



What are the barriers and facilitators to individuals' willingness to be vaccinated for COVID-19?

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What are the barriers and facilitators to individuals' willingness to be vaccinated for COVID-19?

The objective of this report is to summarize evidence on the barriers to and facilitators of individuals' willingness to receive a COVID-19 vaccine and potential strategies to address vaccine hesitancy.

Key Messages:

- There is a growing body of evidence documenting individuals' willingness to receive a COVID-19 vaccine and the factors underlying their willingness.
- Eighteen surveys conducted across the globe from March to July 2020 found individuals' willingness to receive a COVID-19 vaccine varied greatly. The proportion of respondents positively inclined towards receiving a COVID-19 vaccine ranged from 58% in a US-based sample to 93% in an Indonesian-based sample.
- Facilitators associated with increased willingness to receive a COVID-19 vaccine include greater perceived risk from COVID-19, various population characteristics (e.g., being male, older, educated, with higher income), and valuing healthcare provider's recommendations.
- Barriers to willingness included low-perceived risk from COVID-19, being of Latinx or Black racial/ethnic background, and concerns about vaccine safety.
- Barriers and facilitators mapped most commonly to several theoretical domains including: beliefs about consequences; social/professional role and identity; emotion; knowledge; social influences; environmental context and resources; and behavioral regulation.
- Communication strategies may consider various behavior change techniques to address determinants of individuals' willingness to receive a COVID-19 vaccine, including information about health consequences, social support or encouragement, prompts/cues, among others.

Who is this summary for?

This summary was undertaken as a rapid evidence review for the Rhode Island Department of Health's (RIDOH's) Mass Vaccination Taskforce and is intended for use by RIDOH stakeholders and their partners to support decision-making for communication and health messaging campaigns about the COVID-19 vaccine and the RI vaccination program.

Information about this rapid review

This report offers a broad collection of literature and evidence sources with an emphasis on published primary studies that have sought to understand barriers and facilitators of individuals' willingness to receive a COVID-19 vaccine and potential strategies to address these behavioral determinants. The report is presented with the main findings up front, followed by the methods and references at the back of the report.

Updating the review

We will continue to add evidence to this report as it becomes available and provide an updated report to the RIDOH Mass Vaccination Taskforce in Feb 2021.

Many sections conclude with a **"bottom line"** subsection that provides a summary of the studies and/or provides context. These statements are not meant to address all of the evidence in existence on the subject, but rather only that which is featured in this document.

Further information

All papers summarized in this report, and extracted data are available by request to kristin_danko@brown.edu

I. Background

Hesitancy to receive a COVID-19 vaccine is a major concern. Evidence suggests one-third of Americans may be unwilling to receive a COVID vaccine when it becomes available and many more are uncertain (1). While vaccine hesitancy is not new (2), vaccine hesitancy as it relates to COVID-19 presents an imminent public health challenge. Any delay in the uptake of safe and effective vaccines will only prolong transmission of COVID-19, increasing morbidity and mortality, and delaying economic and social recovery from the pandemic. Consequently, there is a push for public health experts and communicators to understand the factors contributing to one's hesitancy to receive a COVID-19 vaccine and to develop messaging campaigns to address these factors. Understanding the unique factors that may influence one's willingness to receive a COVID-19 vaccine among marginalized populations is especially important given the disproportionate impact (health, economic, and emotional) COVID-19 has had on these populations (3-5).

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We thus conducted a rapid review of the evidence of barriers/facilitators to individuals' willingness to receive a COVID-19 vaccine, along with potential strategies to address these barriers/facilitators. Rapid reviews are a form of evidence synthesis that use abbreviated systematic review methods to answer pressing health questions in short time frames, often for localized decision-making purposes. While not a replacement for a full systematic review, they still seek to uphold the principles of robust evidence synthesis including comprehensive searches, rigorous extraction, and transparent reporting (6). The review is part of a larger project in collaboration with the Rhode Island Department of Health (RIDOH) that will combine global published evidence with local formative research to develop a state-wide public health messaging campaign to promote COVID-19 vaccine uptake.

II. Willingness to vaccinate

Of the 818 citations returned from our searches, 18 surveys (1, 7-23) and 4 commentaries (24-27) met our eligibility criteria and are summarized in this report (**Table 1**). With the exception of 5 US-based studies (1, 9, 13, 17, 20), all of the surveys sampled populations outside of the US, including those from Australia (11), Israel (12), Malaysia (23), Indonesia (16), China (14, 21), Kuwait (7), and various European countries (Italy, Denmark, France, Germany, Italy, Portugal, Holland, UK) (8, 10, 15, 18, 19). Samples sizes ranged from 209 to 7,664. Where sampling methods were reported, studies typically recruited participants using convenience sampling (e.g., purposive, snowballing), as compared to random (i.e., representative) sampling methods (19-21). Surveys were conducted between March and July 2020, prior to the release of safety and effectiveness results for Pfizer and Moderna's vaccines.

