vaccination acceptance and uptake among the general public: a living behavioural science evidence synthesis (v5, Aug 31st, 2021)

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Research Question: How can behavioural science help inform messaging to and broader supports for the general public to encourage vaccination for COVID-19? How can behavioural science help address vaccine-related concerns from equity-seeking groups?

New in this update (version 5, 31st Aug 2021)

- 32 studies were added, including 7 from Canada (searched up to Aug 1st, 2021).
- COVID-19 vaccination acceptance and uptake is high among Canadians (~70-80%), although these data are primarily from Canadian market research and opinion poll sources. As of Aug 21st, 2021, the Government of Canada website reports 75% of the Canadian population aged 12+ has received two doses of a COVID-19 vaccine.
- Few Canadian studies to date have investigated barriers/enablers of vaccine acceptance/uptake beyond sociodemographic factors.

Key overall findings

- We identified 175 studies assessing factors associated with vaccination acceptance and uptake with data collected in the period since COVID-19 vaccine approval (i.e. Nov, 2020 onwards); 23 studies were conducted in Canada.
- The overall percentage of Canadians willing to accept a COVID-19 vaccine was 83% (*k*=21; IQR=76-88%). One Canadian study also reported that 61% of parents would be willing to vaccinate their children. Among 6 Canadian studies, median COVID-19 vaccination uptake was 70% (IQR=56-83%).
- We categorised all identified **BARRIERS** and **ENABLERS** to vaccine acceptance/uptake using the **Capability**, **Opportunity**, and **Motivation**-Behaviour (COM-B) model and the *Theoretical Domains Framework* to inform how different strategies might be leveraged to address different types of predominant issues:
    - **Capability**-related factors identified mostly concerned *Knowledge* (or lack thereof) about COVID-19 and vaccines.
    - **Opportunity**-related factors identified included *Environmental context and resources* (relating to access, cost, and convenience) and *Social influences* (mistrust around how the pandemic has been handled, developing social norms around vaccination). Access to and trust in reputable scientific/non-scientific information sources about COVID-19 and COVID-19 vaccines (*Environmental context and resources*) appears to be a growing issue which may reflect the pernicious influence of misinformation on public perception.
    - **Motivation**-related factors identified included *Beliefs about consequences* (including concerns and misunderstanding about COVID-19 vaccine safety, efficacy, and necessity), *Social/professional role and identity* (framing vaccination as a collective responsibility), *Reinforcement* (in particular having a history of getting other vaccines), and *Emotion*.
- 34/175 studies assessed whether vaccine acceptance was associated with race and

ethnicity among equity-seeking groups. Of these, 33/34 studies found that that racialized (Black and Latinx in particular) respondents are less likely to express vaccine acceptance compared to White respondents. One Canadian study found that Indigenous respondents were more likely to refuse COVID-19 vaccination vs. non-Indigenous respondents. When assessing **BARRIERS** and **ENABLERS** to vaccine acceptance/uptake within these groups, respondents from some racialized groups (e.g., Black, Latinx) expressed more mistrust in governments and pharmaceutical companies (*Social influences*) than other groups (e.g., White, Asian). Moreover, a study of Black Canadians (albeit by a non-academic group) highlighted issues relating to vaccine access (*Environmental context and resources*), mistrust in healthcare providers and vaccine makers (*Social influences*), and concerns about vaccine safety (*Beliefs about consequences*) which negatively impacted vaccine acceptance and uptake.

- While there is an increasing amount of Canadian research investigating vaccination acceptance and uptake (although mostly from market research and opinion poll data), more Canadian research would help to better serve and support equity-seeking groups as Canada continues its COVID-19 vaccination program.

Key implications

- Across 9 of 14 *Theoretical Domains Framework* domains, we identified 10 **BARRIERS** and 11 **ENABLERS** (identified in ≥ 3 studies) which may have implications for COVID-19 vaccine interventions (**see Table 2, p26**).
- Based on these data, there is considerable evidence for **Capability-** and **Motivation**-related factors associated with COVID-19 vaccination acceptance and uptake which may help influence vaccination messaging, campaigns, and program design. However, there is also a need to support motivated individuals who may nevertheless experience barriers to access that may be outside their control (**Opportunity**-related factors).
- Addressing these key and recurring identified barriers and enablers should involve multiple approaches at multiple levels to help maximise uptake. Different behavioural strategies are needed when addressing **Capability**-, **Motivation-,** and **Opportunity**-related barriers/enablers. A one-size-fits-all approach is unlikely to address the range of barriers and enablers expressed by the general public. Strategies shown to be effective in supporting vaccination acceptance/uptake for other vaccines [1] should be carefully considered in terms of how they address **Capability**-, **Opportunity**-, or **Motivation**-related barriers currently known for COVID-19 vaccines.

Introduction: Leveraging behavioural science to provide a new lens on COVID-19 vaccination

Since Dec 2020, COVID-19 vaccines have steadily been rolled out across Canada, with 83% of Canadians (aged 12+) having at least one dose and 75% with two doses (as of Aug 21st, 2021, cf. Government of Canada website). Accelerating the pace of vaccination can help curb the spread of COVID-19 which has accounted for an estimated 4.5 million deaths globally, including almost 27,000 Canadians (as of Aug 30th, 2021, cf. Johns Hopkins COVID tracker). High uptake of COVID-19 vaccines across Canada is needed to achieve maximum effectiveness across the population and groups within it, and data continues to show the benefit of full vaccine uptake to substantially reduce hospitalisations for COVID-19 [2], especially in light of emerging variants of concern including the Delta variant. However, hesitancy and other barriers to receiving a COVID-19 vaccine remains a public health concern which may undermine efforts to reduce the continued impact of COVID-19. It is crucial to identify and understand what key factors are associated with vaccination acceptance in the general public and in particular individuals among equity-seeking groups such as those experiencing racial, ethnic, and socioeconomic disparities/marginalization. This is especially important given the disproportionate health, economic, and emotional impact COVID-19 has had on equity-seeking groups in Canada.

A behavioural science approach does not imply an individual-focus, nor does it put the onus of responsibility on individuals. Rather, framing COVID-19 vaccination uptake as a behaviour allows us to draw upon decades of research aimed at understanding factors that affect what people think, feel, decide, and ultimately do. Such an approach fully recognizes that what individuals, groups, communities, and populations do is shaped by the past and present experiences, resources, and constraints afforded or not by the social and physical contexts in which they live and work. These experiences and affordances (or lack thereof) ultimately serve to shape the Capability, Opportunity, and Motivation that drive the behaviour of individuals and groups (cf. **COM-B model** [3]).

Capability-, Opportunity- and Motivation-related factors of individuals are shaped by the multiple social, cultural, historical, community, governmental, clinical, and environmental levels that influence acceptance and uptake of COVID-19 vaccination. We drew upon the overarching COM-B model to situate 14 key behavioural factors that can drive vaccination intention and uptake (**Figure 1**). These 14 factors are reflected in the *Theoretical Domains Framework* (TDF), a synthesis of decades of research and evidence of the key, modifiable factors that influence behaviour [4–6]. TDF factors are linked to specific behaviour change techniques that can be used to address particular barriers and enablers to vaccination, thus linking barriers to solutions. Using these approaches can enable exploration of whether different factors influence vaccine acceptance in different equity-seeking groups which may point to strategies and

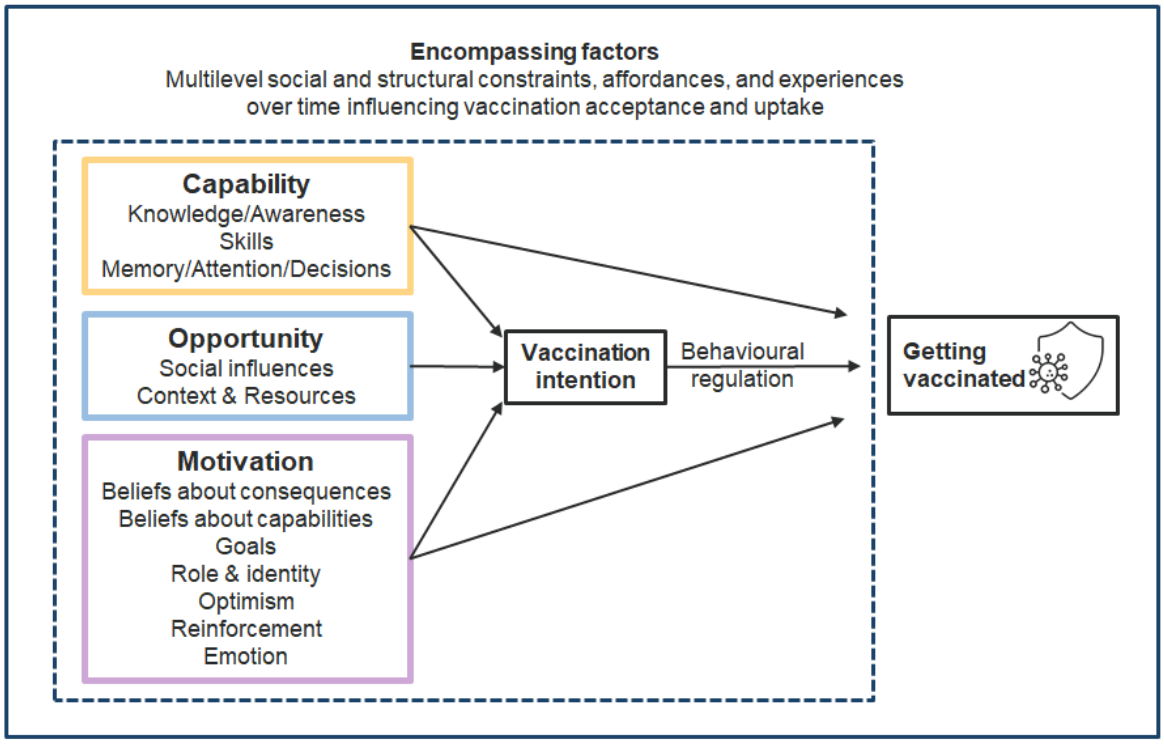
programs that address the needs and concerns of these groups. Such approaches have been used extensively to understand and address behaviour change in other health-related contexts but have yet to be fully leveraged to address COVID-19 vaccination acceptance and uptake [7].

As part of our continued series of monthly (v1, v2, v3, v4) living behavioural science evidence synthesis (LBSES), we will use perspectives from the COM-B model and TDF to help identify factors affecting vaccination acceptance and uptake among the general public globally and in Canada, and in particular those serving equity-seeking groups. The present LBSES can be considered alongside version 3 (published Jun 18th, 2021) of our LBSES focusing on COVID-19 vaccination acceptance/uptake specifically among healthcare workers (HCWs) which can be found here.

Living Behavioural Science Evidence Synthesis Objectives

1. Identify rates of COVID-19 vaccination acceptance in the general public globally and in Canada (p11).
2. Identify rates of COVID-19 vaccination uptake in Canada in the general public globally and in Canada (p11).
3. Identify factors associated with COVID-19 vaccination acceptance and uptake among the general public globally and in Canada (p11).
4. Identify factors associated with COVID-19 vaccination acceptance and uptake among equity-seeking groups (p19).

Figure 1. Potential drivers of vaccination acceptance and uptake based on the COM-B model and Theoretical Domains Framework



Methods

Data sources

We identified three databases that have been capturing published peer-reviewed papers, preprints, published reports, and unpublished datasets relating to our research questions. The first database is run by the McMaster Health Forum who produces a monthly Living Evidence Profile investigating COVID-19 vaccine rollout which includes acceptance/uptake. We searched this Profile manually for papers relevant to our research questions. The second database is run by Kristin Konnyu (Brown University, USA) who is co-author on this review. This database includes weekly searches of MEDLINE (via PubMed) and the Cochrane Register of Clinical Trials (PROSPERO registration: CRD42021253533). Two researchers have been independently undertaking level 1 (title and abstract) and level 2 (full-text) screening (screening team includes co-authors Crawshaw, Konnyu, Castillo, and van Allen). Discrepancies during screening are being resolved via consensus meetings. Data extraction is being undertaken by Crawshaw, Konnyu, Castillo, and van Allen. A third database maintained by the Knowledge Synthesis team in the Emerging Science Group, Public Health Agency of Canada produce a monthly Evergreen

Rapid Review includes which include searches of Pubmed, Scopus, BioRxiv, MedRxiv, ArXiv, SSRN, Research Square, and COVID-19 information centers run by Lancet, BMJ, Elsevier, Nature, and Wiley [8]. The present LBSES focused specifically on identified Canadian data from the Evergreen Rapid Review. The following links represent the most recent publically-available reports based on the databases detailed above:

- *COVID-19 Living Evidence Profile #1: What is known about anticipated COVID-19 vaccine roll-out elements?* [9] **(Most recent search: Apr 20, 2021).**
- *Rapid Evidence Review: What are the barriers and facilitators to individuals' willingness to be vaccinated for COVID-19?* [10]; *Understanding and promoting COVID-19 vaccine uptake among marginalized communities in RI* [11] **(Most recent search: Jul 19, 2021).**
- *Evergreen Rapid Review on COVID-19 Vaccine Knowledge, Attitudes, and Behaviours – Update 9* [8] (**Most recent search: Aug 1, 2021**).

