**Factors affecting COVID-19 vaccination acceptance and uptake among the general public: a living behavioural science evidence synthesis (v1.0, Apr 30th, 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?

| **Table of contents** | **Page #** |
|---|---|

**Key Findings**

- We identified 40 studies that assessed factors associated with vaccination acceptance and/or uptake in the general public in the period since COVID-19 vaccines have been approved (spanning Nov, 2020 - Apr, 2021); only 1 study was conducted in Canada.
- The percentage of individuals willing to accept a COVID-19 vaccine across North American studies (15/40) ranged from 40% to 92% (median=64%, IQR=24%). In the 1 Canadian study identified to date, 62% of respondents were willing to accept vaccination. Thus, while a majority of individuals want to get the COVID-19 vaccine, many would benefit from support in addressing identified barriers to acceptance.
- Based on the Capability, Opportunity, and Motivation-Behaviour (COM-B) model, factors associated with vaccine acceptance focused predominantly on Opportunity and Motivation. Capability factors focused on 'Knowledge'; Opportunity factors identified included 'Environmental context and resources' and 'Social influences', and Motivation factors included 'Beliefs about consequences', 'Social/professional role and identity', 'Reinforcement', and 'Emotion'. These cover 7 of 14 domains of the Theoretical Domains Framework.
- These domains are identical to those identified in our previous report focusing on COVID-19 vaccination acceptance among healthcare workers (HCWs), apart from 'Beliefs about capabilities' which was not captured here.
- Domains that did not emerge to date as factors associated with COVID-19 vaccine acceptance among the general public include: 'Skills'; 'Behavioural regulation'; 'Memory/attention'; 'Goals'; 'Beliefs about capabilities', and 'Optimism'.
- Across studies, concerns and erroneous beliefs about COVID-19 vaccine safety, efficacy, and necessity were common and associated with lower vaccination acceptance.
- Across studies, mistrust of governments and public health agencies was related to lower vaccination acceptance, whereas more proximal social influences such as peer-to-peer/group norms may help encourage vaccination.
- Overall, 10/40 studies assessed whether vaccine acceptance was associated with race and ethnicity. Of these, 9/10 studies suggest that racialized (e.g., Black, Latinx, Asian) respondents are less likely to express vaccine acceptance vs. White respondents.
- Based on data from 4/10 studies, 4 of 14 domains from the Theoretical Domains Framework were associated with COVID-19 vaccine acceptance among racialized

groups: 'Knowledge'; 'Environmental context and resources'; 'Social influences'; and 'Beliefs about consequences'.

- Respondents from some racialized groups (e.g., Black, Latinx) expressed more mistrust than other groups (e.g., White, Asian).
- Concerns about vaccine development were more common among Black, Latinx, and Asian vs. White respondents while concerns over safety were identified across groups.
- There has been a paucity of published Canadian research looking at vaccination acceptance and/or uptake since the approval of COVID-19 vaccines.
- Now that vaccines are being rolled out, 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.

**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 to help curb the spread of COVID-19 which has accounted for an estimated 3.1 million deaths globally, including over 24,000 Canadians (as of April 30th, 2021, cf. Johns Hopkins COVID tracker). High uptake of COVID-19 vaccines is needed to achieve maximum effectiveness within the population and new data is showing the benefit of vaccine uptake to substantially reduce hospitalisations for COVID-19 [1]. However, hesitancy to receive a COVID-19 vaccine remains a major public health concern that may undermine efforts to reduce the continued impact of COVID-19. As such, it is crucial to identify and understand the key factors associated with vaccination acceptance within the general public and in particular individuals among equity-seeking groups (e.g., 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 [2]).

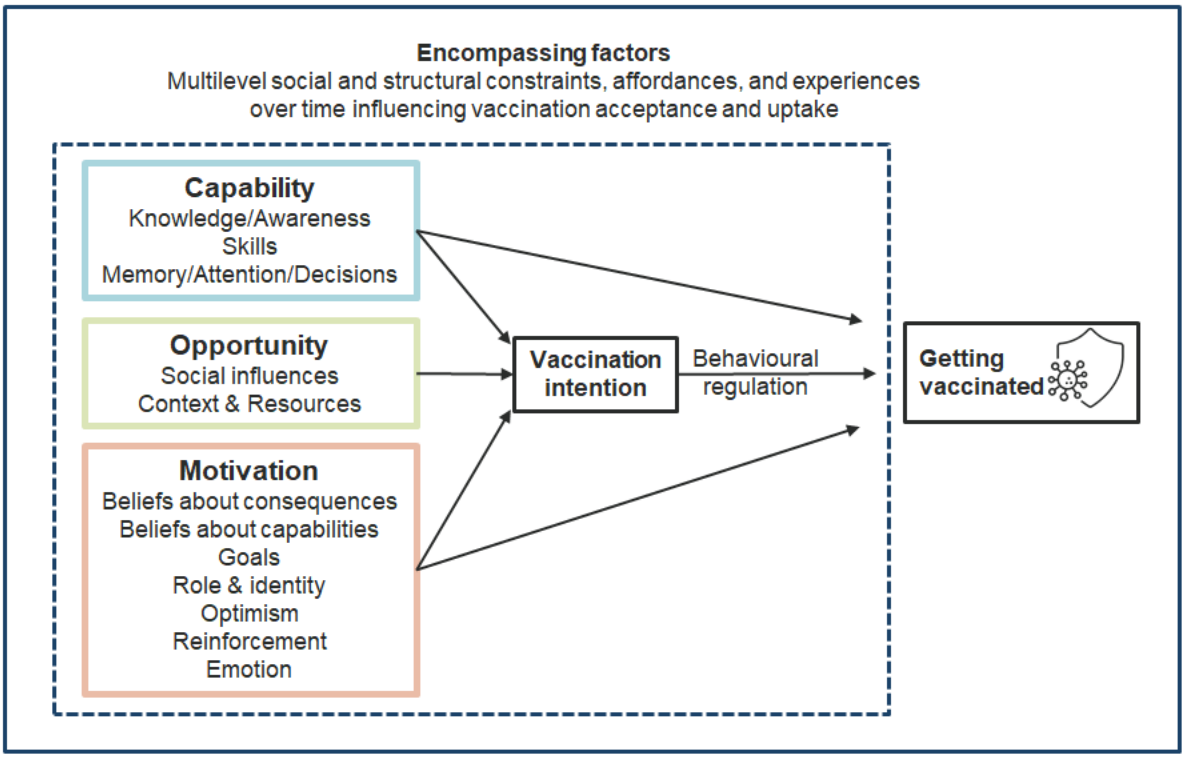
Capability-, Opportunity- and Motivation-related factors of individuals are shaped by the multiple social, cultural, historical, community, governmental, clinical, and environmental levels that influence acceptance and uptake of COVID-19 vaccination. We drew upon the overarching COM-B model to situate 14 key behavioural factors that can drive vaccination intention and uptake (**see 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 [3–5]. 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 [6].

As part of a 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 both globally and in Canada, and in particular those serving equity-seeking groups. We have already conducted version 1 of our LBSES focusing on COVID-19 vaccination acceptance among healthcare workers (HCWs) which can be found here.

**Living Behavioural Science Evidence Synthesis Objectives**

1. Identify rates of vaccination acceptance in the general public globally and in Canada (p15, also see **Table 1**).
2. Identify rates of vaccination uptake in Canada (p15).
3. Identify factors associated with COVID-19 vaccination acceptance and uptake among the general public globally and in Canada (p15, also see **Tables 2-4**).
4. Identify factors associated with COVID-19 vaccination acceptance and uptake among equity-seeking groups (p29, also see **Table 5-8**).

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




## Methods

### Data sources

We used two ongoing evidence syntheses that have been capturing published peer-reviewed papers, preprints, published reports, and unpublished datasets relating to our research question:

- *COVID-19 Living Evidence Profile #1: What is known about anticipated COVID-19 vaccine roll-out elements?* [7] **(most recent search: Apr 9, 2021).**
- *Rapid Evidence Review: What are the barriers and facilitators to individuals' willingness to be vaccinated for COVID-19?* [8] **(most recent search: Apr 20, 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 (spanning Nov, 2020 - Apr, 2021). 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 **Appendix 1** for a list of relevant studies (*k*=102) conducted in the early months (Jan - Oct 2020) of the pandemic which were excluded for this report.

**Data extraction**

The two evidence syntheses were manually searched and cross-referenced for relevant studies. A standardised data extraction form (**see Appendix 2**) 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. The equity-related factors identified in our first review focusing on HCWs suggested that racialized groups may differ in their level of vaccine acceptance. Though the studies reviewed provided limited data, the SafeCare-BC report (an ongoing Canadian dataset) [9] suggests that some racialized groups may have specific concerns regarding COVID-19 vaccines. We, therefore, focused our analysis of equity-related factors to race and ethnicity for this 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.

## Results

### Study characteristics

A total of 40 studies met inclusion criteria and were included [10–49]. **Table 1** provides an overview of the 40 studies. 23 were published peer-reviewers papers and 17 were preprints. All but six studies used cross-sectional survey designs; two cohort studies [36,46], three experimental studies [12,29,49], and one qualitative study [31]. 39/40 studies measured COVID-19 vaccine acceptance; two studies also reported vaccination uptake [27,33].

11 studies collected data on specific groups from the general public: patients with inflammatory bowel disease [17]; people with development disabilities [27]; workers supporting people with intellectual disabilities [32]; patients with psoriasis [44]; patients with a rheumatologic condition [13,14]; patients with cancer [14]; and pregnant people/non-pregnant mothers [15,43]. Two studies recruited migrant samples [26,31] and another study recruited individuals from underserved rural and urban communities [19].