Across countries and time points sampled, the majority of participants stated a certain or likely willingness to receive a COVID-19 vaccine. The proportion of respondents positively inclined towards receiving a COVID-19 vaccine ranged from 58% in a US-based sample (13) to 93% in an Indonesian-based sample (16). Three other US-based surveys found similar but slightly higher levels of willingness (60% to 69%) (1, 17, 20), though there has been concern that Americans' willingness to receive a COVID-19 vaccine has decreased over time (20). A small but important proportion of respondents across surveys were certainly or likely unwilling to receive a COVID-19 vaccine, ranging from 5% of respondents to a Malaysian-based survey (23) to 33% of respondents to a US-based survey (17). Of note for public messaging campaigns, a large portion of participants are still undecided in their intention to receive a COVID-19 vaccine (7% to 32%) (13, 22), especially when taken together with those stating an uncertainty in their willingness/unwillingness to receive a COVID-19 vaccine.

Bottom line: This section summarized evidence from 18 surveys (5 U.S.-based) of varying design, sample size, and populations, on respondent's willingness to receive a hypothetical future COVID-19 vaccine. The evidence suggests that roughly 2/3 of the American population may be willing to receive a COVID-19 vaccine when one becomes available. A small but concerning proportion of the population may be unwilling to receive a COVID-19 vaccine while as much as 1/3 to 1/2 are uncertain and require additional information to make their decision.

Table 1. Survey evidence on willingness to receive a COVID-19 vaccine and participants' reported barriers and facilitators to willingness

Author, Country Date of publication	Sampling method	Sample size	Data collected	Study aim	Willing to receive vaccine (%) ¹
Romer, USA, Sept-2020	Random	1050 ² ; 840 ³	Mar-20 ² ; Jul-20 ³	To assess the relationship between belief in conspiracy theories and adoption of preventive measures recommended by public health authorities and vaccination intentions in a nationally representative US-based sample	Very likely to be vaccinated (60%) ² Not at all or not too likely (15%) ² Not at all or not too likely (26%) ³
Fisher, USA, Sept-2020	NR	1,003	Apr-20	To identify predictors of vaccine hesitancy in the US	Willing (58%) Not sure (32%) Unwilling (11%)
Corpuz, USA, Jul-2020	Convenience	209	May-20	To examine predictors of attitudes and behaviors with regard to the COVID-19 pandemic (including mandatory vaccination endorsement)	NR ⁴
Reiter, USA, Sept-2020	Convenience	2,006	May-20	To examine the acceptability of a COVID-19 vaccine among a national sample of adults in the US	Definitely willing (48%) Probably willing (21%) Not sure (17%) Probably not willing (5%) Definitely not willing (9%)
Malik, USA, Sept-2020	Convenience	672	May-20	To describe vaccine acceptance landscape	Accept if recommended (67%) Not accept if recommended (33%)
Neumann- Böhme, Europe ⁵ , Jun- 2020	NR	7,664	Apr-20	To assess willingness to get a COVID-19 vaccine when one becomes available and understand reasons why/why not	Willing (74%) Not sure (19%) Not willing (7%)
Ali, Kuwait, Sept-2020	Convenience	5,677	Mar/Apr- 20	To examine knowledge of COVID-19 symptoms, protective measures against COVID-19, and source(s) of information about COVID-19	Very likely (46%) Somewhat likely (26%) Neutral (18%) Somewhat unlikely (7%) Very unlikely (3%)
Dodd, Australia, Jun-2020	NR	4,362	Apr-20	To determine Australians perceptions on COVID-19 precautions and vaccine willingness	Would get (86%) Indifferent (9%) Would not get (5%)
Detoc, France, Sep-2020	Convenience	3,259	Mar/Apr- 20	To determine the proportion of people who intend to get vaccinated against COVID-19 in France or to participate in a vaccine clinical trial	Yes, certainly (24%) Yes, possibly (54%) Unsure (12%) No, possibly (6%) Definitely, no (4%)
Wang, China, Aug-2020	Random	2,058	Mar-20	To evaluate the acceptance of future COVID-19 vaccination, the preference for vaccine attributes and vaccination schedules, as well	Accept if available (91%) If accept:

¹ Question prompts, underlying assumptions (e.g., cost, efficacy), and response scales varied somewhat across studies which may have contributed to variation in 'willingness' broadly defined

² Wave 1 of survey

³ Wave 2 of survey

⁴ Assessed barriers and facilitators only; did not survey participants willingness to receive a vaccine