Inclusion criteria

- *Population:* General public and particularly those from equity-seeking groups. Includes patient and student samples, among others.
- *Outcome:* Studies that include a measure (self-report and/or objective) of COVID-19 vaccination willingness/intention/hesitancy/acceptance (referred to as **vaccination acceptance** hereafter), and/or uptake.
- *Time:* Studies that collected data in the period since COVID-19 vaccine approval (Nov, 2020 onwards). Studies that had data collection periods that bridged this timeframe (e.g., Sep 1 - Dec 31, 2020) were included.
- *Design:* Qualitative and survey (observational) data; cross-sectional, experimental, prospective, and cohort designs.

Exclusion criteria

- *Outcome:* Studies that only included a measure of vaccination knowledge.
- *Time:* Studies that collected data collection exclusively between Jan - Oct 2020 (i.e., before COVID-19 vaccines were being authorised for emergency use). See here (p63) for a list of relevant studies (*k*=131) which collected data in the months prior to COVID19 vaccine approvals (Jan – Oct, 2020) which were excluded from this review.

Data extraction

The three data sources were manually searched and cross-referenced for relevant studies (most recent search was from Evergreen Rapid Review: Aug 1, 2021). A standardised data extraction form (**Appendix 1**) was used to extract relevant data relating to study characteristics, behavioural specification, factors affecting vaccination acceptance based on the COM-B model and TDF, and equity-related data. Key barriers and enablers affecting COVID-19 vaccination were identified. Recommendations based on key barriers/enablers were drawn from the team's expertise and key papers and syntheses from the broader vaccination literature [1,12] . The equity-related factors identified in our first review focusing on HCWs suggested that racialized groups may differ in their level of vaccine acceptance. We therefore focused our analysis of equity-related factors to race and ethnicity for this present review. '*k*' refers to the number of studies. Where available, we have captured key statistical analyses (odds ratios (OR); adjusted odds ratios (ORa)) on the factors associated with higher or lower vaccination acceptance/uptake.

Results

Study characteristics

A total of 175 studies met our inclusion criteria (including 32 added to version 5 of this review) [13–185]. **Appendix 2** provides an overview of each included study. 132 were published peer-reviewed papers, 28 were preprints, and 15 were unpublished Canadian datasets (e.g., primary market research and opinion polls, Government surveys). 148/175 used cross-sectional survey designs; 20 were longitudinal studies [25–27,31,37–39,41,52,57–61,65,101,125,132,172,186]; 4 were experimental studies [73,144,147,183]; 2 were qualitative studies [106,174], and 1 was a retrospective study [134]. 157/175 studies measured COVID-19 vaccine acceptance; 18 studies also reported actual vaccination uptake [16,25,27,28,37,38,43,47,52,60,62,101,105,107,134,138,146,151].

65/175 studies collected data on specific groups from the general public: university students/young adults [32,35,43,46,82,96,118,150,173,175]; older adults [30]; patients with chronic disease [108]; patients with inflammatory bowel disease [66,105,121]; patients with chronic respiratory or autoimmune disease [64]; patients with multiple sclerosis [21,154]; patients with celiac disease [104]; patients with HIV [135,158]; outpatients [160]; patients with psoriasis [80]; patients with a rheumatologic condition [122,167,170]; patients with cancer [120,167]; woman with breast cancer [95]; patients with kidney disease [42]; patients with mental illness [107]; patients with type II diabetes [88]; patients with gastroenterology and liver

diseases [14]; people with epilepsy and caregivers [130]; tobacco/marijuana users [48]; people experiencing homelessness [68]; people from sexual and gender minority backgrounds [72]; incarcerated or detained residents [75]; military base personnel [15]; international travelers [156]; people with development disabilities [62]; workers supporting people with intellectual disabilities [63]; pregnant people/perinatal/non-pregnant mothers [16,33,51,94,128,136,139,155,162,179]; reproductive-aged women [29]; parents [56,141], and teachers [22,97]. Three studies recruited migrant samples [106,174,178] and another study recruited individuals from underserved rural and urban communities [74]. One study recruited from a New York Haredi-Orthodox Jewish Community [49].

71/175 studies were conducted exclusively in North America: 48 studies were conducted in the USA [13–18,20,21,29–34,42–47,49–53,62–84] and in 23 Canada [22–28,35–41,54–60,63,186]. Two studies collected data in both the USA and UK [19,61]. 102/175 studies were conducted outside of North America: Qatar [128,149,180]; Italy [87,88,104,105,131,155,159,162,167,173]; UK [106,107,116,168,169,174]; Ireland [139]; Spain [113,177]; Jordan [86,150,184]; China [96,99,118,136–138,172,175,178,181]; India [140,185]; Bangladesh [115,127]; Sri Lanka [114]; Nigeria [161]; Poland [101,120,146]; Turkey [98,124,129,141,152]; Greece [183]; Germany [119,123,144,151]; Japan [92,148]; Portugal [153,154]; France [121,158]; Taiwan [111,160]; Vietnam [108]; Malaysia [89]; Slovenia [163]; Lithuania [130]; Saudi Arabia [100,117,166]; Iraq [142]; Libya [143]; Kazakhstan [109]; Lebanon [110]; Malta [176]; Denmark [132]; Finland [125]; Austria [133]; Israel [134]; Russia [182]; Ethiopia [90,94,97,102,187]; Somalia [85]; Mexico [95]. 12 studies collected data from multiple countries in different regions/classifications: Latin America [147]; Europe [170]; Arab states [91,112,164]; Africa [171]; Global [93,122,135,145,156,165,179]; and low-middle income countries [103,157].

Objective 1: COVID-19 vaccination acceptance rates in the general public

Across 154/175 studies, almost two thirds of respondents from the general public were willing to accept a COVID-19 vaccine (median=64%, IQR=51-79%). These data are comparable to the acceptance rates found among HCWs (*k*=64, median=64%, IQR=46-79%) reported elsewhere (v3, Jun 18th, 2021). In student/young adult samples (*k*=9), average acceptance rates were 76% (IQR=53-84%) [32,35,43,46,82,118,150,173,175] and in pregnant/perinatal samples (*k*=9), average rates of acceptance were 53% (IQR=49-69%) [33,51,94,128,136,139,155,162,179]. The overall percentage of Canadians willing to accept a COVID-19 vaccine was 83% (*k*=21; IQR=76-88%) [22–28,35–37,40,41,54–60,63,186]. One Canadian study also reported that 61% of parents would be willing to vaccinate their children [56].

Objective 2: COVID-19 vaccination uptake rates

18 studies reported COVID-19 vaccination uptake rates [16,17,25,27,28,37,38,43,48,52,60,62,101,105,107,134,146,151]. Data from the Government of Canada website indicates that as of Aug 21st, 2021, 75% of the Canadian population (aged 12+) had received two doses of a COVID-19 vaccine. Among 6 Canadian studies [25,27,28,37,38,60] , median COVID-19 vaccination uptake was 70% (IQR=56-83%).

Objective 3: Factors associated with higher and lower COVID-19 vaccination acceptance

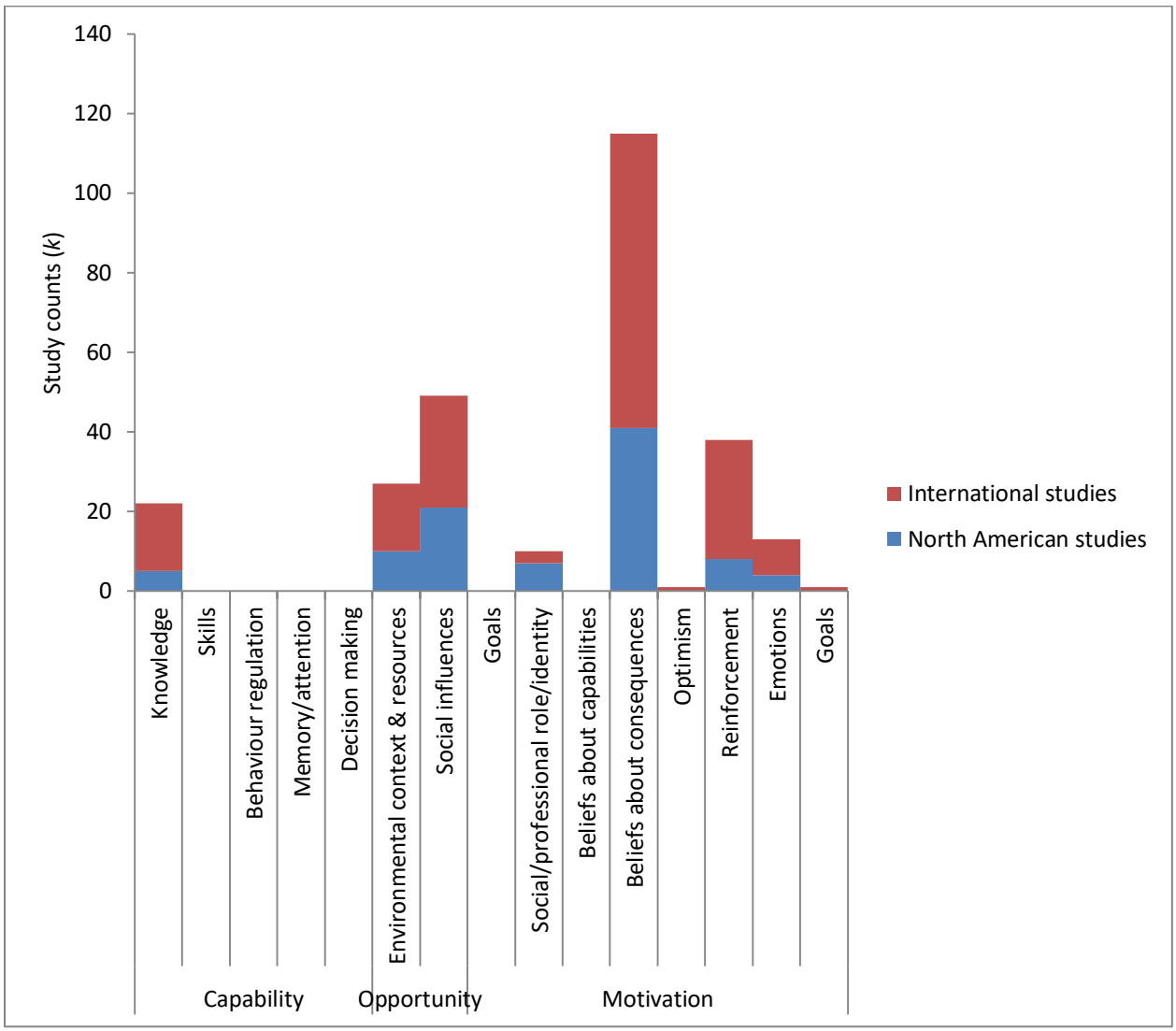
146/175 studies provided evidence of the potential factors underlying COVID-19 vaccine acceptance which were mapped using the COM-B model and TDF. 8 studies either reported rates of vaccination acceptance only or reported data that we were unable to be map onto the COM-B model and TDF [25,38,41,77,147,155,165,185]. Moreover, 8 studies assessed potential factors predicting vaccination acceptance among equity-seeking groups specifically [31,33,34,61,62,65,67,74] (**see Objective 4**). 10/22 eligible Canadian studies identified from the Evergreen Rapid Review – Update 9 [8] focused specifically on sociodemographic determinants of COVID-19 vaccination acceptance/uptake which, while important factors, do not lend themselves to interpretation from a behavioural perspective in any additional detail than already provided.

To date, 9 (of a possible 14) TDF domains appear to be important determinants of COVID-19 vaccine acceptance in the general public (based on recent data since vaccines have been approved for use) (see **Figure 2**):

- **Capability** (*Knowledge* [*k*=22]) (see in-text summary on p16, and detailed coding in **Appendix 3**).

- **Opportunity** (*Environmental context and resources* [*k*=27]; *Social influences* [*k*=49]) (see in-text summary on p16, and detailed coding in **Appendix 4**).
- **Motivation** (*Beliefs about consequences* [*k*=115]; *Social/professional role and identity* [*k*=10]; *Reinforcement* [*k*=38]; *Emotion* [*k*=13]; *Goals* [*k*=1]; *Optimism* [*k*=1] (see in-text summary on p17, and detailed coding in **Appendix 5**).