14 studies were conducted exclusively in North America [16,17,19,24,25,27,29,32,35,37,38,42,44,45], one of which was conducted in Canada [32] One large study collected data in both the USA and UK [36]. 18 studies were conducted outside of North America: Qatar [10,30]; Italy [14,15]; UK [18,31,39]; Spain [20]; Jordan [21]; China [22,26,34,46]; India [23]; Nigeria [28]; Poland [33]; Turkey [48]; and Greece [49]. 7 studies collected data from multiple countries in different regions/classifications: Latin America [12]; Europe [13]; Arab states [40]; Africa [41]; Global [43,47], and low-middle income countries [11].

**Table 1. Evidence of COVID-19 vaccination acceptance among the general public**

| Study author | Publication status | Country | Design | Sample | Sample size | Data collection period | Mean % vaccine acceptance *(actual uptake, if assessed)* | COM-B model factors (*TDF domains*) |
|---|---|---|---|---|---|---|---|---|
| **North American studies (*k*=15)** | | | | | | | | |
| Craig [16] | Published | USA | CS | General public | 1,153 | Nov 9-11 2020 | 61% | Motivation (*Reinforcement*) |
| Dalal et al. [17] | Published | USA | CS | Inflammatory bowel disease patients | 906 | Dec 22 - Jan 26 2021 | 81% | Capability (*Knowledge*)<br><br>Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Doherty et al. [19] | Preprint | USA | CS | General public (underserved rural and urban communities) | 948 | Aug 27 - Dec 15 2020 | 69% | Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences*)<br><br>See **Tables 5-8** for equity-related breakdown |
| Graupensperger et al. [24] | Published | USA | CS | General public (university students) | 647 | Nov 2-13 2020 | 92% | Opportunity (*Social influences*) |

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|---|---|---|---|---|---|---|---|---|
| Grumbach et al. [25] | Published | USA | CS | General public | 3,161 | Nov 27 2020 - Jan 15 2021 | 66% | See **Tables 5-8** for equity-related breakdown |
| Iadarola et al. [27] | Preprint | USA | CS | People with intellectual and developmental disabilities | 825 | Jan 19 - Feb 9 2021 | 62% *(14%)* | See **Tables 5-8** for equity-related breakdown |
| Kaplan & Milstein [29] | Published | USA | Exp | General public | 1,000 (Aug) & 1,000 (Dec) | Aug 20-27 & Dec 16-22 2020 | NR | Opportunity (*Social influences*)<br><br>Motivation (*Social/professional role and identity; Beliefs about consequences*) |
| Lunsky et al. [32] | Published | Canada | CS | Workers supporting adults with intellectual disabilities | 3,371 | Jan 21 - Feb 3 2021 | 62% | Opportunity (*Environmental context and resources; Social influences*)<br><br>Motivation (*Social/professional role and identity; Beliefs about consequences*) |
| Nguyen I et al. [35] | Published | USA | CS | General public | 3,541 (Sep) & 2,033 (Dec) | Sep & Dec 2020 | Sep: 39% & Dec: 49% | Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Nguyen II et al.* [36] | Preprint | USA data only | Cohort | General public | 87,388 | Mar 24 2020 - Feb 16 2021 | 91% | See **Tables 5-8** for equity-related breakdown |

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|---|---|---|---|---|---|---|---|---|
| Nikolovski et al. [37] | Preprint | USA | CS | Clinical trial cohort (age: 65+) | 7,621 | Nov 6-20 2020 | 91% | Motivation (*Beliefs about consequences*) |
| Piltch-Loeb et al. [38] | Preprint | USA | CS | People from vaccine priority group (inc. HCWs) | 2,650 | Dec 13-23 2020 | 40% | Opportunity (*Environmental context and resources; Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Savoia et al. [42] | Preprint | USA | CS | General public | 2,650 | Dec 13-23 2020 | 40% | Opportunity (*Environmental context and resources; Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Sotiriou et al. [44] | 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% | Motivation (*Beliefs about consequences*) |
| Szilagyi et al. [45] | Published | USA | CS | General public | 8,167 total (5,660 from Nov-Dec 2020 sample) | Apr 1 - Dec 8 2020 | Apr: 74% & Dec: 56% | N/A |

| Study author | Publication status | Country | Design | Sample | Sample size | Data collection period | Mean % vaccine acceptance *(actual uptake, if assessed)* | COM-B model factors (*TDF domains*) |
|---|---|---|---|---|---|---|---|---|
| **International studies (*k*=26)** | | | | | | | | |
| Alabdulla et al. [10] | Published | Qatar | CS | General public (inc. HCWs) | 7,821 | Oct 15 - Nov 15 2020 | 60% | Capability (*Knowledge*)<br><br>Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Arce et al. [11] | Preprint | Multiple (mainly LMICs) | CS | General public | 45,928 | Jun 2020 - Jan 2021 | 30% - 97% [median=78 %] | Motivation (*Beliefs about consequences*) |
| Argote et al. [12] | Preprint | Multiple (Latin America) | Exp | General public | 13,189 | 11-29 Jan 2021 | 59% | N/A |
| Beesley et al. [13] | Published | Multiple (Europe) | CS (inc. Qual data) | Rheumatology patients | 1,505 adult & 140 paediatric | Dec 2020 | Adult: 87% & paediatric: 66% | [Based on Qualitative data]<br>Capability (*Knowledge*)<br><br>Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |

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|---|---|---|---|---|---|---|---|---|
| Campochiaro et al. [14] | Published | Italy | CS | Rheumatology and oncology patients | 202 rheum & 68 oncology | Nov 23 - Dec 10 2020 | 82% | Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |
| Carbone et al. [15] | Preprint | Italy | CS | Pregnant people | 142 | Jan 2021 | 28% | N/A |
| Dickerson et al. [18] | Preprint | UK | CS (inc. Qual data) | General public | 535 | Oct 9 - Dec 9 2020 | 29% | [Based on Qual data]<br>Capability (*Knowledge*)<br><br>Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |
| Eguia et al. [20] | Published | Spain | CS | General public (inc. HCWs) | 731 | Sep 10 - Nov 23 2020 | 78% | Motivation (*Beliefs about consequences*) |
| El-Elimat et al. [21] | Preprint | Jordan | CS | General public | 3,100 | Nov 2020 | 37% | Motivation (*Beliefs about consequences; Reinforcement*) |
| Gan et al. [22] | Published | China | CS | General public | 1,009 | Oct 23 - Nov 10 2020 | 60% | Capability (*Knowledge*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |
| Gautam et al. [23] | Preprint | India | CS | General public | 1,078 | Oct - Nov 2020 | 77% | N/A |
| Han et al. [26] | Preprint | China | CS | General public (migrants) | 2,126 | Nov 1-20 2020 | 89% | Motivation (*Beliefs about consequences*) |

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|---|---|---|---|---|---|---|---|---|
| Iheanacho et al. [28] | Preprint | Nigeria | CS | General public | 410 | Nov 20 - Dec 28 2020 | 57% | Motivation (*Beliefs about consequences*) |
| Khaled et al. [30] | Preprint | Qatar | CS | General public | 1,038 | Dec 15 2020 - Jan 25 2021 | 43% | Motivation (*Beliefs about consequences*) |
| Knights et al. [31] | Published | UK | Qual | General public (migrants, inc. HCWs) | 81 | Jun 18 - Nov 30 2020 | NR | [Based on Qual data]<br>Capability (*Knowledge*)<br><br>Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences*) |
| Malesza & Bozym [33] | Preprint | Poland | CS | General public (age: 70+) | 1,427 | Jan - Feb 2021 | *(63%)* | Opportunity (*Social influences*) |
| Mo et al. [34] | Published | China | CS | General public (university students) | 6,922 | Nov 1-28 2020 | 79% | Opportunity (*Environmental context and resources*)<br><br>Motivation (*Beliefs about consequences*) |
| Nguyen II et al.* [36] | Preprint | UK data only | Cohort | General public | 1,254,294 | Mar 24 2020 - Feb 16 2021 | 95% | See **Tables 5-8** for equity-related breakdown |
| Robertson et al. [39] | Preprint | UK | CS | General public (part of an ongoing study) | 12,035 | Nov 24 - Dec 1 2020 | 82% | Motivation (*Beliefs about consequences*) |

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|---|---|---|---|---|---|---|---|---|
| Sallam et al. [40] | Published | Multiple (Arab states) | CS | General public | 3,414 | Dec 14-18 2020 | 29% | Motivation (*Beliefs about consequences*) |
| Samarasekera et al. [41] | Published | Multiple (Africa) | CS | General public | >15,000 | Aug - Dec 2020 | 59% - 94% [median=79 %] | Motivation (*Beliefs about consequences*) |
| Skjefte et al. [43] | Published | Multiple (Global) | CS | Pregnant people & non-pregnant mothers | 17,871 | Oct 28 - Nov 18 2020 | 69% | Opportunity (*Social influences*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |
| Wang et al. [46] | Published | China | Cohort | General public | 2,058 in Mar; 2,013 in Dec; 791 longitudinal | Mar & Dec 2020 | 23% | Opportunity (*Environmental context and resources; Social influences*)<br><br>Motivation (*Beliefs about consequences; Reinforcement*) |
| Wouters et al. [47] | Published | Multiple (Global) | CS | General public | 26,758 | Oct 21 - Dec 16 2020 | 38% - 98% [median=73 %] | N/A |
| Yurttas et al. [48] | Published | Turkey | CS | General public (inc. rheumatology patients & HCWs) | 732 | Jan 4-13 2021 | 29% - 53% [median=39 %] | Motivation (*Emotions*) |
| Zampetakis & Melas [49] | Published | Greece | Exp | General public | 1,006 | Oct 1 - Nov 5 2020 | NR | Motivation (*Beliefs about consequences*) |

Table 1 notes: COM-B model = Capability, Opportunity, and Motivation-Behaviour model; CS = cross-sectional survey; Exp = Experimental study design; HCW = healthcare worker, N/A = studies that did not capture these factors; NR = not reported; Qual = qualitative; TDF = Theoretical Domains Framework; * = Nguyen II et al. collected both USA and UK data so included in both North America and International sections.