⁵ Denmark, France, Germany, Italy, Portugal, Holland, UK

				as the influencing factors on vaccination acceptance among the Chinese adult population	<ul style="list-style-type: none"> • Prefer to be vaccinated right away (52%) • Prefer to delay until vaccine safety is confirmed (48%)
Dror, Israel, Aug-2020	NR	1,941	Mar-20	To determine vaccination compliance among Israeli populations for a future COVID-19 vaccine, and among refusers, explore the impact of occupation, exposure to either a suspected or confirmed COVID-19 cases, and history of vaccinations to influenza.	Accept (75%) Not accept (25%)
Harapan, Indonesia, Jul-2020	Convenience	1,359	Mar/Apr-20	To assess the acceptance of a hypothetical COVID-19 vaccine among the general population in Indonesia	Accept if vaccine is 95% effective (93%) Accept if vaccine is 50% effective (67%)
Wong, Malaysia, Jul-2020	Convenience	1,159	Apr-20	To 1) assess participants' perceptions of susceptibility and severity of the COVID-19 infection, benefits and barriers of the vaccine and cues to action; and 2) identify predictors of participants' intention to receive the COVID-19 vaccine and their willingness to pay for COVID-19 vaccination	Yes, definitely (48%) Yes, probably (30%) Yes, possibly (16%) Probably not (3%) Definitely not (2%)
Palamenghi, Italy, Aug-2020	Random	1,004	NR	To understand Italian citizens' perceptions and behaviors about preventive behaviors and willingness to receive a COVID-19 vaccine	Likely or very likely (59%) Unclear or unlikely (NR)
Barello, Italy, Aug-2020	Convenience	735	NR	To explore Italian university students attitudes towards a future vaccine to prevent COVID-19 and evaluate the impact of the university curricula (healthcare vs. non-healthcare curricula) on the intention to vaccinate	Positive intention (86%) Negative/unclear intention (14%)
Williams, UK, Sept-2020	Convenience	527	Apr-20	To identify and understand the barriers and facilitators to receiving a future COVID-19 vaccine and, using the Behavior Change Wheel as a framework, and to provide recommendations for the design of interventions aimed at maximizing uptake of the vaccine among the public	Receive when available: Definitely (58%) Probably (27%) Unsure (7%) Probably not want (2%) Definitely not want (6%)
Fu, China, Apr-2020	Convenience	541	Mar-20	To report the expectation and acceptance of future COVID-19 vaccine in health care workers compared with the general population and preferences for COVID-19 vaccination	General population willing (73%) HCW population willing (76%)
COCONEL Group, France, Jul-2020	NR	NA	Mar-20	To estimate the French public's intention to receive a COVID-19 vaccine	Use if available (74%) Not use if available (26%)

Abbreviations: HCW: health care worker

III. Barriers and facilitators to vaccination

All 18 surveys provided evidence on the potential factors underlying respondent's willingness/unwillingness to receive a future COVID-19 vaccine (i.e., barriers/facilitators). Using the Theoretical Domains Framework (TDF) (28), a framework developed for implementation researchers to assist in identifying cognitive, affective, social and environmental factors that may influence the performance of a health behavior (i.e. behavioral determinants)(29), we identified six (of a possible 14) domains that appear to be important determinants of one's willingness to receive a COVID-19 vaccine. These included:

- Beliefs about consequences
- Social/professional role and identity
- Emotion
- Knowledge
- Social influences
- Environmental context and resources
- Behavioral regulation

Domains that did not emerge as important determinants of willingness to receive a COVID-19 vaccine included: Skills; Reinforcement; Intentions; Goals; Memory, attention, and decision processes. A summary of the evidence relating to each relevant domain is below.

a) Beliefs about consequences

TDF Domain	Definition	Constructs
Beliefs about Consequence	Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation	Beliefs; Outcome expectancies; Characteristics of outcome expectancies; Anticipated regret; Consequents
Barriers and facilitators identified		
Facilitators	<ul style="list-style-type: none">• Higher perceived risk of contracting COVID-19 (1, 10, 14, 16, 22, 23) or severe COVID-19 infection (12)• Perceived effectiveness of a COVID-19 vaccine (1, 14, 21, 23)• Belief that the vaccination will lead to herd immunity and protect others (22)	
Barriers	<ul style="list-style-type: none">• Low perceived risk from COVID-19 (risk is exaggerated (11); not dangerous to their health (18))• Belief that natural immunity from COVID-19 is better (12)	

One of the most important determinants of individuals' willingness to receive a COVID-19 vaccine was their beliefs about consequences, specifically beliefs related to the severity of the COVID-19 disease and the potential effects of a COVID-19 vaccine to counter it. Individuals reporting a higher perceived risk of contracting COVID-19 consistently reported a greater willingness to receive a COVID-19 vaccine (1, 10, 14, 16, 22, 23). This finding was especially apparent among individuals who perceived themselves to be at greater risk of contracting COVID-19 (e.g., healthcare workers) (14) or having risk factors that make them more likely suffer worse outcomes from it (e.g., older age; underlying comorbidities) (22). On the other hand, individuals who believed that the severity of a COVID-19 infection has been exaggerated or is low were less likely to be willing to receive a COVID-19 vaccine (11, 18).