Figure 2. Frequency of Capability, Opportunity and Motivation factors associated with COVID-19 vaccination acceptance in the general public across 175 studies



These domains are similar to those found in a recent review [10] and our LBSES focusing on COVID-19 vaccination acceptance/uptake among HCWs (v3, Jun 18th, 2021), although these reviews included studies reporting data since the start of the pandemic which were excluded in the present review. As such, our findings indicate that drivers of vaccination acceptance appear to remain consistent to date, even in light of authorised vaccines (from Nov/Dec, 2020). Domains that did not emerge to date as important determinants of COVID-19 vaccine acceptance among the general public included: *Skills*; *Behavioural regulation*; *Memory, attention and decision-making*; and *Beliefs about capability*. Future research should seek to explore these factors as it remains unclear whether the lack of data is due to not being in the survey prompts (168/175 studies used survey-based designs) or not being important barriers/enablers. Given these are known factors of relevance in behaviour change generally; one might expect them to have been identified within this literature, especially the *Beliefs about capability* domain. **Figure 3** and **Figure 4** depict the 21 most frequent barriers and enablers (identified in ≥3 studies) across domains. These will be discussed further in the implications section of this report (**see Table 2, p25**).

Figure 3. Frequency of BARRIERS identified within the literature (only including barriers identified in ≥ 3 studies)

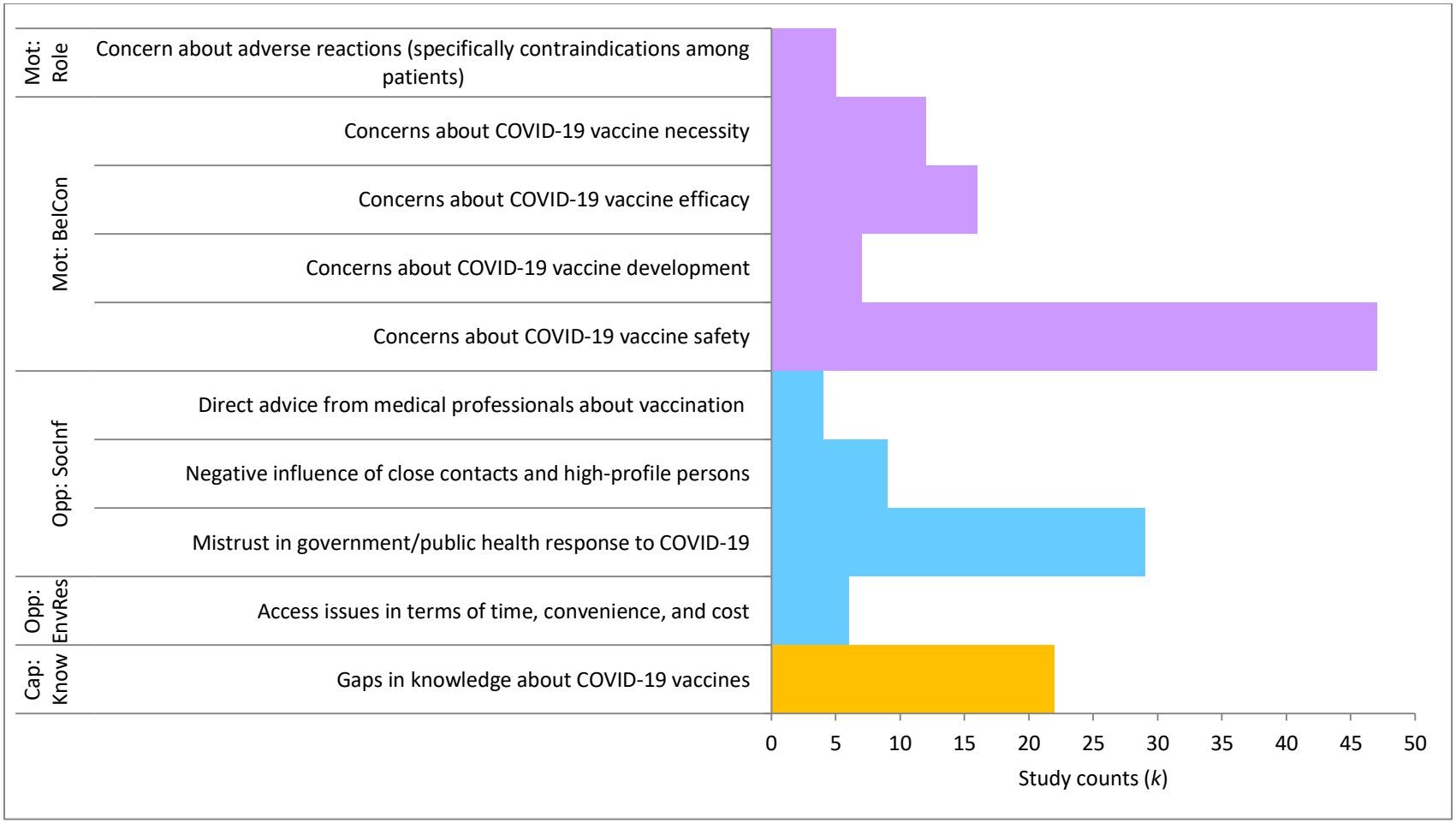


Figure 3 notes: BelCon = *Beliefs about consequences*; Cap = **Capability**; EnvRes = *Environmental context and resources*; Know = *Knowledge*; Mot = **Motivation**; Opp = **Opportunity**; SocInf = *Social influences*

Figure 4. Frequency of ENABLERS identified within the literature (only including barriers identified in ≥ 3 studies)

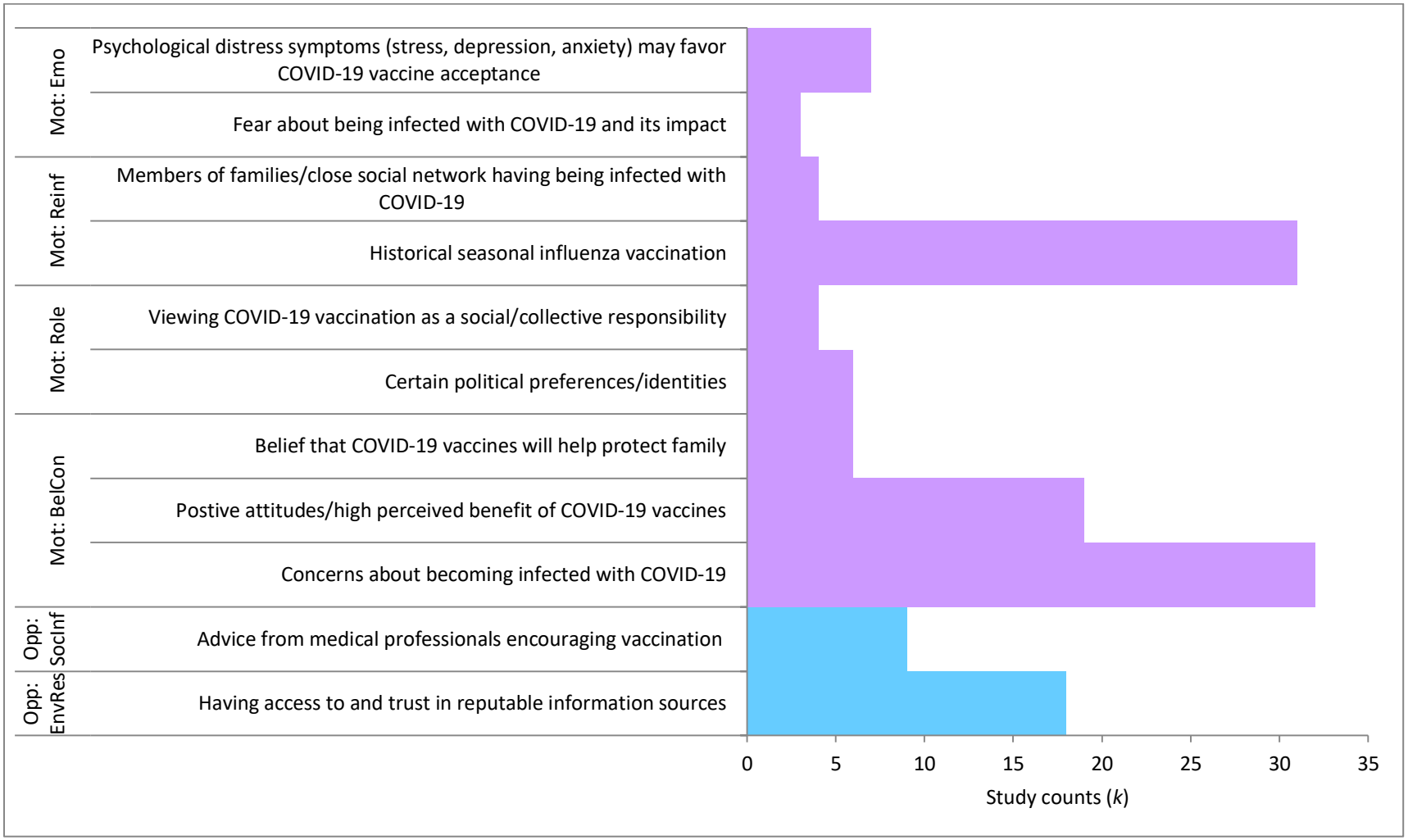


Figure 4 notes: BelCon = *Beliefs about consequences*; Cap = **Capability**; EnvRes = *Environmental context and resources*; Emo = *Emotion*; Know = *Knowledge*; Mot = **Motivation**; Opp = **Opportunity**; Reinf = *Reinforcement*; Role = *Social/professional role and identity*; SocInf = *Social influences*

Capability-related factors associated with higher and lower COVID-19 vaccination acceptance and uptake

Knowledge is the key Capability-related domain identified within this literature (**Appendix 3**). A general lack of knowledge about COVID-19 and COVID-19 vaccines was cited as a barrier in 22 studies [22,35,59,61,66,75,94,103,104,106,108,111,131,136,140,154,168,170,174,180,181,187], including two qualitative studies [106,174], one of which involved interviewing migrants in the UK [106]. One study of rheumatology patients found a desire for additional disease-specific guidance on COVID-19 vaccination given there may be additional risks for comorbid conditions [66]. Similar findings were found in a study of patients with celiac disease [104]. This highlights the importance of tailoring advice for specific clinical populations which may be at a higher risk of developing COVID-19 and have worse outcomes upon infection. One Canadian study of public school teachers found that poor general knowledge about vaccines was associated with lower COVID-19 vaccination acceptance [22].

Opportunity-related factors associated with higher and lower COVID-19 vaccination acceptance and uptake

Evidence indicating the importance of opportunity related-factors was strong (**Appendix 4**). In particular, *Social influence* was a frequently-identified factor associated with vaccination acceptance. Government and health agency mistrust continues to be a frequently cited barrier to vaccine acceptance which is likely exacerbated by misinformation and conspiracy beliefs among the general public (*k*=31) [28,45,49,51,62,67,70,72,74,75,78,79,90,93,95,106,109,115,132,141,145,153,163,164,168,174,179,180,182,184]. The ongoing nature of the pandemic may have contributed to the erosion of trust in governing bodies. Conversely, access to and trust in reputable information sources was associated with higher vaccine acceptance (*k*=17) [13,22,26–28,70,86,87,97,98,116,123,142,150,151,156,175] and actual uptake [26–28]. One Canadian study reported that the top trusted sources for vaccine information were Public Health Agency of Canada (84%), health scientists and researchers (70%), and provincial, territorial, regional health authorities (68%) [27]. Identifying and fostering engagement with such trusted information sources may act as a cue to action in terms of dispelling concerns to encourage vaccination, recognising that different groups are likely to trust different sources.

13 studies identified the role of HCWs in influencing the likelihood of people being vaccinated, in particular among certain patient groups (e.g., patients with a rheumatic condition) and professionals (e.g., gastroenterologists for inflammatory bowel disease patients) [32,81,99,105,136,139,140,145,146,167,170,172,176]. 2 studies reported that hesitancy was linked to individuals waiting for others being vaccinated first [66,74], although it is unclear whether this was driven by altruistic tendencies or safety concerns. 8 studies reported the importance of social norms and in particular descriptive norms (i.e., being aware of what others like you are doing) which relates to comparing the likely uptake of peers ('proximal' influences) [50,63,73,82,127,142,145,175]. This could be particular important to encourage young people to get vaccinated once able to, and also potentially among racialized groups (discussed further in **Objective 4**).