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

37/40 studies included a mean % for vaccination acceptance. Of the studies that did not, one was a qualitative study [31], one did not use a dichotomous outcome [29], and another used multivariate modeling as part of an experimental design [49]. Across all studies, two thirds of respondents were willing to accept a COVID-19 vaccine (median=66%, IQR=31%). Among North American studies (*k*=15), vaccination acceptance rates ranged from 40% [38,42] to 92% [24] (median=64%, IQR=24%). Among studies conducted outside of North America, vaccination acceptance rates ranged from 23% (China; [46]) to 98% (Vietnam; [47] (median=69%, IQR=38%). Among studies collecting data across multiple countries but within similar regions, acceptance rates were wide-ranging (e.g., 59% - 94% among African countries [41]).

**Objective 2: COVID-19 vaccination uptake rates**

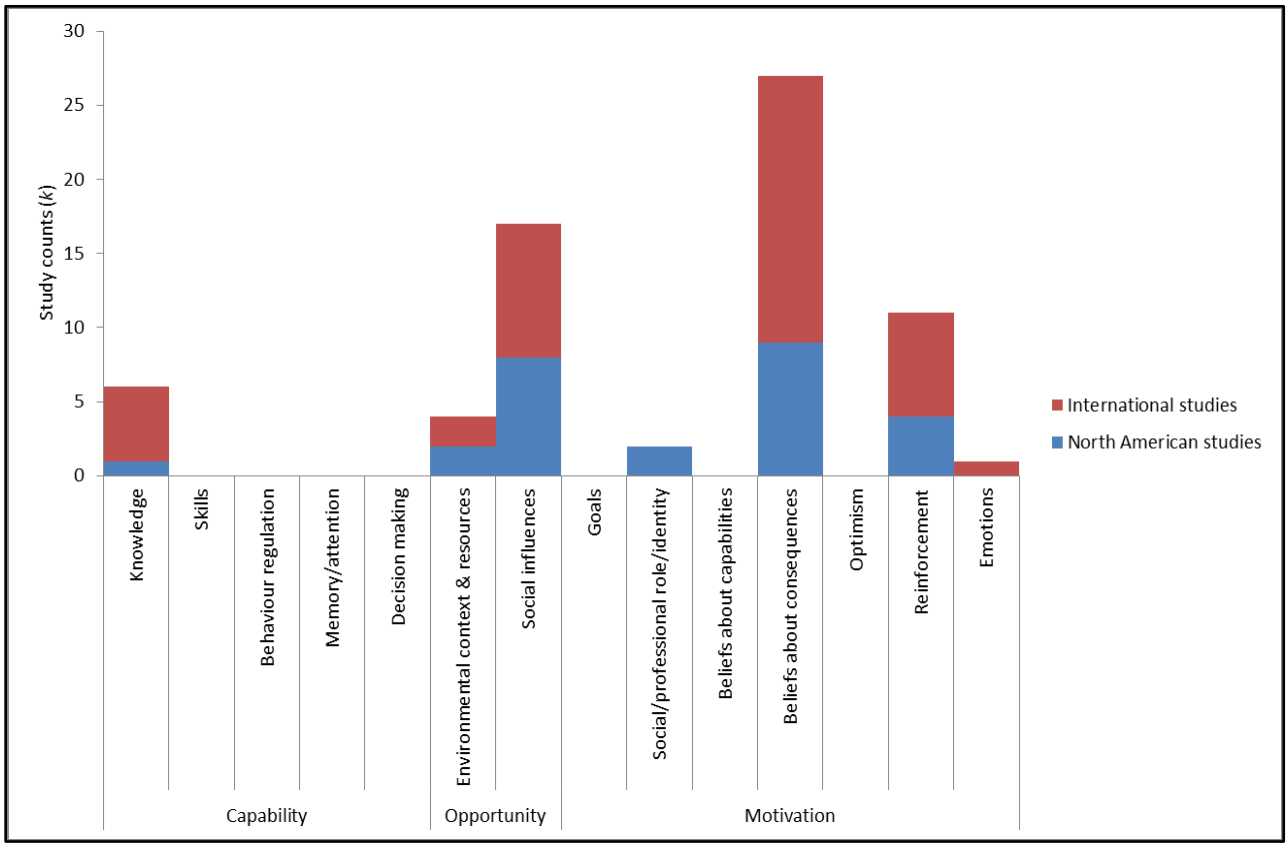
Two studies included self-reported vaccination uptake rates [27,33], although neither was conducted in Canada. Iadarola et al. reported that 14% of respondents (USA) had already had a COVID-19 vaccine [27] whilst Malsza and Bozym reported 63% of respondents (Poland) had received a COVID-19 vaccine. Data from the Government of Canada website reports that as of Apr 24th, 2021, 29% of the population had received at least one dose of a COVID-19 vaccine. Future versions of this LBSES report will continue to capture recently conducted studies that will likely measure actual vaccination uptake and factors (based on COM-B model and TDF) associated with uptake.

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

35/40 studies provided evidence of the potential factors underlying COVID-19 vaccine acceptance which were mapped using the COM-B model and TDF. The remaining 5 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 [12,15,23,45,47]. Four studies assessed potential factors predicting vaccination acceptance among racialized groups (see Objective 4) [19,25,27,36]. To date, 7 (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*=6]) (see **Table 2**).
- Opportunity (Environmental context and resources [*k*=4]; Social influences [*k*=17]) (see **Table 3**).
- Motivation (Beliefs about consequences [*k*=27]; Social/professional role and identity [*k*=2]; Reinforcement [*k*=11]; Emotion [*k*=1] (see **Table 4**).

**Figure 2. Frequency of Capability, Opportunity and Motivation factors associated with COVID-19 vaccination acceptance in the general public across *k*=40 studies up to April 20th, 2021**




These domains are similar to those found in a recent review [8] and our LBSES focusing on vaccination acceptance among HCWs, although these reviews included studies reporting data since the start of the pandemic which were excluded in this report. As such, our findings indicate that drivers of vaccination acceptance appear to remain consistent to date, even in light of authorised vaccines (since 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; Goals; and Optimism.

### Capability-related factors

To date, there is limited evidence for Capability-related factors influencing vaccination acceptance among the general public (**Table 2**). Knowledge was the only domain represented. A general lack of knowledge about COVID-19 vaccines was cited as a barrier in four studies

[10,13,18,31], including one qualitative study [31]. 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. 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.

**Table 2. Capability-related factors associated with COVID-19 vaccination acceptance**

| **TDF Domain (Definition)** | |
|---|---|
| **Knowledge**<br>(What do people know & how does that influence what they do? Do they have the procedural knowledge (know how to do it)?) | |
| Knowledge factors associated with **lower acceptance** | • *k*=4 → Having generally poor understanding of COVID-19 and vaccines<br>○ Of those who were unsure and showed vaccine hesitancy, 36% and 43% respectively reported that supplementing their own understanding of the disease was needed increase vaccine acceptance [10]<br>○ A lack of information (e.g., safety, efficacy, how vaccines work) was preventing rheumatology patients from currently accepting the vaccine (51% adults, 22% paediatric) [13]<br>○ Some hesitant individuals were unaware that effective vaccines had been developed and authorised [18]<br>○ Qual data: A number of migrants reported contradiction of information between different information sources, confusion or indecision with regards to whether to take the vaccine [31] |
| Knowledge factors associated with **higher acceptance** | • *k*=1 → Desire for disease-specific guidance on vaccination safety would encourage acceptance<br>○ Approximately 70% desired specific data regarding vaccine safety/efficacy among patients with inflammatory bowel disease [17]<br>• *k*=1 → Keeping well-informed about vaccine-related news |

| | |
|---|---|
| | ○ Those who pay close attention to the latest news of the vaccine were more willing to be vaccinated (OR=1.60, 95% CI: 1.05–2.45) [22] |

**Opportunity-related factors**

Evidence indicating the importance of opportunity related-factors was strong (**Table 3**). In particular, Social influence was an important factor associated with vaccination acceptance, over and above what we found among HCWs in our earlier LBSES report. Government and health agency mistrust was a frequently cited barrier to vaccine acceptance which is likely exacerbated by misinformation among the general public. 5 studies identified the role of HCWs in influencing the likelihood of being vaccinated people, in particular among certain patient groups (e.g., patients with a rheumatic condition) [13,14,33,37,46]. Two studies reported that hesitancy was linked to individuals waiting for others being vaccinated first, although it is unclear whether this was driven by altruistic tendencies or safety concerns. 3 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) [24,32,34]. 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). Two studies cited potential access issues in terms of time, convenience, and cost which were associated with lower vaccination acceptance. Such practical barriers could be addressed at a system and/or policy level to minimise barriers to access.