Unsurprisingly, individuals reporting stronger beliefs in the effectiveness of a COVID-19 vaccine and its potential to reduce one's chances of a COVID-19 infection were more likely to be willing to receive a COVID-19 vaccine (1, 21, 23). One unique survey of Indonesians even showed individuals' willingness to receive a COVID-19 vaccine varied depending on the assumed effectiveness of the vaccine (95% vs. 50% effective associated with 93% and 67% vaccine acceptance, respectively) (16). In contrast, individuals holding the belief that natural immunity from COVID-19 is better than receiving a vaccine were less likely to accept a vaccine (12). Finally, individuals reporting a willingness to receive a COVID-19 vaccine tended to also believe that it would help protect others and facilitate achieving population herd immunity (and thus end the pandemic) quicker (22).

b) Social/professional role and identity

TDF Domain	Definition	Constructs
Social/professional role and identity	A coherent set of behaviors and displayed personal qualities of an individual in a social or work setting	Professional identity; Professional role; Social identity; Identity; Professional boundaries; Professional confidence; Group identity leadership; Organizational commitment; Self-confidence
Barriers and facilitators identified		
Facilitators	<ul style="list-style-type: none"> • Male (vs. female) (1, 7, 10, 12, 13, 17, 23) • Older age (vs. younger) (1, 13, 17) • Profession as a healthcare worker (vs. non-healthcare worker) (7, 10, 12, 16) • Higher household income (vs. lower) (1, 15) • Moderate/liberal political leaning (vs. conservative) (1, 15) • Higher educational attainment (vs. lower education) (13, 17) 	
Barriers	<ul style="list-style-type: none"> • Racial/ethnic minorities (Lantinx; Black) (1, 13, 17) 	

Overall, the literature suggested certain demographic characteristics are associated with individuals' willingness to vaccinate.

- **Gender:** There was a consistent finding across studies that men were more likely to accept a COVID-19 vaccine than women (1, 7, 10, 12, 13, 17, 23) and, in one study, more likely to accept the vaccine right away vs. accept after a delay (21).
- **Race/ethnicity:** Three US-based surveys found Black Americans (1, 13, 17) and Lantinx (1, 13) respondents were much less likely to be willing to receive a COVID-19 vaccine compared to White Americans. For example, in one national survey conducted in April, only 39% of respondents who identified as Black reported an intent to be vaccinated (vs. 64% who identified as White) with only a slightly higher proportion among respondents who identified as Hispanic (45%) (13). Another national survey conducted in May observed a higher willingness to receive a COVID-19 vaccine for both Black and Lantinx respondents (55% and 74%, respectively). However, the latter study used convenience methods for participant recruitment, and thus was more prone to selection bias (1). Of note, one US-based observed that respondents identifying as Asian were the most likely to report willingness to receive a COVID-19 vaccine (17).
- **Age:** While respondents meeting survey's respective age cut offs for the oldest age category appeared most likely to accept a COVID-19 vaccine, the relationship among younger age groups was more variable and possible not linear. For example, one US-based survey conducted in April found 77% of adults aged 60 or older were willing to receive a COVID-19 vaccine compared to 50%, 47%, and 52% of adults aged 18-29, 30-34, and 45-59, respectively (13). Another US-based survey conducted in May found 76% of adults aged 65 or older were willing to receive a COVID-19 vaccine compared to 71%, 65%, and 64% of adults aged 18-29, 30-49, and 50-64, respectively (1). Additionally, a third US-based study found older adults aged 55 or older were more likely to accept a COVID-19 vaccine (compared to younger adults) if it was recommended to them (17). However, one survey of French citizens found adults over 75 (along with younger women) were less willing to receive a COVID-19 vaccine (15). There is some suggestion that younger adults may be more willing to be vaccinated than middle-aged adults (18, 19) although several studies have noted potential age/sex interactions with that may influence these relationships. For example, men aged 18-24 (12%) were the least willing to receive a COVID-19 vaccine in a large-European survey, whereas uncertainty among women was largest for women aged 45 to 54 (26%) (18).
- **Profession as a healthcare worker:** Evidence from several global surveys suggests that respondents reporting a profession in healthcare were more willing to be vaccinated for COVID-19 compared with non-healthcare workers (7, 10, 12, 16). Evidence from one Israel-based survey however suggests that willingness may vary among different healthcare professions. For

example, the study found that doctors were more willing compared with nurses (78% vs 61%) and healthcare workers working in departments treating COVID-19 patients were more willing compared with those who do not work directly with COVID-19 patients (94% vs 77%) (12).

- **Household income:** Two studies (US- and French-based) found that respondents from households that met their respective low-income definitions were less likely to be willing to be vaccinated for COVID-19 compared with those that were considered high-income (1, 15).
- **Political leaning:** One US-based survey found willingness to receive a COVID-19 vaccine was higher among respondents holding moderate or liberal political views as compared with those conservative views (1). A related finding was observed in a French-based survey that observed those reporting having previously voted at the political extremes (far left or right) or who had not voted were more likely to refuse a COVID-19 vaccine (15).
- **Educational attainment:** Based on the findings of two surveys (one US-based), respondents reporting a higher level of educational attainment were more likely to report a willingness to receive a COVID-19 vaccine (11, 13, 17).