8 studies in our review cited potential access issues in terms of time, convenience, and cost which were associated with lower vaccination acceptance [27,28,46,63,106,125,127,172]. One Canadian study found that among those not yet vaccinated, 60% reported that they were either not part of a priority group for vaccination at that time or had not been able to get a vaccine appointment yet [27]. Such practical barriers could be addressed at a system and/or policy level to minimise barriers to access.

Motivation-related factors associated with higher and lower COVID-19 vaccination acceptance

The most frequently identified factor associated with individuals' willingness to receive a COVID-19 vaccine were *Beliefs about consequences*, specifically beliefs about vaccine safety, efficacy, and necessity (**Appendix 5**). In particular, general safety concerns about the COVID-19 vaccines (e.g., possible side-effects) continue to be identified in newer papers added to versions 4 and 5 of this review. Common concerns and erroneous beliefs focused on the beliefs that COVID-19 vaccine development was rushed (*k*=7) [50,63,67,140,153,168,180] which aligns closely with common safety (*k*=41) and efficacy concerns (*k*=17) [15,27,50,67,86,117,118,121,131,138,148,151,172,173,175,178,181]. Although many such concerns related to general vaccine safety, 4 studies found specific patient groups citing concerns about possible contraindications [64,88,167,170]. 12 studies found that vaccine hesitancy was related to a lack of perceived necessity with respondents citing natural resistance/protection and feeling in good health as reasons not to get vaccinated [49,63,78,81,145,153,162,168,169,176,180,182]. One Canadian study found that among those not wanting to be vaccinated for COVID-19, the top reasons were lacking trust in the safety in the vaccine (45%) or effectiveness (30%), and not believing they are at high risk for COVID-19

(26%) [27]. Two prominent health-related beliefs associated with higher acceptance were concern about catching COVID-19 (*k*=23) [29,30,35,44,69–71,100,103,111,114,116,118,125–127,129,131,137,161,166,172,183] and positive beliefs about the utility of and confidence in vaccines (*k*=16) [27,46,100,102,104,106,110,113,114,116,118,120,130,136,140,142]. Additionally, an understanding that vaccines were necessary to help prevent risk of infection, reduce severity if infected, reduce the risk of spreading to others, and to ultimately help overcome the pandemic was seen in six studies (*k*=6) [63,72,140,145,148,154]. One study found that positive beliefs about the effectiveness of COVID-19 vaccines was associated with actual vaccination uptake [151].

In line with our previous HCW-focused review (v3, Jun 18th, 2021), *Reinforcement* was also a prominent Motivation-related factor associated with vaccination acceptance. 31 studies found historical influenza vaccine behaviour predicted current intentions towards COVID-19 vaccination [14,29,42,48,71,78,83,88,91,95,96,99,105,112,113,120,130,131,139,142,153,154,158,166–168,176,179–181,184]. Moreover, another study of reproductive-aged women found the previous human papillomavirus (HPV) vaccination uptake was associated with COVID-19 vaccine acceptance [29]. Personal experience of COVID-19, either being severely infected themselves or having a close family member/friend die, was associated with higher and lower rates of acceptance, respectively, although these were only reported in four studies to date [70,71,140,166]. Furthermore, engagement in COVID-19 infection behaviours (i.e. personal protective behaviour) throughout the pandemic (and thus potentially reinforcing the importance of vaccines) was associated with higher vaccine acceptance in four studies [85,94,145,160].

The *Social/professional role and identity* domain was less represented in this general public dataset compared with our HCW-focused review which found some differences between HCW professions/specialties. That said, 4 studies found that respondents who perceived vaccination as a personal/social responsibility/role were more likely to accept vaccination [63,69,121,156]. In line with most COVID-19 mitigation strategies (e.g., staying home where possible, face coverings, physical distancing), framing vaccination as a community role/responsibility may help increase motivation to be vaccinated.

In terms of *Emotion*-focused barriers/enablers, one study found that higher scores on COVID-19 related anxiety was related to vaccine acceptance [152] whilst another study found that depressive symptoms was associated with high vaccination acceptance [145]. One study also found that individuals who felt agitated, sad, or anxious due to the physical distancing measures on some days had lower odds of vaccine refusal than individuals who never had those

feelings [153]. *Optimism* was associated with higher acceptance in one study [133]. An experimental study [144] found that COVID-19 vaccination preference (i.e., matching one's preferences for a particular COVID-19 vaccine) was associated with higher intention to vaccinate (captured under the *Goals* domain). Such experiments help to clarify the role of preferences in the changing landscape of approved and available vaccines.

Objective 4: Equity-related factors associated with higher and lower COVID-19 vaccination acceptance

We focused our assessment of equity-related factors on studies that assessed race and ethnicity in relation to vaccine acceptance. Overall, 34/175 studies (mainly conducted in the USA) assessed whether vaccine acceptance was associated with race and ethnicity [16,18,20,23,28,30,31,33,34,42,44,45,49,51,53,54,56,61,62,65–67,69,71,72,74,75,77,78,84,116,168,169]. Of these, 33/34 studies found differences in vaccine acceptance and uptake based on racial/ethnic identity. Some of the key findings from select studies are reported in **Table 1**. In addition to racialized groups, 7 studies were conducted with people experiencing homelessness [68], people from sexual and gender minority backgrounds [72], incarcerated/detained residents [75], members of the New York Haredi-Orthodox Jewish Community [49], and migrant samples [106,174,178]. One recent study focused on Black Canadians specifically, although this study was conducted by non-academic group (market research company) [28].

Table 1. Key differences in vaccine acceptance/uptake among equity-seeking groups (key findings from select studies reported here)

Study authors (Country)	Vaccine acceptance/hesitancy rates among equity-seeking groups
Dalal et al. (USA)	• Respondents who identified as White were associated with vaccination intent (ORa=2.10, 95% CI: 1.20-3.90).
Dickerson et al. (UK)	• 43% (95% CI: 37-54%) of White British and 60% (35-81%) in the least deprived areas do want a vaccine, compared to 13% (9-19%) of Pakistani heritage and 20% (15-26%) in the most disadvantaged areas.
Doherty et al. (USA)	• Black respondents were 1.68 (95% CI: 1.16, 2.45) times more likely to report vaccine hesitancy than White respondents.

Study authors (Country)	Vaccine acceptance/hesitancy rates among equity-seeking groups

Grumbach et al. (USA)	• Vaccine uptake in racialized groups vs. White respondents:
	  ○ Black (ORa=0.29, 95% CI: 0.20-0.43)
	  ○ Latinx (ORa=0.55, 95% CI: 0.43-0.71)
	  ○ Asian (ORa=0.57, 95% CI: 0.47-0.70)
	  ○ Multiple races (ORa=0.65, 95% CI: 0.46-0.92)

Iadarola et al. (USA)	• Black respondents >50 years old were more likely accept a vaccine than younger respondents (OR=3.72, 95% CI: 1.73-8.00).

Nguyen II et al. (USA and UK)	• Vaccine hesitancy in racialized groups vs. White UK respondents:
	  ○ Black (OR=2.84, 95% CI: 2.69-2.99)
	  ○ South Asian (OR=1.66, 95% CI: 1.57-1.76)
	  ○ Middle East/East Asian (OR=1.84, 95% CI: 1.70-1.98)
	  ○ Multiple races/other (OR=1.48, 95% CI: (1.39-1.57)
	• Vaccine hesitancy in racialized groups vs. White USA respondents:
	  ○ Black (OR=3.15, 95% CI: 2.86-3.47)
	  ○ Latinx (OR=1.42, 95% CI: 1.28-1.58)
	  ○ Asian (OR=1.34, 95% CI: 1.18-1.52)
	  ○ Multiple races/other (OR=2.02, 95% CI: 1.70-2.39)

Robertson et al. (UK)	• Vaccine hesitancy in racialized groups vs. White British/Irish UK respondents:
	  ○ Black/Black British (OR=12.96, 95% CI: 7.34-22.89)
	  ○ Pakistani/Bangladeshi (OR=2.31, 95% CI: 1.55-3.44)

Savoia et al. (USA)	• Vaccine hesitancy was predicted by the experience of racial discrimination (OR=1.21, 95% CI: 1.01-1.45).
Szilagy et al. (USA)	• Black (vs. White) respondents were less likely to get a vaccine (38% vs. 59%; ORa=0.70, 95% CI: 0.60-0.80).
Dorman et al. (USA)	• Race/ethnicity also showed a significant effect on willingness to be vaccinated ($p<0.01$). Asian respondents were most likely to want to be vaccinated, followed by non-Hispanic White, Hispanic, and non-Hispanic Black respondents. All racial/ethnic groups differed significantly from one another ($p<0.01$).

Study authors (Country)	Vaccine acceptance/hesitancy rates among equity-seeking groups
Stern et al. (USA)	• Willingness to receive a vaccination (among incarcerated or detained residents) was lowest among Black participants (37%) and highest among Hispanic/Latino (Hispanic) (53%) and American Indian/Alaska Native (48%) participants (p<0.01 for group).
Daly et al. (USA)	• Regression analyses showed statistically significant increases in intentions to vaccinate between October 2020 and February 2021 for all demographic groups examined. Over this period the largest increases in willingness to vaccinate were found among Black (16% increase, 95% CI: 10-22, p<0.01) and Hispanic participants (12% increase, 95% CI: 6-18, p<0.01).
Salmon et al. (USA)	• Intent to get vaccinated was substantially lower among African Americans (32%) and comparable among White non-Hispanics (55%), Hispanics (52%) and Other non-Hispanics (53%). Compared to the Intenders, the 'Wait and Lear' group (i.e., hesitant) were more likely to be African American (OR=2.51, 95% CI: 1.98-3.18).
Teixeira da Silva et al. (USA)	• White participants (among people from sexual and gender minority) were more willing to accept a COVID-19 vaccine than Black, American Indian/Alaskan Native participants, and participants identifying with another race. Asian participants reported greater vaccine acceptance than White participants.
Benis et al. (USA)	• A higher vaccination hesitancy was noted among minorities than among the White population (22% vs. 15%, p<0.01).
Luo et al. (USA)	• Non-Hispanic Black respondents (ORa=0.33, 95% CI: 0.24-0.44) and Hispanic respondents (ORa=0.60, 95% CI: 0.47-0.77) were less willing to get a COVID-19 vaccine than non-Hispanic White respondents.
Niño et al. (USA)	• Black Americans exhibited the lowest probability of likely getting vaccinated, and, in most cases, the gap between Black Americans and other racial groups grew over time.
Sutton et al. (USA)	• Authors found that all races (non-Hispanic Black, Hispanics,

Study authors (Country)	Vaccine acceptance/hesitancy rates among equity-seeking groups
	and Other respondents) were less likely to accept vaccination compared with White respondents except for non-Hispanic Asian respondents.
Thompson et al. (USA)	• Path models revealed significantly greater vaccine uptake rejection among Black participants compared with the overall mean rejection. The association was partially mediated by medical mistrust among Black participants and White participants.
Muhajarine et al. (Canada)	• Respondents who self-identified as Indigenous were 2.4 times as likely to refuse vaccination and 1.7 times as likely to be unsure vs. non-indigenous respondents.
Innovative Research Group (Canada)	• 21% of Canadians were vaccine hesitant with higher levels among Black Canadians (33%) and non-Black visible minorities (25%) compared to White Canadians (19%).

The studies listed in **Table 1** provide evidence to suggest that respondents from racialized communities are less likely to express vaccine acceptance than White respondents. Understanding ***why*** such racial and ethnic differences exist is critical to the success of any vaccination campaign. Assessing barriers and enablers to vaccine acceptance that racialized groups experience may provide valuable insights into factors driving observed disparities, and suggest ways to better support specific groups based on their specific concerns and experienced barriers.

To date, 5 studies have examined factors associated with vaccine acceptance among different racialized groups [28,61,62,67,74], including one study from Canada added to version 5 of this review (conducted by a non-academic group) [28]. Based on USA data, the authors of these studies examined factors associated with vaccine acceptance among Black, Latinx, Asian, and White-identified respondents. In the Canadian study, barriers and enabler to COVID-19 vaccination was explored among Black Canadians. 3 studies added earlier versions of this review examined determinants of vaccine acceptance among marginalized groups, namely: people experiencing homelessness [68], people from sexual and gender minority backgrounds [72], and incarcerated/detained residents [75]. Based on these data, 4 (of a possible 14) TDF domains - *Knowledge* (**Appendix 3**); Environmental context and resources, *Social influences*

(**Appendix 4**), *Beliefs about consequences* (**Appendix 5**) – were identified as potential determinants of COVID-19 vaccine acceptance among equity-seeking groups.