**Table 3. Opportunity-related factors associated with COVID-19 vaccination acceptance**

| **TDF Domain (Definition)** | |
|---|---|
| **Environmental context and resources**<br>(What are the things in people's environment that influence what they do and how do they influence?) | |
| Environmental context and resource factors associated with **lower acceptance** | • *k*=2 → Access issues in terms of time, convenience, and cost<br>○ Finding time to get vaccinated was overwhelming (OR=0.60, 95% CI 0.36-0.98) [32]<br>○ Vaccination convenience (OR=0.64, 95% CI: 0.46–0.91) or vaccine price (OR=0.54, 95% CI: 0.40–0.74) (Environ) associated with delayed vaccination acceptance [46] |
| Environmental context | • *k*=2 → Information-seeking using traditional news |

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|---|---|
| and resource factors associated with **higher acceptance** | sources/social media<br>○ A higher proportion of individuals who had received information from a national TV (47%), local TV (45%), national newspaper (55%), and radio (51%) were vaccine acceptant compared to those who had not [38]<br>○ Use of social media for COVID-19 vaccine-related information was positively associated with the intention to receive a COVID-19 vaccination [34] |
| **TDF Domain (Definition)** | |
| **Social influences**<br>(What do others do? What do others think of what people do or what they should do? Who are they and how does that influence what they do?) | |
| Social influence factors associated with **lower acceptance** | • *k*=6 → State/government/public health agency mistrust/conspiracy<br>○ Vaccine hesitancy associated with view that authorities are motivated by financial gain rather than health of people (OR=1.14, *p*=0.03) [10]<br>○ UK participants who trusted the national health service (NHS) a great deal were most likely to have decided they want a vaccine (44%) vs. those that distrusted NHS (7%) [18]<br>○ Government mistrust was a predictor of hesitancy (OR=3.57, 95% CI: 2.26-5.63) [19]<br>○ Participants who believed that there was a conspiracy behind COVID-19 (OR=0.50, 95 CI: 0.36-0.71) and those who do not trust any source of information on COVID-19 vaccines (OR=0.27, 95% CI: 0.18-0.40), were less likely to have acceptance towards them [21]<br>○ Common reason for hesitancy - don't trust the government (13%) [35]<br>○ Qual data: Migrants also reported a range of beliefs that COVID-19 is a 'Western disease', fear of discrimination or being used as 'guinea pigs',". Also mistrust of doctors, government, and vaccines, believing conspiracies from friends [31]<br>• *k*=2 → Advice from medical professionals to abstain from |

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| | receiving a COVID-19 vaccine<br>○ Advised by doctor to abstain from vaccination among rheumatic patients [13,14]<br>• *k*=2 → Intention to allow others to receive the vaccine first (this could be judged altruistically or related to safety concerns)<br>○ Between 24-26% of participants, independent of their vaccine hesitancy (or lack of) wanted others to get the vaccine first [19]<br>○ The hesitant participants most commonly selected 'prefer to see how others tolerate vaccine first' [17] |
| Social influence factors associated with **higher acceptance** | • *k*=2 → Trust in state/government/public health agency handling of the pandemic<br>○ Those with high trust in COVID-19 vaccine information vs. low trust were more likely to get vaccinated (OR=15.04, 95% CI: 11.26-20.09) [38]<br>○ Non-pregnant mothers: Trust in public health agencies (vs. no trust in public health agencies) (ORa=1.62, 95% CI: 1.38-1.89) [43]<br>• *k*=3 → Advice from medical professionals encouraging vaccination<br>○ Significant independent predictors of vaccine acceptance were being given an explanation by a medical professional as to why they should be vaccinated (OR=4.23, 95% CI: 2.90-5.75) [33]<br>○ The vast majority of those who would be willing to vaccinate indicated they would talk to their healthcare provide or staff before deciding whether or not to receive the vaccine (91% of women and 89% of men) [37]<br>○ Valuing doctor's recommendation (OR=3.13, 95% CI: 1.96-5.01) associated with delayed vaccination acceptance [46]<br>• *k*=1 → Endorsement from a prominent public figure<br>○ When asked how likely they would be to take a vaccine if endorsed by (former) President Trump (USA), 18% chose very likely. Swapping in a Dr. Fauci |

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| | endorsement for a Trump endorsement more than doubled (38%) [29]<br>• *k*=3 → Influence of peer/co-worker vaccination intentions (social norms)<br>○ Likelihood of getting the vaccine if their co-workers did (OR=0.16, 95% CI 0.08-0.29) [32]<br>○ Descriptive norms (i.e., being aware of what others like you are doing) predicted COVID-19 vaccination intention ORa=1.05, 95% CI: 1.03-1.07). Those who thought a greater proportion of typical young adults would get vaccinated were more likely to report intentions to get COVID-19 and influenza vaccines [24]<br>○ Descriptive norm was positively associated with the intention to receive COVID-19 free and self-paid vaccination [34] |

**Motivation-related factors**

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 (**Table 4**). Common concerns and erroneous beliefs focused on the beliefs that COVID-19 vaccine development was rushed (*k*=3) which aligns closely with common safety and efficacy concerns (*k*=11). Although many such concerns related to general vaccine safety, 3 studies found specific patient groups citing concerns about possible contraindications. 3 studies found that vaccine hesitance was related to a lack of perceived necessity with respondents citing natural resistance/protection and feeling in good health as reasons not be get vaccinated. Conversely, the two main beliefs driving higher acceptance were positive beliefs about vaccine safety and efficacy (*k*=6), along with an understanding that vaccines are important to help prevent risk of infection, reduce severity if infected, and reduce the risk of spreading to others (*k*=5).

In line with our previous HCW-focused report, Reinforcement was a prominent Motivation-related factor associated with vaccination acceptance. 7 studies found historical influenza vaccine behaviour predicted current intentions towards COVID-19 vaccination. 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 shown in singular studies. The Social/professional role and identity domain was less represented in this general public dataset compared with our HCW-focused report which found some differences between HCW professions/specialties.

**Table 4. Motivation-related factors associated with COVID-19 vaccination acceptance**

| **TDF Domain (Definition)** | |
|---|---|
| **Beliefs about consequence**<br>(What are the good and bad things that can happen from what people do and how does that influence whether they'll do it in the future?) | |
| Beliefs about consequences factors associated with **lower acceptance** | • *k*=3 → Beliefs about rushed vaccine development/insufficient data on development<br>  ○ Vaccine hesitancy was significantly associated with the belief that there has been insufficient testing of COVID-19 vaccines (OR=1.70, *p*<0.01) [10]<br>  ○ Qual data: Data on vaccination hesitancy (343/535 open text responses) cited perceived lack of evidence/research/speed of development on vaccines [18]<br>  ○ Did not trust the vaccine because of its fast development (OR=5.72, 95% CI: 3.84–8.53) had a higher odds of reporting vaccination non-intent compared with those who did not have those beliefs (Lunsky et al., 2021)<br>• *k*=3 → Perceived necessity (beliefs about natural resistance/already protected/already in good health)<br>  ○ Vaccine hesitancy was significantly associated with the belief that natural exposure to germs and viruses gives the safest protection (OR=1.22, *p*<0.01) [10]<br>  ○ Qual data re vaccination hesitancy (343/535 open text responses) cited already adopting other healthy behaviours so no need for vaccination [18]<br>  ○ Those that believed the vaccine is unnecessary |

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| | because of good health (OR=4.22, 95% CI: 2.66-6.68) had a higher odds of reporting vaccination non-intent compared with those who did not have those beliefs [32]<br>• *k*=11 → Concern about vaccine safety/risk of adverse reactions/efficacy<br>○ The most common reason expressed for reluctance to take the vaccine in LMIC studies was concern about side effects [11]<br>○ The hesitant participants most commonly selected 'concern that long term safety of vaccines is unknown' [17]<br>○ Concerns about side effects of COVID vaccines associated with increased hesitancy (Risk Ratio=8.28; 95% CI: 4.32-15.90) [30]<br>○ Overall, vaccine safety was the leading concern; 25% of respondents believed that a COVID-19 vaccine would be unsafe and 18% believed that vaccines generally were not safe [41]<br>○ Psoriasis patients citing concerns mainly about its safety and efficacy (94%) [44]<br>○ Reasons for not getting vaccinated include safety/efficacy, adverse events, beliefs that vaccines are harmful, beliefs that COVID doesn't exist, belief already have immunity, chronic disease for which vaccine is not recommended [20]<br>○ Were scared of the vaccine's potential side effects (OR=2.30, 95% CI: 1.56-3.39) had a higher odds of reporting vaccination non-intent compared with those who did not have those beliefs (Lunsky et al., 2021)<br>○ Concern about the side effects and safety of the vaccine (30%); Plan to wait and see if it is safe and may get it later (15%); Concern that the vaccine is being developed too quickly (10%) [35]<br>○ The main reasons for vaccine hesitancy were concerns over future unknown effects of a vaccine |

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| | (43%) [39]<br>○ Range of concerns associated with vaccination hesitancy: COVID-19 origin (natural vs. man-made) (OR=0.47, 95% CI: 0.38-0.57); COVID-19 is man-made to force people to get the vaccine? (yes vs. no) (OR=1.89, 95% CI: 1.46-2.43); COVID-19 vaccine will be used to implant microchips to humans? (yes vs. no) (OR=2.39, 95% CI: 1.72-3.30); COVID-19 vaccine causes infertility? (yes vs. no) (OR=2.73, 95% CI: 1.90-3.93); Are you against vaccination in general? (yes vs. no) (OR=9.26, 95% CI: 6.60-12.99) [40]<br>○ Less likely to take vaccine if benefit was lower (50% vs. 70% vs. 90% efficacy). Less likely to take vaccine if risk of adverse event was higher (1/100 million or 1/million in comparison to 1 per 100,000 ($p$<0.05)) [29]<br>○ Qual data: Reliance on 'home remedies' was also thought to present challenges"; vaccines not safe/won't work; anticipating discrimination [31]<br>• $k$=2 → Concern about adverse reactions (specifically contraindications among patients)<br>○ This lack of information/concerns about possible medication contraindications, safety and efficacy for patients with autoimmune conditions, and side effects [13]<br>○ Reasons for declining COVID-19 vaccination among rheumatologic patients were fear of adverse reactions (n=14) and of rheumatic disease worsening (n=3), safety concerns related to the rapidity of vaccine production (n=6), doubt on its usefulness (n=1) [14]<br>• $k$=3 → High/low risk perception about contracting COVID-19<br>○ Association between COVID-19 risk perception and vaccine acceptance showed that persons who had high risk perception of COVID-19 may not necessarily accept the vaccine (OR=0.45; 95% CI: 0.30-0.68) [28]<br>○ Those with higher perceived risk of contracting |