c) Emotion

TDF Domain	Definition	Constructs
Emotion	A complex reaction pattern, involving experiential, behavioral, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear; Anxiety; Affect; Stress; Depression; Positive/negative affect; Burn-out
Barriers and facilitators identified		
Facilitators	<ul style="list-style-type: none"> • Not worried about COVID-19 vaccine side effects (23) • Fear about COVID-19 (10) 	
Barriers	<ul style="list-style-type: none"> • Concerned with safety of the vaccine (12, 13, 18, 21) (including speed at which it was developed and safety for specific populations) • Concerns for religious beliefs (e.g., halal/kosher) 	

Emotion was an important determinant of respondents' willingness to receive a COVID-19 vaccine, particularly related to fears about the vaccine safety given its rapid development (12, 13, 18, 21). For example, one US-based study found concerns about the safety (and effectiveness) of a vaccine was the most common reason cited by participants who were unsure or unwilling to receive a COVID-19 vaccine (13). Another survey of European citizens found respondents were concerned about the experimental nature of COVID-19 vaccines and the fact that there was no evidence about its safety for specific groups (e.g., pregnant women, people with allergies or preexisting conditions such as multiple sclerosis) (18). This same study observed that concerns about side effects were more frequent among women than men (18) (consistent with women being less willing to receive a COVID-19 vaccine across multiple studies). One study observed that almost half (48%) of participants willing to receive a COVID-19 vaccine preferred to delay until the new vaccine's safety was confirmed (21). In contrast, one study found that participants reporting no worries about the possible side-effects of a COVID-19 vaccine were more likely to report a definite intention to receive a COVID-19 vaccine (23).

Beyond concerns about safety, there was some evidence to suggest that worry and fears about COVID-19 (e.g., contracting the virus or transmitting it to someone in their family) may increase one's willingness to receive a COVID-19 vaccine (10, 20) and that certain religious groups may have concerns about whether COVID-19 vaccines are halal/kosher (23).

d) Knowledge

TDF Domain	Definition	Constructs
Knowledge	An awareness of the existence of something	Knowledge (including knowledge of condition/scientific rationale); Procedural knowledge; Knowledge of task environment
Barriers and facilitators identified		
Barriers	<ul style="list-style-type: none"> Lack of knowledge about vaccine safety and effectiveness (13, 21) 	

Closely related to the domain of emotion was the domain of knowledge. Individuals who felt uncertain about the safety and effectiveness of COVID-19 vaccines (i.e., wanted more information to inform their decision-making) were less likely to be willing to receive a COVID-19 vaccine (13, 21).

e) Social influences

TDF Domain	Definition	Constructs
Social influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors	Social pressure; Social norms; Group conformity; Social comparisons; Group norms; Social support; Power; Intergroup conflict; Alienation; Group identity; Modelling
Barriers and Facilitators identified		
Facilitators	<ul style="list-style-type: none"> Healthcare provider recommendation (1, 17, 21) 	

Social influences appear to also play a role in accepting a COVID-19 vaccine. Evidence from China and the United States indicates that individuals value their health care provider's recommendations and would be more willing to receive a COVID-19 vaccine if their doctor recommended it (1, 17, 21).

f) Environmental context and resources

TDF Domain	Definition	Constructs
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior	Environmental stressors; Resources/material resources; Organizational culture/climate; Salient events/critical incidents; Person and environment interaction; Barriers and facilitators
Barriers and facilitators identified		
Facilitators	<ul style="list-style-type: none"> Affordable and convenient (if feasible) (1, 14, 21) Persistent incidence or high prevalence of COVID-19 (1, 14) 	
Barriers	<ul style="list-style-type: none"> Mistrust in vaccine development and dissemination (13, 19) 	

Various factors related to individuals' environmental context and access to resources appeared to influence their willingness to receive a vaccine, including vaccine price and ease of access, trust in vaccine development, and regional infection rates from the virus. With respect to price and access, unsurprisingly, individuals are more likely to be willing to receive a COVID-19 vaccine if it is affordable/covered by insurance (1, 14, 21) and convenient to obtain (14). They are also more willing to receive a COVID-19 vaccine if the number of people becoming infected with COVID-19 is higher (1) or the disease turns out to be persistent/seasonal (14). In contrast, individuals' lacking trust in scientific research or entities involved in vaccine development were less likely to be willing to receive a COVID-19 vaccine (13, 19).

g) Behavioral regulation

TDF Domain	Definition	Constructs
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring; Breaking habit; Action planning
Barriers and facilitators identified		
Facilitators	<ul style="list-style-type: none">• Previous influenza vaccine (12, 13, 17, 21)	

Finally, a consistent and reliable predictor of individuals' willingness to receive a COVID-19 vaccine was having received the influenza vaccine during previous influenza seasons. This finding may relate to the automatic behavior of obtaining a vaccine (and thus a behavior to be promoted in the population in the future) but may also be an indirect measure of vaccine confidence in general (12, 13, 17, 21).