Capability-related factors associated with higher and lower COVID-19 vaccination acceptance among equity-seeking groups

Only 1 from 5 studies presented evidence suggesting that Capability-related factors were associated with vaccine acceptance among Black, Latinx, Asian, and White-identified respondents (**Appendix 3**). Nguyen II et al. found that among those who reported lower vaccine acceptance in the US, Black and Latinx individuals cited a lack of *Knowledge* about the vaccine (51% and 51%, respectively) at a higher rate than White individuals (42%). In the UK, Black (45%) and South Asian (42%) respondents cited not knowing enough about the vaccine at a higher rate than White respondents (37%). However, these differences are based on reported frequencies only [61]. Another study found that incarcerated or detained residents reported a desire for further information about COVID-19 vaccines in order to increase vaccination acceptance [75].

Opportunity-related factors associated with higher and lower COVID-19 vaccination acceptance among equity-seeking groups

In terms of *Environmental context and resources*-related barriers, one study that sought to examine vaccine acceptance among underserved communities in the USA found that owning a mobile phone or computer was associated with lower vaccine acceptance across racialized groups [74] (**Appendix 4**). Moreover, among a sample of Black Canadians, the ability to take paid time off to recover from COVID was associated with lower willingness to get a COVID-19 vaccine [28].

Four studies reported data suggesting that distrust in institutions was associated with lower vaccine acceptance [62,67,74]. While Doherty et al. found that lack of trust in the government predicted lower vaccine acceptance across all groups surveyed, Iadarola found that Black respondents reported more distrust in government at a significantly higher rate (96%) than other groups (80% Latinx, 78% White, 0% Asian; $p<0.01$). Iadarola et al. also found that Black (96%) and Latinx (91%) participants were more concerned about being used as an experiment than other groups (76% White, 67% Asian; $p<0.05$). Grumach et al. also found evidence of greater mistrust among Black respondents who were three times more likely to express distrust in companies making vaccines than White respondents (ORa=3.08, 95% CI: 2.00-4.73). Similar findings were found among samples of incarcerated/detained residents [75] and people from sexual and gender minority backgrounds [72]. A Canadian study found that trust in healthcare

providers and vaccine makers was associated with higher vaccine acceptance among Black Canadians [28]. Taken together, these studies suggest that distrust plays an important role in determining how willing different equity-seeking groups are to COVID-19 vaccination and that some groups may experience greater trust-related hesitancy. One study [74] found that wanting others to receive the vaccine first was marginally predictive of lower vaccine acceptance (OR=1.44, 95% CI: 0.98-2.11). The authors note between 24-26% of participants, independent of their vaccine hesitancy or acceptance wanted others to get the vaccine first (p= 0.77). It is unclear what may motivate this preference. Another study found that altruistic motivation was associated with higher vaccination acceptance in a sample of people from sexual and gender minority backgrounds [72].

Motivation-related factors associated with higher and lower COVID-19 vaccination acceptance among equity-seeking groups

Four studies [28,61,67,74] reported *Beliefs about consequences* as a factor associated with vaccine acceptance among racialized groups (**Appendix 5**). Three studies found that safety concerns were associated with lower vaccine acceptance, including one Canadian study [28]. Doherty et al. found that participants with safety concerns were 4 times more likely express vaccine hesitancy (OR=4.28, 95% CI: 3.06-5.97) across all groups [74]. However, they also found that Latinx respondents (32%) were less likely to cite safety concerns as a reason for delaying or not wishing to get the COVID-19 vaccine than were White (54%) and Black (53%) respondents. Another study reporting frequencies of reasons for refusing a vaccine found that concerns over safety was the most common reason cited across all participants [61]. Black respondents in the USA reported higher rates of safety concerns based on reported frequencies. Two studies found that concerns over vaccine efficacy were associated with lower vaccine acceptance [67,74]. While Doherty et al. found that efficacy concerns predicted lower vaccine acceptance across all groups, Grumbach et al. found that Black, Latinx, and Asian respondents were about twice as likely to express efficacy concerns than were White respondents. Finally, one study found that Black, Latinx and Asian respondents were more likely to express concerns over a rushed approval process [67]. One Canadian study found that feeling high-risk for catching COVID-19 was associated with higher vaccine acceptance among Black Canadians [28].

Discussion

Key implications

This report details version 5 of our LBSES investigating factors affecting COVID-19 vaccination acceptance and uptake among the general public among studies published up to Aug 1st, 2021. A total of 175 studies (including 32 studies added for version 5 of this review), with 23 conducted in Canada.

Across 9 of 14 domains from the Theoretical Domains Framework, we have identified 10 **BARRIERS** (**Figure 3**) and 11 **ENABLERS** (**Figure 4**) (identified in ≥ 3 studies) which may have implications for COVID-19 vaccine interventions. Although there were no new key barriers or enablers identified for version 5 of this review, the enabler – 'access to and trust in reputable scientific/non-scientific information sources about COVID-19 and COVID-19 vaccines' (*Environmental context and resources*) - appears to be a growing issue (present in 6/32 studies added to version 5) which likely reflects the pernicious influence of mis- and disinformation surrounding COVID-19 vaccines (cf. World Health Organisation statement).

Addressing these key and recurring barriers and enablers 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 the general public. In **Table 2,** we provide a non-exhaustive list of recommendations based on general principles from behaviour science which may help form the basis for behaviour-focused interventions to increase COVID-19 vaccination in the general public. These recommendations are supplemented with intervention suggestions from the broader vaccination literature [12].

Based on these data, there is considerable evidence for Capability- and Motivation-related factors associated with COVID-19 vaccination acceptance and uptake which may help influence vaccination messaging, campaigns, and program design. However, there is also a need to support motivated individuals who may nevertheless experience barriers to access that may be outside their control (Opportunity-related factors). For example, we have identified 4 Opportunity-related barriers to COVID-19 vaccination, namely: mistrust in government/public health response to COVID-19; negative influence of close contacts and high-profile persons; direct advice from medical professionals about vaccination; and access issues in terms of time, convenience, and cost. For many of these barriers, system/policy-level solutions are needed to increase vaccine Opportunity for the general public and those serving equity-seeking groups in particular.

Table 2. Key BARRIERS (*n*=10) and ENABLERS (*n*=11) to COVID-19 vaccination acceptance and uptake in the general public along with recommendations based on behavioural science principles and the broader vaccination literature [12]

Domain	Barriers/Enabler	Recommendations based on behavioural science principles and the broader behavioural science vaccination literature [12] [likely impact]
BARRIERS		
Capability: *Knowledge*	Gaps in knowledge about COVID-19 vaccines (*k*=22)	Address knowledge gaps through educational campaigns tailored to different groups across a range of formats, disseminated from trusted sources that likely differ for different groups; one-size-fits-all knowledge dissemination unlikely to reach those who may benefit most.
Opportunity: *Social Influences*	Mistrust in government/public health response to COVID-19 (*k*=29)	Help rebuild trust through transparent communication about COVID-19 vaccination and community engagement and cultural understanding, especially for individuals from equity seeking groups. Acknowledging past harms against racialized groups that validates feelings of mistrust and aims to rebuild trust by addressing inequities.
	Negative influence of close contacts and high-profile persons (*k*=9)	Recognize the importance of people's social circles and prominent public figures and the influence they can have on intention and behaviour (e.g., descriptive norm messages). Work within trusted circles and engage meaningfully **[modest impact]**.
	Direct advice from medical professionals about vaccination (*k*=4)	Ensure that guidance for certain groups (e.g., rheumatologic diseases, people who are pregnant) is clear and transparent. It might be important for medical professionals with whom equity-seeking groups can identify with to provide such advice/support **[substantial impact]**.

Opportunity: *Environmental context and resources*	Access issues in terms of time, convenience, and cost (*k*=6)	Ensure that COVID-19 vaccination is as simple as possible in terms of time, convenience (e.g., on-site vaccination), and cost (note, perceived 'simplicity' may differ between individuals) **[substantial impact]**.
Motivation: *Beliefs about consequences*	Concerns about COVID-19 vaccine safety (*k*=47)	Reassure and be transparent about vaccine risks using trusted sources and communication modalities that leverage risk communication tools and approaches that go beyond numerical risk and benefit data. This information should be communicated in plain language (and in multiple languages) and in multiple formats to maximise reach.
	Concerns about COVID-19 vaccine development (*k*=7)	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 (as above - same plain language, multiple language, multiple formats considerations apply).
	Concerns about COVID-19 vaccine efficacy (*k*=16)	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 effect, hospitalization and/or death (as above - same plain language, multiple language, multiple formats considerations apply).

	Concerns about COVID-19 vaccine necessity (*k*=12)	Reassure the need for vaccines, emphasizing the protection of one's self and others to build towards community immunity.
	Concerns about adverse reactions (specifically contraindications among patients, e.g., patients with rheumatologic diseases) (*k*=5)	Reassure and be transparent about disease/treatment-specific vaccine risks using trusted sources and communication modalities. Ensure that applicable disease/treatment-specific guidance is readily available for patients, medical professionals, and others alike.
ENABLERS		
Opportunity: *Environmental context and resources*	Having access to and trust in reputable information sources (*k*=18)	Identify and make available reputable and trustworthy sources of information sources more accessible to help counter misinformation about COVID-19 vaccines. Consider campaigns displayed through social media platforms in different formats to counter misinformation.
Opportunity: *Social influences*	Advice from medical professionals encouraging vaccination (*k*=9)	Continue to leverage the medical community to champion vaccination and ensure availability and support for them to address the needs of their patients. It might be important for medical professionals with whom equity-seeking groups can identify with to provide such advice/support [**substantial impact**].
Motivation: *Beliefs about consequences*	Concerns about becoming infected with COVID-19 (*k*=32)	Reiterate the seriousness of being infected by COVID-19 and potential longer-term consequences (e.g., 'long-covid'), although care must be taken among those that experiencing high/persistent stress/anxiety which may have implications for mental health and wellbeing.

	Positive attitudes/high perceived benefit of COVID-19 vaccines (*k*=19)	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, activities important to younger populations such as attending concerts, in-person schooling, team sports etc.).
	Belief that COVID-19 vaccines will help protect family (*k*=6)	Leverage the prosocial nature of vaccination which will help protect others. This may involve engaging with family-oriented cultures/communities and multi-generational households to encourage vaccination.
Motivation: *Social/professional role and identity*	Certain political preferences/identities (*k*=6)	Aim to prevent Canada's ongoing COVID-19 vaccination program being used as a political tool which may alienate certain individuals/groups.
	When getting vaccinated seen as a professional or collective/prosocial responsibility (*k*=4)	Instill the notion of vaccination as a professional and social responsibility; normalize such behaviour **[substantial impact]**.
Motivation: *Emotion*	Fear about being infected with COVID-19 and its impact (*k*=3)	Whilst being careful not to stoke fear, reiterate the seriousness of COVID-19 and its societal consequences (e.g., lockdowns). However, be mindful that there are some who can't get vaccinated or who are susceptible to infection that may experience high/persistent fear/anxiety about catching COVID-19, who may require additional supports.
	Psychological distress symptoms (stress, depression, anxiety) may	Acknowledge that some psychological disorder-thinking (stress, depression, anxiety) may influence personal protective behaviours such as

	favor COVID-19 vaccine acceptance (*k*=7)	vaccination (although there must be caution with this). Focus on reassuring people (across a range of formats) of the benefits of vaccination and benefits of engaging in other protective measures.
Motivation: *Reinforcement*	Historical seasonal influenza vaccination (*k*=31)	Leverage successful interventions to increase seasonal influenza vaccination which may be applicable to COVID-19; consider incentivizing vaccination **[substantial impact]**.
	Members of families/close social network having being infected with COVID-19 (*k*=4)	Emphasis messaging around vaccination protecting others, potentially drawing upon the personal stories of others.

Future directions for research in this area

Although some behavioural domains did not yet emerge as factors associated with COVID-19 vaccine acceptance in the general public, there may be opportunity for considering a greater breath of possible barriers and enablers which could be guided by frameworks such as the TDF. Domains from the TDF that did not emerge to date as factors associated with COVID-19 vaccine acceptance among the general public include: Skills; Behavioural regulation; Memory/attention; and Beliefs about capabilities. It may be that other methods of data collection (e.g., qualitative methods) may be better suited to elucidate the range of potential barriers and enablers to vaccination acceptance and uptake. To date, we have only identified two qualitative studies exploring drivers of COVID-19 vaccination acceptance and uptake in the general public [106,174], therefore, further qualitative research is needed.