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| | COVID-19 were more hesitant [38]<br>○ Those with a high-risk perception of contracting COVID-19 or of infecting a family member or friend had 1.30 times the odds of being at a higher level of hesitancy compared to those not having such concerns (OR=1.30, 95% CI: 1.06-1.60) [42] |
| Beliefs about consequences factors associated with **higher acceptance** | • *k*=6 → =Positive beliefs about vaccine safety/risk of adverse reactions/efficacy<br>○ Participants who believed that vaccines are generally safe (OR=9.26, 95% CI: 6.02-14.24) nine times more likely to accept vaccines [21]<br>○ Participants who trust the effectiveness of the vaccine were more willing to be vaccinated (OR=6.42, 95% CI: 3.72-11.07) [22]<br>○ Those who perceived a COVID-19 vaccination as important (OR=8.71, 95% CI: 5.89-12.89), safe (OR=1.80, 95% CI: 1.24-2.61), and effective (OR=2.66, 95% CI: 1.83-3.87) were significantly more likely to accept COVID-19 vaccination [26]<br>○ Perceived efficacy of the COVID-19 vaccination was positively associated with the intention to receive COVID-19 free and self-paid vaccination [34]<br>○ Pregnant people: Confident in safety of COVID-19 vaccine post-approval by country's health agencies (vs. not confident) (ORa=3.68, 95% CI: 3.02-4.50). Non-pregnant mothers: Confident in safety of COVID-19 vaccine post-approval by country's health agencies (vs. not confident) (ORa=5.12, 95% CI: 4.06-6.46). Pregnant people: Confident in COVID-19 vaccine efficacy post approval by country's health agencies (ref: not confident) (ORa=1.26, 95% CI: 1.02-1.55). Non-pregnant mothers: Confident in COVID-19 vaccine efficacy post approval by country's health agencies (vss. not confident) (ORa=2.35, 95% CI: 1.93-2.87) [43]<br>○ Believing that COVID-19 vaccination was effective (OR=2.07, 95% CI: 1.07–3.99) associated with |

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| | immediate vaccination acceptance [46]<br>• *k*=5 → Perceived necessity (to prevent risk of infection, reduce severity if infected, and reduce risk of spreading to others)<br>○ Lower risk of non-intent: Perceived risk of becoming ill with COVID-19 (OR=0.51, 95% CI 0.34-0.76); Perception that vaccination would protect their family (OR=0.19,95% CI 0.13-0.28); Perception that getting vaccinated would protect their clients (0.36, 95% CI 0.24–0.54); Those with vaccination non-intent had lower odds of being concerned about their clients becoming ill (OR=0.57, 95% CI 0.34-0.97) [32]<br>○ Regarding COVID-19, the most strongly associated beliefs included that the COVID-19 vaccine will help protect "myself and others" (OR=38.60, 95% CI: 32.40-46.10), the COVID-19 vaccine would be safe and effective (OR=21.60, 95% CI: 18.90-24.70), and being comfortable with short term side effects such as prolonged injection site pain (OR10.90, 95% CI: 9.10-13.10) [37]<br>○ The main reasons for being willing to take up a vaccine were to avoid catching COVID-19 or becoming ill from the disease (55%) [39]<br>○ Perceiving a high or very high risk of infection (OR=1.59, 95% CI: 1.06–2.40) associated with immediate vaccination acceptance [46]<br>○ Based on the Health Beliefs Model: Intention to vaccinate against COVID-19 is greater when perceived severity of the disease is high, perceived benefits from the vaccination are high, perceived susceptibility after having the new vaccine is low, and perceived barriers for the vaccination procedure are low (model explained 59% of the variance in vaccination intentions) [49]. |
| **TDF Domain (Definition)** | |
| **Social/professional role and identity**<br>(How does their role/responsibility (in various settings) influence whether they do or not? How | |

| | |
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| does who they are influence whether they do something or not? Is the behaviour something they are supposed to do or is someone else responsible?) | |
| Role and identity factors associated with **lower acceptance** | • No specific role/identity factors identified to date |
| Role and identity factors associated with **higher acceptance** | • *k*=1 → Political preference/identity<br>  ○ Of those likely to take a vaccine, 64% favoured (now President) Biden (vs. 27% Trump, vs. 9% undecided). Even for vaccines that were described as 90% effective, more Biden voters reported they would be very likely to be inoculated in comparison to Trump voters (38.3 vs. 26.5%, *p*<0.05) [29]<br>• *k*=1 → Role responsibility at work<br>  ○ Getting vaccinated was part of their job (OR=0.43, 95% CI 0.28-0.66) (workers supporting adults with intellectual disabilities) [32] |
| **TDF Domain (Definition)** | |
| **Reinforcement**<br>(How have their experiences (good and bad) of doing it in the past influence whether or not they do it? Are there incentives/rewards?) | |
| Reinforcement factors associated with **lower acceptance** | • *k*=1 → Past experience with severe COVID-19 infection<br>  ○ Respondents who had COVID-19 with severe symptoms were more hesitant about taking the vaccine with 1.42 times the odds of being at a higher level of hesitancy compared to those who did not experience the disease at all (OR=1.42, 95% CI: 1.01-1.99) (Savoia et al., 2021)<br>• *k*=2 → Past experience with vaccine-related allergic reactions and refusal<br>  ○ Allergies to past vaccines among rheumatic patients [13]<br>  ○ History of refusing a certain type of vaccination (OR=0.57, 95% CI: 0.40–0.82) associated with delayed vaccination acceptance (Wang et al., 2021) |
| Reinforcement actors associated with **higher acceptance** | • *k*=7 → Historical influenza vaccination<br>  ○ Those who had a flu vaccine in the last 3 years, took |

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| | regular medication were significantly less likely to be vaccine hesitators [10]<br>○ Rheumatic and oncology patients who joined 2020 influenza vaccine campaign were keener to get COVID-19 vaccination (90% vs. 36%, $p$<0.01) [14]<br>○ Those that had already had a flu vaccine this year were more likely to want a COVID-19 vaccine (51% vs. 21%) [18]<br>○ Seasonal influenza vaccine (OR=2.04, 95% CI: 1.31–3.17) were more likely to accept Covid-19 vaccines [21]<br>○ Participants who had been vaccinated against influenza in the past were more willing to receive the SARS-CoV-2 vaccine (OR=2.18, 95% CI: 1.47-3.21) [22]<br>○ Pregnant people: Did receive flu vaccination last year (vs. did not receive) (ORa=1.40, 95% CI: 1.18-1.67). Non-pregnant mothers: Did receive flu vaccination last year (vs. did not receive) (ORa=1.58, 95% CI: 1.36-1.82) [43]<br>○ Adding proof of vaccination (e.g., vaccination card) associated with greater likelihood of vaccination acceptance (given its potential privileges, its use as a status symbol, or as a ticket to normalcy) [16]<br>• $k$=1 → Personal experience with COVID-19-related death<br>○ Having a close family member or friend who had died of COVID-19, respondents were 47% more acceptant of the vaccine (OR=1.47, 95% CI: 1.08-1.99) [38] |
| **TDF Domain (Definition)** | |
| **Emotion**<br>How do they feel (affect) about what they do and do those feelings influence what they do? | |
| Emotion Factors associated with **lower acceptance** | • No emotion factors identified in literature to date |
| Emotion factors associated with **higher acceptance** | • $k$=1 → Higher scores on COVID-19 related anxiety was related to vaccine acceptance (OR=1.09, 95% CI: 1.03-1.16) [48] |

**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, 10/40 studies assessed whether vaccine acceptance was associated with race and ethnicity. Of these, 9/10 found differences in vaccine acceptance and uptake based on racial/ethnic identity. The main findings from these studies are reported in **Table 5**.

**Table 5. Differences in vaccine acceptance across racialized groups**

| Study authors (Country) | Vaccine acceptance/hesitancy rates among racial and ethnic 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. |
| Grumbach et al. (USA) | • Vaccine uptake in racialized groups vs. White respondents:<br>○ Black (ORa=0.29, 95% CI: 0.20-0.43)<br>○ Latinx (ORa=0.55, 95% CI: 0.43-0.71)<br>○ Asian (ORa=0.57, 95% CI: 0.47-0.70)<br>○ 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:<br>○ Black (OR=2.84, 95% CI: 2.69-2.99)<br>○ South Asian (OR=1.66, 95% CI: 1.57-1.76)<br>○ Middle East/East Asian (OR=1.84, 95% CI: 1.70-1.98)<br>○ Multiple races/other (OR=1.48, 95% CI: (1.39-1.57) |

| Study authors (Country) | Vaccine acceptance/hesitancy rates among racial and ethnic groups |
|---|---|
| | • Vaccine hesitancy in racialized groups vs. White USA respondents:<br>○ Black (OR=3.15, 95% CI: 2.86-3.47)<br>○ Latinx (OR=1.42, 95% CI: 1.28-1.58)<br>○ Asian (OR=1.34, 95% CI: 1.18-1.52)<br>○ Multiple races/other (OR=2.02, 95% CI: 1.70-2.39) |
| Robertson (UK) | • Vaccine hesitancy in racialized groups vs. White British/Irish UK respondents:<br>○ Black/Black British (OR=12.96, 95% CI: 7.34-22.89)<br>○ Pakistani/Bangladeshi (OR=2.31, 95% CI: 1.55-3.44) |
| Savoia (USA) | • Vaccine hesitancy was predicted by the experience of racial discrimination (OR=1.21, 95% CI: 1.01-1.45). |
| Szilagy (USA) | • Black (vs. White) respondents were less likely to get a vaccine (38% vs. 59%; ORa=0.70, 95% CI: 0.60-0.80). |

These studies provide evidence to suggest that respondents from racialized communities are less likely to express vaccine acceptance than White respondents. For example, one survey study conducted in the USA [42] found that participants who reported past experiences with discrimination also reported greater vaccine hesitancy when compared to those who did not report past racial discrimination (OR=1.21, 95% CI: 1.01-1.45). Another survey study in the USA [36] found that Black respondents reported lower vaccine uptake even when controlling for other factors. The authors note that this disparity persisted even among individuals who endorsed a willingness to obtain a vaccine. Though one study [19] reported that vaccine hesitancy declined over time (OR=0.76, 95% CI: 0.63-0.92) across racialized groups. 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.