Bottom line:

This section summarized evidence from 18 surveys (5-US based) of varying design, sample size, and populations, on the reported barriers and facilitators of individuals' willingness to receive a COVID-19 vaccine. Barriers and facilitators mapped most commonly to the TDF domains; beliefs about consequences, social/professional role and identity, emotion, knowledge, social influences, environmental context and resources, and behavioral regulation. Across domains, the most relevant **barriers** to individuals' willingness to receive a COVID-19 vaccine appear to be low perceived-risk from COVID, being of Latinx or Black racial/ethnic background, and concerns about vaccine safety. The most relevant **facilitators** appear to be greater perceived risk from COVID, various population characteristics (e.g., being male, older, educated, with higher income), and valuing healthcare provider's recommendations.

V. Strategies (drawn from the evidence) to increase vaccination

Although no study in this review tested the effectiveness of strategies to address the factors (i.e. barriers/facilitators) influencing individuals' willingness to receive a COVID-19 vaccine, most offered recommendations of strategies public health experts and communicators may consider in designing campaigns to optimize vaccine uptake. The recommendations fell under general themes of:

- *educate, persuade, tailor, and build trust* to increase individuals' motivation; and
- *minimize barriers to access* to increase individuals' opportunity to receive a COVID-19 vaccine.

These strategies are described below.

Educate

- Inform the public on the basics of the immune system and how vaccines work (26)
- Communicate evidence on the safety and effectiveness of COVID-19 vaccines (12, 18, 21, 23) and do so in a way that it is accessible to individuals with varying educational backgrounds (13)
- Describe the process of vaccine development and how the quality and safety of COVID-19 vaccines have been ensured, despite rapid timelines (12, 15)

Persuade

- Emphasize the severity of COVID and the high risk it poses to self and others (1, 23)
- Emphasize the responsibility one has to protect others (8)
- Increase the presence of public health messaging in mainstream media, particularly in conservative outlets (20)

Tailor

- Target messages and outreach to populations at risk for not being vaccinated (e.g., women, American Black and Latinx populations) (13, 17, 18, 23) and the specific factors impacting willingness in these populations. (N.B. messaging and education to high-risk marginalized groups requires community engagement and cultural humility (17))
- Target messaging to state of individuals' vaccine willingness. For example, for individuals positively inclined to receive a COVID-19 vaccine, communicate vaccine efficacy and promote healthcare provider recommendations. For uncertain/unwilling individuals, aim to alleviate concerns about vaccine side effects (1)
- Anti-vaccination rhetoric and beliefs are difficult to overcome with informational health messaging; suggest utilizing narratives/stories (13)
- Consider using motivational interviewing by trained vaccine counsellors to engage vaccine-hesitant individuals (13)
- Consider using multiple strategies simultaneously (e.g., trusted physicians promote vaccine uptake against a backdrop of innovative strategies to combat vaccine misinformation) (13)

Build trust

- Monitor data on vaccine safety and side effects and make this information publicly available on a regular basis (21)
- Be humble and upfront – evidence on vaccine safety and effectiveness is evolving daily and we are working with the information at hand. Acknowledge the possibility of varying effects or possible side effects to avoid further loss of trust if or when unforeseen events happen (13)
- Leverage the use of trusted agents, particularly healthcare providers, to educate and encourage vaccine uptake (1, 17, 21)
- Engage in bidirectional collaborative dialogue with the public as compared to 'top down' approaches (19)

Minimize barriers to access

- Price, convenience, etc. (21)

VI. Strategies (drawn from behavioral science) to increase vaccination

In addition to strategies recommended in the literature, we linked the key TDF domains identified to behavior change techniques (BCTs) believed to influence these domains. Potential BCTs that may be considered in designing campaigns to optimize vaccine uptake are listed in **Table 2**. With the exception of certain BCTs that were deemed irrelevant to the target behavior of receiving a COVID-19 vaccine (e.g., biofeedback, self-monitoring of the behavior), we present the comprehensive list of potential BCTs linked to each domain. Public health experts and communicators would thus need to consider the feasibility and appropriateness of applying potentially relevant BCTs in practice, given logistical constraints and population factors. Of note, one may consider prioritizing BCTs targeting multiple domains (noted with a *) as these offer the convenient advantage of addressing multiple domains/behavioral determinants simultaneously.

Table 2. Potential behavior change techniques (BCTs) to address identified behavioral domains