Now that COVID-19 vaccines have been taken up by a majority of Canadians, there is a clear need for more Canadian research to help understand the factors associated with vaccination acceptance and uptake in the general public and in particular those from equity-seeking groups to help better inform how best to support greater vaccination in those remaining to get vaccinated. There may also be an opportunity to focus efforts on certain age groups such as teenagers/young people to ensure they are adequately encouraged and supported to get vaccinated. It is encouraging that the current version of this review (version 5) captured two Canadian studies (albeit one by a non-academic market research group [28]) which reported lower vaccine acceptance rates among Indigenous peoples [23] and identified some key barriers and enablers to vaccination among Black Canadians which included access/support, mistrust, and risk perceptions [28]. Assessing barriers and enablers to vaccine acceptance that racialized groups experience may provide valuable insights into factors driving observed disparities, especially when considered alongside the COM-B related barriers/enablers that each racialized group experience to better support each group.

There was some evidence indicating that knowledge was associated with vaccination acceptance among the general public. 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. Whilst knowledge is undoubtedly important, it is usually insufficient as a stand-alone strategy, therefore, additional evidence-based, modifiable barriers must also be considered (cf. recent brief from the Ontario COVID-19 Science Advisory Table [188]). This point is further highlighted by the fact that Opportunity factors – which are deemed to lie outside the individual – have been shown to be important determinants of vaccination acceptance/uptake. As such, key infrastructure, supports, and

resources need to be in place to support individuals to enact their intentions now that vaccines continue to be steadily rolled out across Canada.

Future directions for this LBSES

Given that COVID-19 vaccines have been rolling out since Dec 2020, we expect to continue to see more research investigating drivers of actual uptake, in addition to vaccination acceptance. From a behavioural science perspective, this will provide an opportunity to assess whether the same factors associated with vaccine acceptance (intention) are also associated with actual vaccination uptake (behaviour) and whether vaccine intention predicts behaviour. Evidence from other behavioural literatures suggests a gap between intention and action and measures 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 vaccination [188]. From an equity-seeking group perspective, future versions of this LBSES will continue to assess what is driving observed differences in vaccination acceptance and uptake. In particular, we will attempt to identify additional Canadian studies from the grey literature, as per the recent rapid review from National Collaborating Centre for Methods and Tools. Moreover, we will connect with Canadian researchers who are spearheading the important work of nuancing observed differences to vaccine acceptance to better account for how the lived experiences of equity-seeking groups may impact barriers and enablers to vaccine acceptance.

Future planned LBSES

- Identify **alignment and gaps** between experienced barriers/enablers and currently tested strategies for certain equity-seeking groups.

Funding statement

To help health- and social-system leaders as they respond to unprecedented challenges related to the COVID-19 pandemic, the Ottawa Hospital Research Institute is preparing living evidence profiles like this one. This living review is funded by the Public Health Agency of Canada. The opinions, results, and conclusions are those of the Ottawa Hospital Research Institute and are independent of the funder. No endorsement by the Public Health Agency of Canada is intended or should be inferred.

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Citation

Crawshaw, J., Konnyu, K., Castillo, G., van Allen, Z., Smith, M., Trehan, N., Gauvin, F.P., Grimshaw, JM., Presseau, J. Factors affecting COVID-19 vaccination acceptance and uptake among the general public: a living behavioural science evidence synthesis (v5, Aug 31st, 2021). Ottawa: Ottawa Hospital Research Institute, Aug 31, 2021.

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Appendices

Appendix 1. Data abstraction form templates

Study characteristics	Behaviour specs	Key findings/themes by COM-B and TDF do	
Author:	Action(s):	Capability	
Year:	Actor(s):		Knowledge:
URL:	Context(s):		Skills:
Design:	Target:		Behaviour regulation:
Publication status:	Time:		Memory/attention:
Countries/provinces:			Decision making:
Data collection date range:		Opportunity	
			Environmental context & resources:
			Social influences:
		Motivation	
			Intention (capture % intention/hesitant/confident where available)
			Goals:
			Social/professional role/identity:
			Beliefs about capabilities:
			Beliefs about consequences:
			Optimism:
			Reinforcement:
			Emotions:
		Other	Specify:
		%/Mean vaccine intention and/or hesitancy	

Equity seeking groups	TDF/COM-B Key findings/themes					
Race/ethnicity/indigeneity groups included:	Group A:		Group B:		Group C:	
	Capability		Capability		Capability	
		Knowledge:		Knowledge:		Knowledge:
		Skills:		Skills:		Skills:
		Behaviour regulation:		Behaviour regulation:		Behaviour regulation:
		Memory/attention:		Memory/attention:		Memory/attention:
		Decision making:		Decision making:		Decision making:
	Opportunity		Opportunity		Opportunity	
		Environmental context & resources:		Environmental context & resources:		Environmental context & resources:
		Social influences:		Social influences:		Social influences:
	Motivation		Motivation		Motivation	
		Intention (capture % intention/hesitant/confident where available)		Intention (capture % intention/hesitant/confident where available)		Intention (capture % intention/hesitant/confident where available)
Other notes:		Goals:		Goals:		Goals:
		Social/professional role/identity:		Social/professional role/identity:		Social/professional role/identity:
		Beliefs about capabilities:		Beliefs about capabilities:		Beliefs about capabilities:
		Beliefs about consequences:		Beliefs about consequences:		Beliefs about consequences:
		Optimism:		Optimism:		Optimism:
		Reinforcement:		Reinforcement:		Reinforcement:
		Emotions:		Emotions:		Emotions:
	Other	Specify:	Other	Specify:	Other	Specify:
	%/Mean vaccine intention and/or hesitancy		%/Mean vaccine intention and/or hesitancy		%/Mean vaccine intention and/or hesitancy	

Appendix 2. Evidence of COVID-19 vaccination acceptance and uptake among the general public (*k*=175)

Study author	Publication status	Country	Design	Sample	Sample size	Data collection period	Mean % vaccine acceptance [actual uptake, if assessed]
North American studies (*k*=73), listed in order of review updates							
Neely et al.	Published	USA	CS	General public	1,003	Jan 9-21, 2021	59%
Serper et al.	Published	USA	CS	Patients with gastroenterology and liver diseases	1,215	Dec 13-23, 2020	85%
Theis et al.	Published	USA	CS	General public (military base personnel)	816	Nov, 2020 - Jan, 2021	77%
Razzaghi et al.	Published	USA	CS	General public (pregnant women)	135,968	Dec 14, 2020 - May 8, 2021	[16%]
Baack et al.	Published	USA	CS	General public	2,726	Mar - May, 2021	52% (reported that they had been vaccinated or were definitely intending to get vaccinated) including [34%] (who had already received a COVID-19 vaccine)
Bogart et al.	Published	USA	CS	General public (Black and African American adults)	207	Nov - Dec, 2020	40%
Pennycook et al. *	Published	USA data only	CS	General public	1,338	Mar - Dec, 2020	NR
Szilagyi et al.	Published	USA	CS	General public	5,891	Feb 17 - Mar 16, 2021	66%

Xiang et al.	Published	USA	CS	General public (patients with multiple sclerosis)	401	Dec 1, 2020 - Jan 7, 2021	70%
Racey et al.	Published	British Columbia, Canada	CS	General public (public school teachers)	5,076	Aug 20 - Nov 3, 2020	90%
Muhajarine et al.	Preprint	Saskatchewan, Canada	CS	General public	7,265	May 4, 2020 - Apr 3, 2021	76%
Dubé et al.	Published	Quebec, Canada	CS	General public	3,300	Apr - Dec, 2020	73%
Angus Reid IV	Unpublished dataset	Canada	LT	General public	2,040	Jul, 2021	86%
INSPQ II	Unpublished dataset	Canada	LT	General public	~3,300	Jul, 2021	91%
Statistics Canada III	Unpublished dataset	Canada	LT	General public	10,678	Mar - May, 2021	95% [45%]
Innovative Research Group	Unpublished dataset	Canada	CS	General public	2,838	May - Jun, 2021	79% [60%]
Berenson et al.	Published	USA	CS	General public (reproductive-aged women)	342	Nov 17 - Dec 19, 2020	34%
Luo et al.	Published	USA	CS	General public (Medicare beneficiaries)	6,715	Oct - Nov, 2020	61%
Niño et al.	Published	USA	LT	General public	5,023 (across 9 waves)	Apr, 2020 - Jan, 2021	% NR (reported prediction probabilities)
Silva et al.	Published	USA	CS	General public (university students)	237	Nov, 2020	92%

Sutton et al.	Published	USA	CS	General public (pregnant, breastfeeding, and non-pregnant reproductive-aged women)	1,012	Jan 7-29, 2021	Non-pregnant respondents (76%) Breastfeeding respondents 55%) Pregnant respondents (44%)
Thompson et al.	Published	USA	CS	General public	1,835	Jun - Dec, 2020	52%
Afifi et al.	Published	Manitoba, Canada	CS	Genera public (older adolescents/young adults, 16-21 years)	664	Nov - Dec, 2020	65%
Government of Manitoba	Unpublished dataset	Manitoba, Canada	CS	General public	600	May 14-20, 2021	87%
Angus Reid III	Unpublished dataset	Canada	LT	General public	4,948	Jun, 2021	[84%]
Leger II	Unpublished dataset	Canada	LT	General public	1,542	Jun, 2021	88%
Garcia et al.	Published	USA	CS	General public (patients on dialysis)	1,515	Jan 8 - Feb 11, 2021	80%
Kecojevic et al.	Published	USA	CS	General public (university students)	457	Feb - Mar, 2021	53% [23%]
Killgore et al.	Published	USA	CS	General public	1,017	Dec 10-15, 2020	55%
Milan et al.	Published	USA	CS	General public (mothers with mood disorders)	240	Dec, 2020	60% (PTSD); 76% (other mood disorders)
Sharma et al.	Published	USA	CS	General public (university students)	282	Feb – Mar, 2021	53%
Whiteman et al.	Published	USA	CS	General public (aged >65 years)	42,736,710	Dec 14, 2020 - Apr 10, 2021	[79%]

Yang et al.	Published	USA	CS	General public (tobacco or marijuana users)	387	Dec, 2020 - Jan, 2021	49%
Carmody et al.	Published	USA	CS	General public (Orthodox Jewish Community)	102	Dec 7, 2020 - Jan 20, 2021	12%
Latkin et al.	Published	USA	CS	General public	585	Nov, 2020	22%
Levy et al.	Published	USA	CS	General public (pregnant women)	590	Dec 14, 2020 - Jan 14, 2021	58%
King et al.	Preprint	USA	LT	HCWs + General public	Jan survey: n= 791,716 Feb survey: n= 710,529 Mar survey: n= 732,308	Jan 6 - Mar 31, 2021	78% [78%]
McCabe et al.	Preprint	USA	CS	HCWs + General public	34,470	Dec 4, 2020 - Feb 9, 2021	81%
Tang et al.	Preprint	Canada	CS	General public	14,621	Jan - Feb, 2021	91%
Syan et al.	Preprint	Canada	CS	General public	1,001	Jan 15 - Feb 15, 2021	83%
McKinnon et al.	Preprint	Canada	CS	General public (parents)	380	Jan - Apr, 2021	61% willing to vaccinate child
Angus Reid I	Unpublished dataset	Canada	LT	General public	1,319	May, 2021	82%
Statistics Canada I	Unpublished dataset	Canada	LT	General public	25,321,400	Jan - Feb, 2021	82%
Leger I	Unpublished dataset	Canada & USA	LT	General public	1,624 (Can only)	May, 2021	86%

Impact Canada	Unpublished dataset	Canada	LT	General public	2,037	Feb, 2021	83%
INSPQ I	Unpublished dataset	Canada	LT	General public	~3,300	May, 2021	74%
Engage Manitoba	Unpublished dataset	Canada	LT	General public	33,904	Jun 4-8, 2021	88% [86%]
Statistics Canada II	Unpublished dataset	Canada	LT	General public	1,025	Mar - Apr, 2021	80% [80%]
Angus Reid II	Unpublished dataset	Canada	CS	General public	1,601	May, 2021	60% [55%]
Nguyen II et al.* [61]	Preprint	USA data only	Cohort	General public	87,388	Mar 24, 2020 - Feb 16, 2021	91%
Iadarola et al. [62]	Preprint	USA	CS	People with intellectual and developmental disabilities	825	Jan 19 - Feb 9, 2021	62% [14%]
Lunsky et al. [63]	Published	Canada	CS	Workers supporting adults with intellectual disabilities	3,371	Jan 21 - Feb 3, 2021	62%
Ricotta et al. [64]	Preprint	USA	CS	Patients with chronic respiratory or autoimmune disease, and health control sample	2,535	Feb, 2021	NR
Daly et al. [65]	Preprint	USA	LT	General public	7,840	Oct, 2020 - Feb, 2021	61%