Our review further identified four studies [19,25,27,36] that examined factors associated with vaccine acceptance among different racialized groups. Based on USA data, the authors of these studies examined factors associated with vaccine acceptance among Black, Latinx, Asian, and White-identified respondents. Based on these data, 4 (of a possible 14) TDF domains –

Knowledge (see **Table 6**); Environmental context and resources, Social influences (see **Table 7**), Beliefs about consequences (see **Table 8**) – were identified as potential determinants of COVID-19 vaccine acceptance among racialized groups.

**Capability-related factors across racialized groups**

Only 1 from 4 studies presented evidence suggesting that capability-related factors were associated with vaccine acceptance among Black, Latinx, Asian, and White-identified respondents (**Table 6**). 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 [36].

**Table 6. Capability-related factors associated with COVID-19 vaccination acceptance across racialized groups**

| **TDF Domain (Definition)** | |
|---|---|
| **Knowledge**<br>(What do people know & how does that influence what they do? Do they have the procedural knowledge (know how to do it)?) | |
| Knowledge factors associated with **lower acceptance** | • *k*=1 → not knowing enough about COVID-19 vaccines was cited as a common reason for lower vaccine acceptance [36]<br>  ○ Frequency comparisons suggest Black, Latinx, and South Asian respondents cited lack of knowledge at higher rates than White respondents [36] |

**Opportunity-related factors across racialized groups**

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 [19] (**Table 7**). Three studies reported data suggesting that distrust in institutions was associated with lower vaccine acceptance [19,25,27]. 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). Taken together, these studies suggest that distrust plays an important role in determining how willing different racialized groups are to COVID-19 vaccination and that some groups may experience greater trust-related hesitancy. One study [19] 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.

**Table 7. Opportunity-related factors associated with COVID-19 vaccination acceptance across racialized groups**

| **TDF Domain (Definition)** | |
|---|---|
| **Environmental Context and Resources**<br>(What are the things in people's environment that influence what they do and how do they influence?) | |
| Environmental Context and Resource factors associated with **lower acceptance** | • *k*=1 → Ownership of mobile phones and computers was associated with lower vaccine acceptance [19]<br>○ Mobile phones (OR=2.12, 95%CI 1.31-3.43)<br>○ Computers (OR=1.46, 95%CI: 1.00-2.13) |
| **TDF Domain (Definition)** | |
| **Social influences**<br>(What do others do? What do others think of what people do or what they should do? Who are they and how does that influence what they do?) | |
| Social influence factors associated with **lower acceptance** | • *k*=3 → Distrust in government and companies making vaccines was associated with lower vaccine acceptance<br>○ Distrust predicted lower vaccine acceptance (OR=3.57, 95% CI: 2.26-5.63) across all groups [19]<br>○ Black-identified respondents expressed more distrust in companies making vaccines than White respondents (ORa=3.08, 95% CI: 2.00-4.73) [25]<br>○ Black-identified respondents reported higher rates (96%) of distrust in government than Latinx (80%), |

| | |
|---|---|
| | White (78%), and Asian (0%) respondents ($p$<0.01) [27]<br>○ Latinx and Black respondents reported concerns over being used as an experiment more often (96% and 91%, respectively) than White or Asian respondents (76% and 67%, respectively) ($p$=0.05) [27]<br>• $k$=1 → Wanting others to receive vaccine first was marginally associated with lower vaccine acceptance (OR=1.44, 95% CI: 0.98-2.11) [19] |

**Motivation-related factors across racialized groups**

Three studies [19,25,36] reported Beliefs about consequences as a factor associated with vaccine acceptance among racialized groups (**Table 8**). Two studies found that safety concerns were associated with lower vaccine acceptance. 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 [19]. 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 [36]. 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 [19,25]. 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 [25].

**Table 8. Motivation-related factors associated with COVID-19 vaccination acceptance across racialized groups**

| **TDF Domain (Definition)** | |
|---|---|
| **Beliefs about consequence**<br>(What are the good and bad things that can happen from what people do and how does that influence whether they'll do it in the future?) | |
| Beliefs about consequences factors | • $k$=2 → Safety concerns (i.e., side effects and adverse reactions) were associated with lower vaccine acceptance |

| | |
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| associated with **lower acceptance** | ○ Safety concerns predicted lower vaccine acceptance across all groups (OR=4.28, 95% CI: 3.06-5.97) [19]<br>○ Safety concerns were the most commonly cited reason for lower acceptance among White (54%), Black (53%) and Latinx (32%) participants (p<0.01) [19]<br>○ Black respondents in the USA cited side effects as the most common reason for vaccine hesitancy (57% vs. 52% White, 55% Latinx, 50% Asian respondents) [36]<br>• *k*=2 → Concerns over vaccine efficacy was associated with lower vaccine acceptance<br>○ Efficacy concerns were associated with lower acceptance across all groups (OR= 3.50, 95% CI: 1.57-7.82) [19]<br>○ Black (ORa=2.39, 95% CI: 1.58-3.61), Latinx (ORa=2.04, 95% CI: 1.58-2.64) and Asian (ORa=1.85, 95% CI: 1.51-2.27) respondents twice as likely to express doubts in vaccine efficacy than White respondents [25]<br>• *k*=1 → Concerns over a rushed approval process<br>○ Black (ORa=2.10, 95% CI: 1.44-3.05), Latinx (ORa=1.68, 95% CI: 1.34-2.10) and Asian (ORa=1.81, 95% CI: 1.53-2.15) respondents reported greater concern than White respondents [25] |

## Discussion

### Overview

This report details version 1 of our LBSES looking at factors affecting COVID-19 vaccination acceptance and uptake among the general public. A total of 40 studies were identified spanning Nov, 2020 - Apr, 2021, thus representing research conducted since the approval of COVID-19 vaccines in Dec 2020. Vaccination acceptance rates across 15 North American studies ranged from 40% to 92% (median=64%, IQR=24%) indicating that a majority of individuals want to get the COVID-19 vaccine but that many would benefit from support in addressing identified barriers to acceptance. Only 1 study was conducted in Canada which highlights a paucity of recent published Canadian research in this area.

Based on the Capability, Opportunity, and Motivation-Behaviour (COM-B) model [2], a number of important factors were identified that focused primarily on Opportunity and Motivation. Capability factors (i.e., the individuals capacity to engage in the behaviour) focused on the role of Knowledge; Opportunity factors (i.e., all the factors that lie outside the individual that make the behaviour possible or prompt it) identified included Environmental context and resources and Social influences, and Motivation factors (i.e., the thought processes within the individual that energize and direct the behaviour) included Beliefs about consequences, Social/professional role and identity, Reinforcement, and Emotion. These cover 7 of 14 domains of the Theoretical Domains Framework (TDF) and are almost identical to the key domains identified in our previous report focusing on COVID-19 vaccination acceptance among HCWs (which included data since start of the pandemic). As such, our findings indicate that drivers of vaccination acceptance appear to remain consistent to date, even in light of authorised vaccines (since Dec 2020).

Across studies, concerns and erroneous beliefs about COVID-19 vaccine safety, efficacy, and necessity (captured under Beliefs about consequences) were common and associated with lower vaccination acceptance. Mistrust of governments and public health agencies (captured under Social influences) was associated with lower vaccination acceptance. As seen in our HCW-focused report, previous vaccination behaviour (captured under Reinforcement) consistently predicted intention to receive a vaccine for COVID-19. As such, there may be opportunities to adapt previous campaign strategies and programs encouraging routine vaccination to the COVID-19 context, although addressing system-level mistrust will be crucial going forward to encourage vaccination uptake. There may also be opportunities to leverage social norms and in particular descriptive norms (i.e., being aware of what others like you are

doing; captured under Social influence) which were shown to be associated with higher vaccination acceptance in 3 studies. This could be particular important to encourage young people to get vaccinated once able to.

In terms of racialized groups, 9 studies conducted in North America provided evidence suggesting that racialized (e.g., Black, Latinx, Asian) respondents are less likely to express vaccine acceptance than White respondents. We identified 4 of 14 domains of the TDF associated with vaccination acceptance among racialized groups, namely, Knowledge, Environmental context and resources; Social influences, and Beliefs about consequences. Government and public health agency mistrust was again cited as an important barrier to vaccination and concerns about vaccine development were more common among Black, Latinx, and Asian vs. White respondents while concerns about vaccine safety were common across all groups. Such findings may help inform strategies and programs addressing the specific needs and concerns of such equity-seeking groups, although additional field work needs to be conducted in Canada with a particular focus on indigenous communities in which perspectives and data are currently lacking.

**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; Goals; Beliefs about capabilities; and Optimism. 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.

Now that vaccines are being rolled out, 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. 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 [50]). 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 are being rolled out across Canada.

**Future directions for this LBSES**

Given that COVID-19 vaccines have been rolling our since Dec 2020, we expect to see more research to investigate 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 [50]. 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. 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 which **strategies/techniques** are effective in supporting COVID-19 vaccination acceptance and uptake in the general public.
- Identify **alignment and gaps** between experienced barriers/enablers and currently tested strategies, and any lack of data for certain equity-seeking groups.

- Summarize **actionable implications** in general and in particular among those serving equity-seeking groups.