Theoretical domain	Behavior change technique to address domain (30)
Beliefs about consequences	<p>*Information about emotional consequences – Provide information (e.g., written, verbal, visual) about emotional consequences of performing the behavior</p> <p>Covert sensitization – Advise to imagine performing the unwanted behavior in a real-life situation followed by imagining an unpleasant consequence</p> <p>Anticipated regret – Induce or raise awareness of expectations of future regret about performance of the unwanted behavior</p> <p>Social and environmental consequences – Provide information (e.g., written, verbal, visual) about social and environmental consequences of performing the behavior</p> <p>Comparative imagining of future outcomes – Prompt or advise the imagining and comparing of future outcomes of changed versus unchanged behaviour</p> <p>Vicarious reinforcement – Prompt observation of the consequences (including rewards and punishments) for others when they perform the behavior</p> <p>Threat – Inform that future punishment or removal of reward will be a consequence of performance of an unwanted behavior</p> <p>Pros and cons – Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behavior</p> <p>Covert conditioning – Advise to imagine performing the wanted behavior in a real-life situation followed by imagining a pleasant consequence</p>
Emotion	<p>Reduce negative emotions – Advise on ways of reducing negative emotions to facilitate performance of the behavior</p> <p>*Information about emotional consequences – Provide information (e.g., written, verbal, visual) about emotional consequences of performing the behavior</p> <p>*Social support (emotional) – Advise on, arrange, or provide emotional social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behavior</p>
Knowledge	<p>Information about health consequences – Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behavior (Note: consequences can be for any target, not just the recipient(s) of the intervention)</p>
Social influences	<p>Social comparison – Draw attention to others' performance to allow comparison with the person's own performance</p> <p>Social support or encouragement (general) – Advise on, arrange or provide social support (e.g., from friends, relatives, colleagues, 'buddies' or staff) or noncontingent praise or reward for performance of the behavior. It includes encouragement and counselling, but only when it is directed at the behavior</p> <p>Information about others' approval – Provide information about what other people think about the behavior. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do</p> <p>*Social support (emotional) – Advise on, arrange, or provide emotional social support (e.g., from friends, relatives, colleagues, 'buddies' or staff) for performance of the behavior</p>

	<p>Social support (practical) – Advise on, arrange, or provide practical help (e.g., from friends, relatives, colleagues, ‘buddies’ or staff) for performance of the behavior</p> <p>*Vicarious reinforcement – Prompt observation of the consequences (including rewards and punishments) for others when they perform the behavior</p> <p>*Restructuring the social environment – Change, or advise to change the social environment in order to facilitate performance of the wanted behavior or create barriers to the unwanted behavior (other than prompts/cues, rewards and punishments)</p> <p>Modelling or demonstrating the behavior – Provide an observable sample of the performance of the behavior, directly in person or indirectly (e.g., via film, pictures, for the person to aspire to or imitate)</p> <p>Identification of self as role model – Inform that one's own behavior may be an example to others</p> <p>Social reward – Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behavior</p>
Environmental context and resources	<p>Restructuring the physical environment – Change, or advise to change the physical environment in order to facilitate performance of the wanted behavior or create barriers to the unwanted behavior (other than prompts/cues, rewards and punishments)</p> <p>Discriminative (learned) cue – Identify an environmental stimulus that reliably predicts that reward will follow the behavior</p> <p>Prompts/cues – Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behavior. The prompt or cue would normally occur at the time or place of performance</p> <p>*Restructuring the social environment – Change, or advise to change the social environment in order to facilitate performance of the wanted behavior or create barriers to the unwanted behavior (other than prompts/cues, rewards and punishments)</p>

Abbreviations: BCT: behavior change techniques; TDF: Theoretical domains framework

VII. Summary

Our rapid review of individuals' willingness to receive a COVID-19 vaccine and the factors driving their willingness suggests that racial/ethnic minorities and low-income households are less willing to be vaccinated for COVID-19. These findings are concerning given that COVID-19 disproportionately affects these specific sub-groups. Additionally, we also found that individuals holding fears about vaccine safety and expressing low perceived risk from COVID-19 are less willing to be vaccinated. Strategies to promote COVID-19 vaccine uptake have been put forward by researchers based on the findings of their surveys, which we complemented with strategies drawn from behavioral science. A successful COVID-19 vaccination campaign will likely need to include multiple strategies, tailored to specific factors influencing willingness in different populations.

An important limitation of this work is that all studies surveyed populations prior to the release of the data on safety and effectiveness of Pfizer and Moderna vaccines and the roll out of the Phase 1 vaccinations in the US and abroad. We intend to address this limitation by updating the literature search and included more recent studies in our planned update in February.

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Additional information

i. Methods

Inclusion criteria

We included any primary research (survey, focus group, interview) designed to assess participants' willingness to receive a COVID-19 vaccine and elicit the underlying reasons for willingness (or lack thereof). Additionally we included any primary research or commentary that suggested potential strategies to address potential barriers/facilitators to individuals' willingness to take a COVID-19 vaccine.

Literature search strategies

We searched for primary studies in MEDLINE (via PubMed) and Cochrane Register of Clinical Trials. Searches were conducted on Sept 28, 2020. We did not employ any language restrictions to the search but included filters to remove nonhuman studies and articles that are not primary studies. We included MeSH or Emtree terms, along with free-text words, that were related to COVID-19, vaccination/immunization, willingness, barrier, facilitator, health knowledge, and attitudes. **Appendix A** includes the current search strategy for each database.

Screening process

Citations from all searches were de-duplicated and then entered into Abstrackr software (<http://abstrackr.cebm.brown.edu/>) to enable title and abstract screening. Abstracts were screened in duplicate by two independent reviewers and conflicts were resolved through discussion. The Abstrackr software uses machine learning capabilities to predict the likelihood of relevance of each citation; daily, the list of unscreened abstracts was sorted so that most potentially relevant articles were presented first. Full texts for potentially relevant abstracts were retrieved and screened and extracted in duplicate by two reviewers; conflicts were resolved through discussion.