Dalal et al. [66]	Published	USA	CS	Inflammatory bowel disease patients	906	Dec 22, 2020 - Jan 26, 2021	81%
Grumbach et al. [67]	Published	USA	CS	General public	3,161	Nov 27, 2020 - Jan 15, 2021	66%
Kuhn et al. [68]	Preprint	USA	CS	People experiencing homelessness	90	Dec, 2020 - Jan, 2021	52%
Benis et al. [69]	Published	USA	CS	General public (social media users)	1,644	Dec 10-24, 2020	NR
Piltch-Loeb et al. [70]	Preprint	USA	CS	People from vaccine priority group (inc. HCWs)	2,650	Dec 13-23, 2020	40%
Savoia et al. [71]	Preprint	USA	CS	General public	2,650	Dec 13-23, 2020	40%
Teixeira da Silva et al. [72]	Published	USA	CS	People from sexual and gender minority backgrounds	1,350	Oct 19 - Dec 16, 2020	NR (1-10 scale, mean=7, SD= 3.1
Kaplan & Milstein [73]	Published	USA	Exp	General public	1,000 (Aug) & 1,000 (Dec)	Aug 20-27 & Dec 16-22, 2020	NR
Doherty et al. [74]	Preprint	USA	CS	General public (underserved rural and urban communities)	948	Aug 27 - Dec 15, 2020	69%
Stern et al. [75]	Published	USA	CS	Incarcerated or detained residents	5,110	Sep 22 - Dec 12, 2020	45%
Park et al. [76]	Published	USA	CS	General public (Asian Americans and Pacific Islanders specifically)	1,646	Oct 24 - Dec 11, 2020	44%

Szilagyi et al. [77]	Published	USA	CS	General public	8,167 total (5,660 from Nov-Dec 2020 sample)	Apr 1 - Dec 8, 2020	Apr: 74% & Dec: 56%
Salmon et al. [78]	Published	USA	CS	General public	2,525	Nov 25 - Dec 7, 2020	50% classified as 'intenders'
Nguyen I et al. [79]	Published	USA	CS	General public	3,541 (Sep) & 2,033 (Dec)	Sep & Dec, 2020	Sep: 39% & Dec: 49%
Sotiriou et al. [80]	Published	USA	CS	Patients with psoriasis and immunosuppressed patients with other skin conditions	941	Nov 10-25, 2020	Psoriasis group: 80% & other skin condition group: 51%
Nikolovski et al. [81]	Preprint	USA	CS	Clinical trial cohort (age: 65+)	7,621	Nov 6-20, 2020	91%
Graupensperger et al. [82]	Published	USA	CS	General public (university students)	647	Nov 2-13, 2020	92%
Craig [83]	Published	USA	CS	General public	1,153	Nov 9-11, 2020	61%
Dorman et al. [84]	Published	USA	CS	General public	26,324	Oct - Nov, 2020	NR (most of the groups had mean scores between 4 (neutral) and 5 (slightly agree)

Study author	Publication status	Country	Design	Sample	Sample size	Data collection period	Mean % vaccine acceptance [actual uptake, if assessed]
International studies (*k*=104), listed in order of recency of data collection							
Ahmed et al.	Published	Somalia	CS	General public	4,543	Dec, 2020 - Jan, 2021	77%
Aloweidi et al.	Published	Jordan	CS	HCWs + General public	646 (287 from medical field and 359 from non-medical field)	Jan 22 - Feb 28, 2021	35%
Fedele et al.	Published	Italy	CS	General public (parents)	1,590	Nov 14-28, 2020	27%
Guaraldi et al.	Published	Italy	CS	Patients with type 2 diabetes	1,176	Jan 1-28, 2021	86%
Syed Alwi et al.	Published	Malaysia	CS	General public	1,411	Dec 23-29, 2020	83%
Zewude & Habtegiorgis	Published	Ethiopia	CS	General public	319	Mar, 2021	46%
Abu-Farha et al.	Published	Multiple (Arab states)	CS	General public	2,925	Dec, 2020	25%
Kadoya et al.	Published	Japan	CS	General public	4,253	Feb, 2021	47%
Lindholt et al	Published	Multiple	CS	General public	18,231	Sep, 2020 - Feb, 2021	47-83% (mean % = 61%)
Mose & Yeshaneh	Published	Ethiopia	CS	General public (pregnant women)	396	Jan 1-30, 2021	71%
Villarreal-Garza et al.	Published	Mexico	CS	General public (women with breast cancer)	540	Mar 12-26, 2021	66%
Abebe et al.	Published	Ethiopia	CS	General public	492	Mar 1-15, 2021	63%

Fan et al.	Published	China	CS	General public (university students)	3,145	Jan, 2021	% NR (but 5.3 on 1-7 scale)
Handebo et al.	Published	Ethiopia	CS	General public (school teachers)	301	Dec, 2020 - Jan, 2021	55%
Karabela et al.	Published	Turkey	CS	General public	1,216	Feb 1-18, 2021	54%
Pennycook et al. *	Published	UK data only	CS	General public	1,338	Mar - Dec, 2020	NR
Xu et al.	Published	China	CS	General public (parents)	4,748	Dec 18-31, 2020	75%
Alobaidi et al.	Published	Saudi Arabia	CS	General public	1333	Jan 6-19, 2021	72%
Babicki et al.	Published	Poland	LT	General public	2,048	Dec & Mar, 2021	52% (among those that had not yet been vaccinated) [27%]
Belsti et al.	Published	Ethiopia	CS	General public	1,184	Feb - Mar, 2021	32%
Bono et al.	Published	Multiple (LMICs)	CS	General public	10,183	Dec 10, 2020 - Feb 9, 2021	76%
Costantino et al.	Published	Italy	CS	General public (patients with celiac disease)	103	Feb 22-26, 2021	75%
Crispino et al.	Published	Italy	CS	General public (patients with inflammatory bowel disease)	276	Apr 5-15, 2021	54% [40%]
Deal et al.	Published	UK	Qual	General public (migrants)	32	Sep, 2020 - Mar 2021	28%
Gibbon et al.	Published	UK	CS	General public (patients in a medium secure psychiatric hospital population)	92	NR (however, reported actual uptake so must have been post-approval)	[80%]

Huynh et al.	Published	Vietnam	CS	General public (patient with a chronic illness)	425	Dec, 2020 - Jan, 2021	84%
Issanov et al.	Published	Kazakhstan	CS	General public	417	Aug - Nov, 2020	64%
Kasrine Al Halabi et al.	Published	Lebanon	CS	General public	579	Nov - Dec, 2020	59%
Lin et al.	Published	Taiwan	CS	General public (inc. HCWs)	Public: 768; HCWs: 279	Oct 15 - Dec 21, 2020	% NR (but 6.5 on a 1-10 scale)
Qunaibi et al.	Preprint	Multiple (Arab states)	CS	General public	36,220	Jan 14-29, 2021	17%
Rodríguez-Blanco et al.	Published	Spain	CS	General public	2,501	Dec, 2020	48%
Wijesinghe et al.	Published	Sri Lanka	CS	General public	895	Jan, 2021	54%
Abedin et al.	Published	Bangladesh	CS	General public	3,646	Dec 12, 2020 - Jan 7, 2021	75%
Allington et al.	Published	UK	CS	General public	4,343	Nov 21 - Dec 21, 2020	NR
Almaghaslah et al.	Published	Saudi Arabia	CS	General public	862	Jan 15 - Feb 7, 2021	20%
Bai et al.	Published	China	CS	General public (university students)	2,881	Dec 27, 2020 - Jan 18, 2021	76%
Bendau et al.	Published	Germany	CS	General public	1,779	Jan 1-11, 2021	65%
Brodziak et al.	Published	Poland	CS	General public (patients with cancer)	635	Jan 26 - Feb 18, 2021	60%
Caron et al.	Published	France	CS	General public (patients with inflammatory bowel disease)	104	Jan 8 - Feb 22, 2021	55%

Felten et al.	Published	Multiple (Global)	CS	General public (patients with autoimmune and inflammatory diseases)	1,258	Dec 12-21, 2020	Suspicious cluster (16%); Hesitant cluster (65%); Voluntary cluster (97%)
Gehrau et al.	Published	Germany	CS	General public	629	Nov 23 - Dec 7, 2020	NR
Goncu Ayhan et al.	Published	Turkey	CS	General public	300	Jan 1 - Feb 1, 2021	37%
Hammer et al.	Published	Finland	LT	General public	1,059	Nov 27 - Dec 1, 2020	64%
İkiışık et al.	Published	Turkey	CS	General public	384	Dec 25-30, 2020	55%
Kabir et al.	Published	Bangladesh	CS	General public	697	Jan, 2021	69%
Mohan et al.	Published	Multiple (Qatar + Asian countries)	CS	General public (perinatal women)	341	Oct 15 - Nov 15, 2020	49%
Nazlı et al.	Published	Turkey	CS	General public	467	Mar - Apr, 2021	85%
Puteikis et al.	Published	Lithuania	CS	General public (people with epilepsy + caregivers)	58	Dec, 2020	47%
Reno et al.	Published	Italy	CS	General public	1,011	Jan 19-26, 2021	69%
Sønderskov et al.	Published	Denmark	CS	General public	1,491	Feb 4-24, 2021	89%
Schernhammer et al.	Published	Austria	CS	General public	1,007	Nov, 2020 – Feb, 2021	36%
Segal et al.	Published	Israel	RS	General public (military personnel)	18,719	Dec, 2020 – Feb, 2021	[85%]
Siewe Fodjo et al.	published	Multiple (26 countries)	CS	General public (Patients with HIV)	247	Jul - Nov, 2020	76%

Tao et al.	published	China	CS	General public (pregnant women in China)	1,392	Nov 13-17, 2020	77%
Wang et al.	published	China	CS	General public	8,742	Jan10-22, 2021	67%
Wang et al.	published	China	CS	General public (university students)	3,145	Jan 5-16, 2021	NR
Geoghegan et al.	published	Ireland	CS	General public (pregnant women)	300	Dec, 2020	38%
Kumari et al.	published	India	CS	General public	1,294	Mar 13-25, 2021	84%
Yılmaz et al.	published	Turkey	CS	General public (parents)	1,035	Feb 8-21, 2021	60% themselves; 36% to vaccinate children
Al-Metwali et al.	Published	Iraq	CS	HCWs + General public	1,680	Dec 1-19, 2020	62%
Elhadi et al.	Published	Libya	CS	HCWs + General public	15,087	Dec 1-18, 2020	70%
Sprengholz et al. [144]	Published	Germany	Exp	General public	1,012	Feb 23-24, 2021	72%
Nguyen II et al.* [61]	Preprint	UK data only	Cohort	General public	1,254,294	Mar 24, 2020 - Feb 16, 2021	95%
Urrunaga-Pastor et al. [145]	Published	Multiple (200+ countries)	CS	General public (Latin American and Caribbean respondents)	472,521	Jan 15 - Feb 1, 2021	80%
Malesza & Bozym [146]	Preprint	Poland	CS	General public (age: 70+)	1,427	Jan - Feb, 2021	[63%]
Argote et al. [147]	Preprint	Multiple (Latin America)	Exp	General public	13,189	11-29 Jan, 2021	59%

Machida et al. [148]	Published	Japan	SC	General public	2,956	Jan 14-28, 2021	62%
Khaled et al. [149]	Preprint	Qatar	CS	General public	1,038	Dec 15, 2020 - Jan 25, 2021	43%
Sallam et al. [150]	Published	Jordan	CS	General public (university students)	1,106	Jan 19-23, 2021	35%
Malesza & Wittmann [151]	Published	Germany	CS	General public (age: 75+)	1,084	Jan 4-17, 2021	57% [21%]
Yurttas et al. [152]	Published	Turkey	CS	General public (inc. rheumatology patients & HCWs)	732	Jan 4-13, 2021	29% - 53% (median=39%)
Soares et al. [153]	Published	Portugal	CS	Gen public	1,943	Sep 29, 2020 - Jan 8, 2021	35%
Serrazina et al. [154]	Published	Portugal	CS	Patients with multiple sclerosis	256	Dec 21, 2020 - Jan 3, 2021	81%
Carbone et al. [155]	Preprint	Italy	CS	Pregnant people	142	Jan, 2021	28%
Radic et al. [156]	Published	Global	CS	International travelers	1,221	Dec, 2020 - Jan, 2021	NR
Arce et al. [157]	Preprint	Multiple (mainly LMICs)	CS	General public	45,928	Jun, 2020 – Jan, 2021	30% - 97% (median=78%)
Vallée et al. [158]	Published	France	CS	Patients with HIV	237	Jan, 2021	71%
Biasio et al. [159]	Published	Italy	CS	General public	885 (Jun, 2020); 160 (Jan, 2021)	Jun, 2020 & Jan, 2021	91%
Kukreti et al. [160]	Published	Taiwan	CS	HCW & outpatient samples	500 (HCWs); 238 (patients)	Sep 24 - Dec 31, 2020	31%