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## Appendices

### Appendix 1. List of additional studies (*k*=102) looking at COVID-19 vaccination acceptance since start of the pandemic (Jan - Oct, 2020), excluded for the purposes of this report

| First Author | Study Title | Journal | Year | Country | Study Design | Data Collection Period |
|---|---|---|---|---|---|---|
| Alali | Perception and awareness of COVID-19 among health science students and staff of Kuwait University: An online cross-sectional study | Preprint | 2021 | Kuwait | Survey | June – July, 2020 |
| Alley | As the pandemic progresses, how does willingness to vaccinate against COVID-19 evolve? | Journal of Environmental Research and Public Health | 2021 | Australia | Survey | April - Aug, 2020 |
| Al-Qerem | COVID-19 vaccination acceptance and its associated factors among a Middle Eastern population | Frontiers in Public Health | 2021 | Jordan | Survey | Oct 2020 |
| Alqudeimat | Acceptance of a COVID-19 vaccine and its related determinants among the general adult population in Kuwait | Medical Principles and Practice | 2021 | Kuwait | Survey | Aug 26 - Sept 1, 2020 |
| Attwell | Converting the maybes: Crucial for a successful COVID-19 vaccination strategy | PloS One | 2021 | Australian | Survey | May 2020 |
| Benham | Attitudes, current behaviours and barriers to public health measures that reduce COVID-19 transmission: A qualitative study to inform public health messaging | PloS One | 2021 | Canada | Qualitative | Aug – Sept, 2020 |
| Bogart | COVID-19 related medical mistrust, health impacts, and potential vaccine hesitancy among Black Americans living with HIV | Journal of Acquired Immune Deficiency Syndromes | 2021 | United States | Survey | May – July, 2020 |
| Bokemper | Timing of COVID-19 vaccine approval and endorsement by public figures | Vaccine | 2021 | United States | Experimental | Sept 9 – 22, 2020 |
| Borriello | Preferences for a COVID-19 vaccine in Australia | Vaccine | 2021 | Australia | Survey | March 27 – 31, 2020. |

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|---|---|---|---|---|---|---|
| Caserotti | Associations of COVID-19 risk perception with vaccine hesitancy over time for Italian residents | Social Science & Medicine | 2021 | Italy | Survey | Feb – Jun, 2020 |
| Chen | An online survey of the attitude and willingness of Chinese adults to receive COVID-19 vaccination | Human Vaccines & Immunotherapeutics | 2021 | China | Survey | May – June, 2020 |
| Chu | Integrating health behavior theories to predict American's intention to receive a COVID-19 vaccine | Patient Education and Counseling | 2021 | United States | Survey | Sept 2020 |
| Daly | Willingness to vaccinate against COVID-19 in the US: longitudinal evidence from a nationally representative sample of adults from April-October 2020 | Preprint | 2021 | United States | Survey | April-Oct, 2020 |
| Ditekemena | COVID-19 vaccine acceptance in the Democratic Republic of Congo: A cross-sectional survey | Vaccines | 2021 | Democratic Republic of Congo | Survey | Aug-Sept 2020 |
| Ehde | Willingness to obtain COVID-19 vaccination in adults with multiple sclerosis in the United States | Multiple Sclerosis and Related Disorders | 2021 | United States | Survey | April 10 - May 6, 2020 |
| Feleszko | Flattening the curve of COVID-19 vaccine rejection-an international overview | Vaccines | 2021 | Multicounty | Survey | June 2 – 9, 2020 |
| Freeman | COVID-19 vaccine hesitancy in the UK: The Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II | Psychological Medicine | 2020 | United Kingdom | Survey | Sept 24 – Oct 17, 2020 |
| Gbashi | Systematic delineation of media polarity on COVID-19 vaccines in Africa using computational linguistic models | JMIR Medical Informatics | 2020 | Multi-Country (Africa) | Qualitative | Feb-May 2020 |
| Gerussi | Vaccine hesitancy among Italian patients recovered from COVID-19 infection towards Influenza and Sars-Cov-2 vaccination | Vaccines | 2021 | Italy | Survey | March– May 2020 |
| Gheorghe | Knowledge, attitudes and practices related to the COVID-19 outbreak among Romanian adults with cancer: A cross-sectional national survey | ESMO Open | 2021 | Romania | Survey | April-May 2020 |
| Guidry | Willingness to get the COVID-19 vaccine with and without emergency use authorization | American Journal of Infection Control | 2021 | United States | Survey | Jul 2020 |
| Hetherington | Covid-19 vaccination intentions among Canadian parents of 9-12 year old children: Results from the All Our Families longitudinal cohort | Preprint | 2021 | Canada | Survey | May-June 2020 |

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|---|---|---|---|---|---|---|
| Hursh | Quantifying the impact of public perceptions on vaccine acceptance using behavioral economics | Frontiers in Public Health | 2020 | United States | Survey | June 2020 |
| Jiang | Knowledge, attitudes and mental health of university students during the COVID-19 pandemic in China | Children and Youth Services Review | 2020 | China | Survey | Feb 10, 2020 |
| Jung | Concerns for others increases the likelihood of vaccination against influenza and COVID-19 more in sparsely rather than densely populated areas | Proceedings of the National Academy of Sciences | 2021 | United States | Survey + Experimental | Sept 2018 - 2020 pre vaccine approval |
| Karlsson | Fearing the disease or the vaccine: The case of COVID-19 | Personality and individual differences | 2021 | Finland | Survey | Mar - Apr 2020 |
| Kerr | Predictors of COVID-19 vaccine acceptance across time and countries | Preprint | 2020 | Multi-Country (12 Countries) | Survey | March – Oct, 2020 |
| Kourlaba | Willingness of Greek general population to get a COVID-19 vaccine | Global Health Research and Policy | 2021 | Greece | Survey | April 28 – May 3, 2020 |
| Latkin | Mask usage, social distancing, racial, and gender correlates of COVID-19 vaccine intentions among adults in the US | PLoS One | 2021 | United States | Survey | May 14 – 18, 2020 |
| Leng | Individual preferences for COVID-19 vaccination in China | Vaccine | 2021 | China | Experiment | NA |
| Lennon | Unique predictors of intended uptake of a COVID-19 vaccine | Preprint | 2020 | United States | Survey | Aug-Oct, 2020 |
| Lin | Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China | PLoS Neglected Tropical Diseases | 2020 | China | Survey | May 1 – 19, 2020 |
| Lockyer | Understanding Covid-19 misinformation and vaccine hesitancy in context: Findings from a qualitative study involving citizens in Bradford, UK | Preprint | 2020 | United Kingdom | Qualitative | “Autumn” 2020 |
| Loomba | Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA | Nature Human Behaviour | 2021 | United Kingdom & United States | Experiment | Sep 7 – Sep 14, 2020 |
| Lucia | COVID-19 vaccine hesitancy among medical students | Journal of Public Health | 2020 | United States | Survey | NA |

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|---|---|---|---|---|---|---|
| Ma | Predicting intentions to vaccinate against COVID-19 and seasonal flu: The role of consideration of future and immediate consequences | Health Communications | 2021 | United States (unclear, MTurk sample) | Survey | April 7 – May 32, 2020 |
| Manning | COVID-19 vaccination readiness among nurse faculty and student nurses | Nursing Outlook | 2021 | United States | Survey | Aug 10 – Sept 14, 2020 |
| McPhedran | Efficacy or delivery? An online Discrete Choice Experiment to explore preferences for COVID-19 vaccines in the UK | Economics Letters | 2021 | United Kingdom | Experiment | Aug 27 – Sept 3, 2020 |
| Meier | Predictors of the intention to receive a SARS-CoV-2 vaccine | Journal of Public Health | 2021 | United States | Survey | Oct 28 – 30, 2020 |
| Mercadante | Will they, or Won't they? Examining patients' vaccine intention for flu and COVID-19 using the Health Belief Model | Research in Social and Administrative Pharmacy | 2020 | United States | Survey | Oct 2 – 29, 2020 |
| Momplaisir | Understanding drivers of COVID-19 vaccine hesitancy among Blacks | Clinical Infectious Diseases | 2021 | United States | Qualitative | Jul – Aug, 2020 |
| Motta | Can a COVID-19 vaccine live up to Americans' expectations? A conjoint analysis of how vaccine characteristics influence vaccination intentions | Social Science & Medicine | 2021 | United States | Experiment | Aug 2020 |
| Murphy | Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom | Nature Communications | 2021 | Ireland & United Kingdom | Survey | March - April 2020 |
| Olomofe | Predictors of uptake of a potential Covid-19 vaccine among Nigerian adults | Preprint | 2021 | Nigeria | Survey | June – July, 2020 |
| Pastorino | Impact of COVID-19 pandemic on Flu and COVID-19 vaccination intentions among university students | Vaccines | 2021 | Italy | Survey | June 8 – July 12, 2020 |
| Qiao | Risk exposures, risk perceptions, negative attitudes toward general vaccination, and COVID-19 vaccine acceptance among college students in South Carolina | Preprint | 2020 | United States | Survey | Sept - Oct 2020 |
| Ruiz | Predictors of intention to vaccinate against COVID-19: results of a nationwide survey | Vaccine | 2021 | United States | Survey | June 15–16, 2020 |