Data extraction

Data was extracted by one reviewer and confirmed by a second using an online Google sheet. For all studies, we extracted details the study design (survey, focus group, interview), country, language, time (of data collection and publication), population characteristics, and publication status. We also extracted the proportion or respondents reported as willing (or not) to vaccinate, barriers/facilitators associated with willingness (or lack of), potential strategies to address barriers/facilitators (if reported), and main study conclusions. We categorized reported barriers/facilitators of respondents willingness to vaccinate using the Theoretical Domains Framework (TDF) (28). The TDF framework was developed for implementation researchers to assist in identifying cognitive, affective, social and environmental factors that may influence the performance of a health behavior (i.e. behavioral determinants)(29). Behavioral determinants are categorized into one (or more, if relevant) of fourteen appropriate domains such as knowledge, skills, and beliefs about consequences (28). For instance, if an individual is afraid of taking a COVID-19 vaccine due to possible safety risks, this may be coded under the domains of 'Emotion' (e.g., fear, anxiety) and 'Beliefs about consequences' (e.g., perceived risk from vaccine). We then used lists of behavior change techniques (BCTs) linked to TDF domains to suggest potential BCTs/strategies that may be considered in a vaccination campaign (31).

Where reported, we sought to extract relevant data on barriers/facilitators and strategies to address them for populations that may be considered marginalized. For the purpose of our extractions, we considered the following groups that have been historically marginalized and may be disproportionately affected by COVID-19 and/or display differential willingness to take a COVID-19 vaccine including: elderly (i.e. Age 65 or older), Black/African-American, Latinx, Native American/Alaskan Native, low-income households, LGBTQ, immigrants, and prisoners.

Synthesis

We synthesized extracted data into tables and summarized themes narratively focusing on: a) willingness to vaccinate; b) barriers/facilitators to vaccinate; c) strategies to increase vaccination (as recommended from the literature); and d) strategies to increase vaccination (as suggested by behavioral science). We considered whether determinants are more/less commonly associated with certain populations,

particularly populations that have been historically marginalized and consider implications for strategies within the wider population and among specific subpopulations.

Conflict of interest

None declared

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Appendix A. Literature search

PubMed Search 1: targeted to train Abstractkr

("coronavirus"[MeSH] OR "coronavirus infections"[MeSH Terms] OR "coronavirus"[All Fields] OR "covid 2019"[All Fields] OR "SARS2"[All Fields] OR "SARS-CoV-2"[All Fields] OR "SARS-CoV-19"[All Fields] OR "severe acute respiratory syndrome coronavirus 2" [supplementary concept] OR "coronavirus infection"[All Fields] OR "severe acute respiratory pneumonia outbreak"[All Fields] OR "novel cov"[All Fields] OR "2019ncov"[All Fields] OR "sars cov2"[All Fields] OR "cov22"[All Fields] OR "ncov"[All Fields] OR "covid-19"[All Fields] OR "covid19"[All Fields] OR "coronaviridae"[All Fields] OR "corona virus"[All Fields])

AND

("Immunization"[Mesh] OR "Immunotherapy"[Mesh] OR "Vaccination"[Mesh] OR "Mass Vaccination"[Mesh] OR "Immunization Programs"[Mesh] OR ((immunization OR immunisation OR vaccinat*) AND (program* OR rate*)) OR vaccinat* OR revaccinat* OR immunization OR immunization OR "Disease Outbreaks/prevention and control"[Mesh])

AND

(Acceptance OR willingness OR adherence OR uptake OR barrier* OR facilitator* OR "Health Knowledge, Attitudes, Practice"[MeSH] OR "Patient Acceptance of Health Care "[MeSH] OR "Vaccination/psychology"[MeSH])

PubMed Search 2: broader to find studies missed by search one

("coronavirus"[MeSH] OR "coronavirus infections"[MeSH Terms] OR "coronavirus"[All Fields] OR "covid 2019"[All Fields] OR "SARS2"[All Fields] OR "SARS-CoV-2"[All Fields] OR "SARS-CoV-19"[All Fields] OR "severe acute respiratory syndrome coronavirus 2" [supplementary concept] OR "coronavirus infection"[All Fields] OR "severe acute respiratory pneumonia outbreak"[All Fields] OR "novel cov"[All Fields] OR "2019ncov"[All Fields] OR "sars cov2"[All Fields] OR "cov22"[All Fields] OR "ncov"[All Fields] OR "covid-19"[All Fields] OR "covid19"[All Fields] OR "coronaviridae"[All Fields] OR "corona virus"[All Fields])

AND

("Immunization"[Mesh] OR "Immunotherapy"[Mesh] OR "Vaccination"[Mesh] OR "Mass Vaccination"[Mesh] OR "Immunization Programs"[Mesh] OR ((immunization OR immunisation OR vaccinat*) AND (program* OR rate*)) OR vaccinat* OR revaccinat* OR immunization OR immunization)

Cochrane COVID-19 Study Register search 1

(vaccin* OR immunizat*)

AND

(Acceptance OR willingness OR adherence OR uptake OR barrier* OR facilitator*)