Iheanacho et al. [161]	Preprint	Nigeria	CS	General public	410	Nov 20 - Dec 28, 2020	57%
Mappa et al. [162]	Published	Italy	CS	Pregnant people	161	Dec 27, 2020	53%
Petravić et al. [163]	Published	Slovenia	CS	Gen public (inc. HCWs)	12,042	Dec 17-27, 2020	59%
Sallam et al. [164]	Published	Multiple (Arab states)	CS	General public	3,414	Dec 14-18, 2020	29%
Wouters et al. [165]	Published	Multiple (Global)	CS	General public	26,758	Oct 21 - Dec 16, 2020	38% - 98% (median=73%)
Alfageeh et al. [166]	Published	Saudi Arabia	CS	General public	2,137	Dec 8-14, 2020	48%
Campochiaro et al. [167]	Published	Italy	CS	Rheumatology and oncology patients	202 rheum & 68 oncology	Nov 23 - Dec 10, 2020	82%
Dickerson et al. [168]	Preprint	UK	CS (inc. Qual data)	General public	535	Oct 9 - Dec 9, 2020	29%
Robertson et al. [169]	Preprint	UK	CS	General public (part of an ongoing study)	12,035	Nov 24 - Dec 1, 2020	82%
Beesley et al. [170]	Published	Multiple (Europe)	CS (inc. Qual data)	Rheumatology patients	1,505 adult & 140 paediatric	Dec, 2020	Adult: 87% & paediatric: 66%
Samarasekera et al. [171]	Published	Multiple (Africa)	CS	General public	>15,000	Aug - Dec, 2020	59% - 94% (median=79%)
Wang et al. [172]	Published	China	Cohort	General public	2,058 in Mar; 2,013 in Dec; 791 longitudinal	Mar & Dec, 2020	23%

Di Giuseppe et al. [173]	Published	Italy	CS	General public (university students)	1,518	Sep 14 - Nov 30, 2020	84%
Knights et al. [174]	Published	UK	Qual	General public (migrants, inc. HCWs)	81	Jun 18 - Nov 30, 2020	NR
Mo et al. [175]	Published	China	CS	General public (university students)	6,922	Nov 1-28, 2020	79%
Cordina et al. [176]	Published	Malta	CS	General public	3,363	Oct 26 - Nov 26, 2020	50%
Eguia et al. [177]	Published	Spain	CS	General public (inc. HCWs)	731	Sep 10 - Nov 23, 2020	78%
Han et al. [178]	Preprint	China	CS	General public (migrants)	2,126	Nov 1-20, 2020	89%
Skjefte et al. [179]	Published	Multiple (Global)	CS	Pregnant people & non-pregnant mothers	17,871	Oct 28 - Nov 18, 2020	69%
Alabdulla et al. [180]	Published	Qatar	CS	General public (inc. HCWs)	7,821	Oct 15 - Nov 15, 2020	60%
Gan et al. [181]	Published	China	CS	General public	1,009	Oct 23 - Nov 10, 2020	60%
Tran et al. [182]	Published	Russia	CS	General public	876	Sep 26 - Nov 9, 2020	42%
Zampetakis & Melas [183]	Published	Greece	Exp	General public	1,006	Oct 1 - Nov, 5 2020	NR
El-Elimat et al. [184]	Preprint	Jordan	CS	General public	3,100	Nov, 2020	37%

Gautam et al. [185]	Preprint	India	CS	General public	1,078	Oct – Nov, 2020	77%

Table 1 notes: COM-B model = Capability, Opportunity, and Motivation-Behaviour model; CS = cross-sectional survey; Exp = Experimental study design; HCW = healthcare worker, LMIC = low and middle income country; LT = longitudinal study; N/A = studies that did not capture these factors; NR = not reported; Qual = qualitative; TDF = Theoretical Domains Framework; * = Nguyen II et al. and Pennycook et al. collected both USA and UK data so included in both North America and International sections; RS = Retrospective study; Unpublished dataset = mainly primary market research and opinion polls, Government surveys

Appendix 3. Capability-related factors associated with COVID-19 vaccination acceptance and uptake

TDF Domain (Definition)
Knowledge (What do HCW know & how does that influence what they do? Do they have the procedural knowledge (know how to do it)?)
Vaccination acceptance • *k*=22 → **BARRIER:** Insufficient knowledge/education/understanding about COVID-19 and COVID-19 vaccines [22,35,59,61,66,75,94,103,104,106,108,111,131,136,140,154,168,170,174,180,181,187]   ○ **Equity-seeking group data** → Frequency comparisons suggest Black, Latinx, and South Asian respondents cited lack of knowledge at higher rates than White respondents [61]. Among incarcerated/detained residents, a common reason reported for COVID-19 vaccine hesitancy was waiting for more information [75] ***Vaccination uptake*** • No studies yet identified linking knowledge directly to vaccination uptake data

Appendix 4. Opportunity-related factors associated with COVID-19 vaccination acceptance and uptake

TDF Domain (Definition)
Environmental context and resources (What in HCWs environment influence what they do and how do they influence?)
Vaccination acceptance • *k*=6 → **BARRIER:** Access issues in terms of time, convenience, and cost [46,63,106,125,127,172] • *k*=18 → **ENABLER:** Access to and trust in reputable scientific/non-scientific information sources about COVID-19 and COVID-19 vaccines (e.g., cues to action) [13,22,26,70,86,87,97,98,100,106,108,116,123,142,150,151,156,175] ***Vaccination uptake*** • *k*=1 → **BARRIER:** Access issues in terms of time, convenience, and cost [27] • *k*=1 → **ENABLER:** Access to and trust in reputable scientific/non-scientific information sources about COVID-19 and COVID-19 vaccines (e.g., cues to action) [26]
TDF Domain (Definition)
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?)
Vaccination acceptance • *k*=29 → **BARRIER:** State/government/public health agency/media mistrust [45,49,51,62,67,70,72,74,75,78,79,90,93,95,106,109,115,132,141,145,153,163,164,168,174,179,180,182,184] ○ **Equity-seeking group data** → Black respondents reported great levels of mistrust compared to White respondents [62,67,74]. Among incarcerated/detained residents who would refuse a COVID-19 vaccination, 20% cited distrust of health care, correctional, or governmental personnel or institutions [75]. Among individuals from sexual and gender minority backgrounds, medical

mistrust was associated with lower COVID-19 vaccination acceptance [72]

- *k*=9 → **BARRIER:** Influence of social contacts, family members, peers, co-workers, and political figures in relation to COVID-19 vaccination acceptance (social norms) [18,50,63,73,82,127,142,145,175]
- *k*=4 → **BARRIER:** Direct advice from medical professionals about vaccination [139,140,167,170]
- *k*=9 → **ENABLER:** Advice from medical professionals encouraging vaccination [32,81,99,105,136,145,146,172,176]

Vaccination uptake

- *k*=1 → **BARRIER:** State/government/public health agency/media mistrust
    - **Equity-seeking group data** →Study of Black Canadians found that mistrust in healthcare providers and vaccine makers negatively impacted vaccine acceptance and uptake [28]
- *k*=1 → **ENABLER:** Positive influences of social contacts, family members, peers/colleagues, and political figures in relation to COVID-19 vaccination [43]

Appendix 5. Motivation-related factors associated with COVID-19 vaccination acceptance and uptake

TDF Domain (Definition)
Beliefs about consequence (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?)

Vaccination acceptance
• *k*=47 → **BARRIER:** Concerns about vaccine safety (e.g., side-effects) [15,17,18,20,35,36,42,50,51,55,59,63,66,73,76,78–80,84,86,89,100,121,122,124,125,127,128,130–132,136,138,139,149,157–159,164,169,171,174,177–179,182,184]
• *k*=16 → **BARRIER:** Beliefs about vaccine efficacy and in particular efficacy against COVID-19 variants of concern [15,50,67,86,117,118,121,131,138,148,151,172,173,175,178,181]
  ○ **Equity-seeking group data** → Black and Asian respondents twice as likely to express doubts in vaccine efficacy than White respondents [67]
• *k*=12 → **BARRIER:** Beliefs that vaccine not necessary (e.g., feel in good health, already protected) [49,63,78,81,145,153,162,168,169,176,180,182]
• *k*=7 → **BARRIER:** Concerns about rushed vaccine development [50,63,67,140,153,168,180]
  ○ **Equity-seeking group data** → Black, Latinx and Asian respondents reported greater concern about rushed approval process than White respondents [67]
• *k*=5 → **BARRIER:** Concern about adverse reactions (specifically contraindications among patients) [64,88,95,167,170]
• *k*=32 → **ENABLER:** Concerns about being infected by COVID-19 (e.g., perceived susceptibility to COVID-19 and its severity) [21–24,26,29,30,35,44,69–71,86,91,93,97,100,103,111,114,116,118,125–127,129,131,137,161,166,172,183]

○ **Equity-seeking group data** → Study of Black Canadians reported that perception about being high risk for COVID-19 was associated with higher vaccine acceptance/uptake [28]. • *k*=19 → **ENABLER:** Positive attitudes and confidence towards COVID-19 vaccines (e.g., perceived benefit) [27,46,90,96,97,100,102,104,106,110,113,114,116,118,120,130,136,140,142] • *k*=6 → **ENABLER:** Belief that getting vaccinated will protect family/others specifically [63,72,140,145,148,154] ○ **Equity-seeking group data** → Role of altruistic motivation - among people from sexual and gender minority backgrounds, acceptance of a COVID-19 vaccine was positively associated with altruistic motivations [72] ***Vaccination uptake*** • *k*=3 → **BARRIER:** Concerns about vaccine safety (e.g., side-effects) [27,101,107] • *k*=2 → **BARRIER:** Concerns about vaccine efficacy [27,151] • *k*=1 → **BARRIER:** Concerns about rushed vaccine development [101] • *k*=1 → **ENABLER:** Positive attitudes and confidence towards COVID-19 vaccines (e.g., perceived benefit) [27]
TDF Domain (Definition)
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?)
Vaccination acceptance • *k*=6 → **ENABLER:** Certain political preferences/identities [20,44–46,73,133] • *k*=4 → **ENABLER:** When getting vaccinated seen as a professional or collective/prosocial

responsibility [63,69,121,156] ***Vaccination uptake*** • *k*=1 → **ENABLER:** When getting vaccinated seen as a professional or collective/prosocial responsibility [43]
TDF Domain (Definition)
Reinforcement (How have their experiences (good and bad) of doing it in the past influence whether or not they do it? Are there incentives/rewards?)
Vaccination acceptance • *k*=2 → **BARRIER:** Past experience with vaccine-related allergic reactions and refusal [170,172] • *k*=1 → **BARRIER:** Previously tested positive for COVID-19 themselves were more hesitant towards vaccination [71] • *k*=31 → **ENABLER:** Historical seasonal influenza vaccination [14,29,42,48,71,78,83,88,91,95,96,99,105,112,113,120,130,131,139,142,153,154,158,166–168,176,179–181,184] • *k*=4 → **ENABLER:** Members of families/close social network having being infected with COVID-19 [70,90,140,166] • *k*=5 → **ENABLER:** Engaging with COVID-19 infection behaviours (i.e. personal protective behaviour) throughout the pandemic [23,85,94,145,160] • *k*=1 → **ENABLER:** Previous human papillomavirus (HPV) vaccination uptake among women [29] ***Vaccination uptake*** • *k*=1→ **ENABLER:** Historical seasonal influenza vaccination [43]
TDF Domain (Definition)

Emotion How do they feel (affect) about what they do and do those feelings influence what they do?
Vaccination acceptance • *k*=3 → **BARRIER:** Psychological distress (generalized anxiety, post-traumatic stress disorder) was associated with lower vaccine acceptance [22,44,45] • *k*=7 → **ENABLER:** Psychological distress (stress, depression, COVID-19-focused anxiety) was associated with higher vaccine acceptance [48,119,129,139,145,152,153] • *k*=3 → **ENABLER:** Fear about the consequences of contracting COVID-19 [119,136,141] ***Vaccination uptake*** • No studies yet identified linking emotion directly to vaccination uptake data
TDF Domain (Definition)
Goals How important is what they do & does that influence whether or not they do it?
Vaccination acceptance • *k*=1 → **ENABLER:** Matching vaccine preference [144] ***Vaccination uptake*** • No studies yet identified linking goals directly to vaccination uptake data
TDF Domain (Definition)
Optimism How does whether they are optimistic/pessimistic influence what they do?
Vaccination acceptance • *k*=1 → **ENABLER:** Optimism associated with higher acceptance [133] ***Vaccination uptake*** • No studies yet identified linking optimism directly to vaccination uptake data