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|---|---|---|---|---|---|---|
| Schwarzinger | COVID-19 vaccine hesitancy in a representative working-age population in France: a survey experiment based on vaccine characteristics | The Lancet. Public Health | 2021 | France | Experiment | July 2020 |
| Scott | Vaccination patterns of the northeast Ohio Amish revisited | Vaccine | 2021 | United States | Survey | April 2020 |
| Seale | Examining Australian public perceptions and behaviors towards a future COVID-19 vaccine | BMC Infectious Diseases | 2021 | Australia | Survey | March 18 – 24, 2020 |
| Strickland | Integrating operant and cognitive behavioral economics to inform infectious disease response: Prevention, testing, and vaccination in the COVID-19 pandemic | Preprint | 2021 | United States | Experiment | March 2020 & May 2020 & Jul 2020 & Sep 2020 |
| Tam | Factors associated with decision making on COVID-19 vaccine acceptance among college students in South Carolina | Preprint | 2020 | United States | Survey | Sept-Oct 2020 |
| Teovanovic | Irrational beliefs differentially predict adherence to guidelines and pseudoscientific practices during the COVID-19 pandemic | Applied Cognitive Psychology | 2021 | Siberia | Survey | April 10 – 22, 2020 |
| Tervonen | Willingness to wait for a vaccine against COVID-19: Results of a preference survey | The Patient-Patient-Centered Outcomes Research | 2020 | Multi-Country | Survey | May 5 – 29, 2020 |
| Turcu-Stiolica | Influence of COVID-19 on health-related quality of life and the perception of being vaccinated to prevent COVID-19: An approach for community pharmacists from Romania and Bulgaria | Journal of Clinical Medicine | 2021 | Romania & Bulgaria | Survey | July 15 – Aug 15, 2020 |
| Wang | Change of willingness to accept COVID-19 vaccine and reasons of vaccine hesitancy of working people at different waves of local epidemic in Hong Kong, China: Repeated cross-sectional surveys | Vaccines | 2021 | China | Survey | Feb 2020 & Aug-Sep 2020 |
| Williams | Social patterning and stability of intention to accept a COVID-19 vaccine in Scotland: Will those most at risk accept a vaccine? | Vaccines | 2021 | Scotland | Survey | May – Aug, 2020 |

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|---|---|---|---|---|---|---|
| Wong | Acceptance of the COVID-19 vaccine based on the health belief model: a population-based survey in Hong Kong | Vaccine | 2021 | China | Survey | July 27 – Aug 18, 2020 |
| Yin | Unfolding the determinants of COVID-19 vaccine acceptance in China | Journal of medical Internet research | 2021 | China | Survey | Jan – Oct, 2020 |
| Yoda | Willingness to receive COVID-19 vaccination in Japan | Vaccines | 2021 | Japan | Survey | Sept 2020 |
| Yu | Understanding the prevalence and associated factors of behavioral intention of COVID-19 vaccination under specific scenarios combining effectiveness, safety, and cost in the Hong Kong Chinese general population | International Journal of Health Policy and Management | 2021 | China | Survey | Sept 16-30, 2020 |
| Zeballos | Social media exposure, risk perception, preventive behaviors and attitudes during the COVID-19 epidemic in La Paz, Bolivia: A cross sectional study | PloS One | 2021 | Bolivia | Survey | April – May, 2020 |
| Zhang | Behavioral intention to receive self-financed and free COVID-19 vaccination among Chinese factory workers who resumed work during the pandemic: Cross-sectional online survey | Journal of Medical Internet Research | 2021 | China | Survey | Sept 1-7, 2020 |
| Zhang | Willingness of the general population to accept and pay for COVID-19 vaccination during the early stages of COVID-19 pandemic: A nationally representative survey in mainland China | Human Vaccines & Immunotherapeutics | 2021 | China | Survey | March – May, 2020 |
| Akarsu. | While studies on COVID-19 vaccine is ongoing, the public's thoughts and attitudes to the future COVID-19 vaccine | International Journal of Clinical Practice | 2021 | Turkey | Survey | June 10 – July 10, 2020 |
| AlHajri | Willingness of parents to vaccinate their children against influenza and the novel coronavirus disease-2019 | The Journal of Pediatrics | 2021 | Kuwait | Survey | Aug 26 – Sept 1, 200 |
| Al-Mohaithef | Determinants of COVID-19 vaccine acceptance in Saudi Arabia: A web-based national survey | Journal of Multidisciplinary Healthcare | 2020 | Saudi Arabia | Survey | NA |
| Barello | Vaccine hesitancy' among university students in Italy during the COVID-19 pandemic | European Journal of Epidemiology | 2020 | Italy | Survey | NA |

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|---|---|---|---|---|---|---|
| Bell | Parents' and guardians' views on the acceptability of a future COVID-19 vaccine: A multi-methods study in England | Vaccine | 2020 | England | Mixed Methods | April 19 – May 11, 2020 |
| Callaghan | Correlates and disparities of intention to vaccinate against COVID-19 | Social Science & Medicine | 2020 | United States | Survey | May 28 – June 8, 2020 |
| COVID Collaborative | COVID Collaborative survey: Coronavirus vaccination hesitancy in the Black and Latinx communities | NA | 2020 | United States | Survey | Aug 27-30 |
| Dodd | Willingness to vaccinate against COVID-19 in Australia | The Lancet Infectious Diseases | 2021 | Australia | Survey | April 17-21 |
| Dodd | Concerns and motivations about COVID-19 vaccination | The Lancet Infectious Diseases | 2021 | Australia | Survey | June – July, 2020 |
| Dong | Public preference for COVID-19 vaccines in China: A discrete choice experiment | Health Expectations | 2020 | China | Experiment | June – July, 2020 |
| Dror | Vaccine hesitancy: the next challenge in the fight against COVID-19 | European Journal of Epidemiology | 2020 | Israeli | Survey | March 2020 |
| Faasse | Public perceptions of COVID-19 in Australia: perceived risk, knowledge, health-protective behaviors, and vaccine intentions | Frontiers in Psychology | 2020 | Australia | Survey | March 2 – 9, 2020 |
| Goldman | Caregiver willingness to vaccinate their children against COVID-19: Cross sectional survey | Vaccine | 2020 | Multi-Country | Survey | March 26 – May 31 |
| Graffigna | Relationship between citizens' health engagement and intention to take the COVID-19 vaccine in Italy: A mediation Analysis | Vaccines | 2020 | Italy | Survey | NA |
| Harapan | Acceptance of a COVID-19 vaccine in Southeast Asia: A cross-sectional study in Indonesia | Frontiers in Public Health | 2020 | Indonesia | Survey | March 25 – April 6, 2020 |
| Head | A national survey assessing SARS-CoV-2 vaccination intentions: Implications for future public health communication efforts | Science Communication | 2020 | United States | Survey | May 2020 |
| Khubchandani | COVID-19 vaccination hesitancy in the United States: A rapid national assessment | Journal of Community Health | 2021 | United States | Survey | June 2020 |

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| Kreps | Factors associated with US adults' likelihood of accepting COVID-19 vaccination | JAMA Network Open | 2020 | United States | Survey | July 9, 2020 |
| La Vecchia | Attitudes towards influenza vaccine and a potential COVID-19 vaccine in Italy and differences across occupational groups, September 2020 | Medicina Del Lavoro | 2020 | Italy | Survey | Sept 2020 |
| Muqattash | Survey data for COVID-19 vaccine preference analysis in the United Arab Emirates | Data in Brief | 2020 | United Arab Emirates | Survey | July 4 – Aug 4, 2020 |
| Olagoke | Intention to vaccinate against the novel 2019 Coronavirus disease: The role of health locus of control and religiosity | Journal of Religion and Health | 2021 | United States | Survey | March 22, 2020 |
| Palamenghi | Mistrust in biomedical research and vaccine hesitancy: the forefront challenge in the battle against COVID-19 in Italy | European Journal of Epidemiology | 2020 | Italy | Survey | NA |
| Pogue | Influences on attitudes regarding potential COVID-19 vaccination in the United States | Vaccines | 2020 | United States | Survey | NA |
| Prati | Intention to receive a vaccine against SARS-CoV-2 in Italy and its association with trust, worry and beliefs about the origin of the virus | Health Education Research | 2020 | Italy | Survey | April 2020 |
| Qiao | Vaccine acceptance among college students in South Carolina: Do information sources and trust in information make a difference? | Preprint | 2020 | United States | Survey | Sept 2020 |
| Reiter | Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated? | Vaccine | 2020 | United States | Survey | May 2020 |
| Rhodes | Intention to vaccinate against COVID-19 in Australia | The Lancet Infectious Diseases | 2020 | Australia | Survey | June 15 – 23, 2020 |
| Romer | Conspiracy theories as barriers to controlling the spread of COVID-19 in the U.S | Social Science & Medicine | 2020 | United States | Survey | March 2020 |
| Salali | COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the UK and Turkey | Psychological medicine | 2020 | United Kingdom & Turkey | Survey | May 2020 |
| Sherman | COVID-19 vaccination intention in the UK: results from the COVID-19 vaccination acceptability study (CoVAccS), a nationally representative cross-sectional survey | Human Vaccines & Immunotherapeutics | 2020 | United Kingdom | Survey | July 14 – 17, 2020 |

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| The COCONEL Group | A future vaccination campaign against COVID-19 at risk of vaccine hesitancy and politicisation | The Lancet Infectious Diseases | 2020 | France | Survey | March 27 – 29, 2020 |
| Wang | Acceptance of COVID-19 Vaccination during the COVID-19 Pandemic in China | Vaccines | 2020 | China | Survey | March 2020 |
| Wang | Intention of nurses to accept coronavirus disease 2019 vaccination and change of intention to accept seasonal influenza vaccination during the coronavirus disease 2019 pandemic: A cross-sectional survey | Vaccine | 2020 | China | Survey | Feb 31 – March 31, 2020 |
| Ward | The French public's attitudes to a future COVID-19 vaccine: The politicization of a public health issue | Social Science & Medicine | 2020 | France | Survey | April 2020 |
| Williams | Towards intervention development to increase the uptake of COVID-19 vaccination among those at high risk: Outlining evidence-based and theoretically informed future intervention content | British Journal of Health Psychology | 2020 | United Kingdom | Survey | April 2020 |
| Wong | The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay | Human Vaccines & Immunotherapeutics | 2020 | Malaysia | Survey | April 3 – 12, 2020 |
| Zhang | Parental acceptability of COVID-19 vaccination for children under the age of 18 Years: Cross-sectional online survey | JMIR Pediatrics and Parenting | 2020 | China | Survey | Sept 1 – 7, 2020 |
| Whitebridge | Perceptions, knowledge, and behaviors related to COVID-19 among social media users: Cross-sectional study | Journal of Medical Internet Research | 2020 | Multi-Country (Arabian Gulf countries) | Survey | March 28 – April 4, 2020 |

## Appendix 2. 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 | |