Health promotion approaches to the COVID-19 pandemic preparedness and response: A behavioural science lens

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Question: Which strategies did downstream health promotion approaches use or recommend to support capability, opportunity, and motivation for adoption and maintenance of individual behaviour change as part of COVID-19 pandemic preparedness and response?

Executive Summary

- Health promotion approaches have been central in response to the COVID-19 pandemic. Here, we sought to provide a behavioural lens to evidence on health promotion approaches identified in a recent a [COVID-END rapid evidence profile](#) on upstream and downstream health promotion approaches that focus on individual behaviour change as part of COVID-19 pandemic preparedness and response.
- We used a behavioural science framework (the Behaviour Change Wheel), to classify and synthesise strategies by linking the key drivers (i.e., capability, opportunity, and motivation) of behaviour change adoption and maintenance of change, to interventions strategies and policy categories.
- We additionally took consideration of what strategies are most suited for the adoption of behaviours and strategies that are most useful for sustaining behaviours.

Key Findings:

- *Capability*: Identified strategies with a predominant focus on enhancing capability (knowledge, skills, memory and attention) including increasing access to credible information by using consistent messaging at national and local levels and across a variety of media channels (e.g. television broadcasts, social media, news media, communication networks such as WhatsApp). Health information that addresses community-specific concerns and dispels misinformation was indicated, especially with trusted local champions and community leaders disseminating information. Programs, materials, guidance, and resources that are culturally relevant to specific communities, provided in various languages, and in accessible formats was also indicated in this literature. Addressing vaccine trust by increasing awareness of vaccine safety, efficacy, necessity, and about the governing bodies/health authorities who regulate vaccines (which is also linked to the social influences that impact on Motivation) was suggested. At a strategic level, knowledge mobilisation by behavioural science organisations (e.g., Behavioural Science and COVID-19 blog series) was indicated as important for organizations and governments to respond to the pandemic. (Primary BCW intervention functions/strategies identified: education, modelling).

- *Motivation*: Identified strategies with a predominant focus on enhancing motivation (e.g., by addressing beliefs about consequences, self-efficacy, intention and goals, role and identity, emotion) highlighted a number of suggested approaches. There are specific ways to more effectively community risk: Risk communication must sufficiently communicate susceptibility *and* severity but also address other health beliefs, such as promoting perceived benefits, barriers, and highlighting cues to act. Messaging strategies are recommended that: harness social norms; highlight social/moral responsibility, collective action, and civic duty; use simple and clear messaging about the benefits of the behaviour and adherence; demonstrate efficacy of behaviours; positive messaging emphasising adaptiveness and behavioural control; make the message short and catchy; ensure the right messenger; personalised messaging demonstrating appreciation for sacrifices, and operational transparency around vaccines. Using trusted messengers (particularly as role models) and messages, consulting with specific communities and tailoring messaging to their needs were all indicated. (Primary BCW intervention functions/strategies identified: persuasion, modelling)

- *Opportunity*: Identified strategies with a predominant focus on enhancing opportunity (i.e., environmental context and resources, and social influences) focused most frequently on restructuring the physical and social environments to meet community needs (mobile apps for contact tracing; promoting physical distancing using circle markers in parks, bench markings, one-way routes to; encouraging staggered start times or simplifying processes around flexible work arrangements). Creating opportunities to consult with communities to identify specific barriers/enablers to behaviours and in the creation of guidance and interventions was further indicated. When restructuring the environment, the needs of the specific communities must be kept in mind to reduce health inequalities, particularly indigenous and equity-deserving populations. Providing funding, ongoing resources and support to implement programs was underscored. (Primary BCW interventions functions/strategies identified: environmental/social planning, regulation, enablement, service provision)

- *Adopting vs sustaining*: Generally, interventions that aimed to influence capability (particularly knowledge) and motivation, by education and persuasion through communication/marketing, are best suited to the phase of behaviour adoption. Meanwhile, strategies that aim to increase opportunity to enact behaviours by restructuring environments using social/environmental planning are best suited to the phase of behaviour maintenance.

Conclusion

This behavioural science deep-dive demonstrates the benefit of incorporating behavioural science perspectives into health promotion approaches for future pandemic preparedness and response efforts.

Background

The multi-faceted challenges of the COVID-19 pandemic have seen a number of strategies, interventions, and polices implemented to minimise the health impact of this novel virus. Health promotion-based approaches have been at the heart of many responses to the pandemic, highlighted in a COVID-END rapid evidence profile in January 2023, which synthesized research evidence and experiences documented in reports from specific OECD countries. Here, we sought to provide a behavioural lens to this evidence base, aiming to show how insights from behavioural science complement health promotion approaches in a manner that may help in informing ongoing pandemic response and future pandemic preparedness.

Health promotion approaches typically move beyond a focus on individual behaviour, focusing on the supportive social and environmental settings, strategies and policies that create the circumstances that enable individuals to improve their health. At the face of it, this may seem at odds with a behavioural science approach which is sometimes viewed as focusing on individual behaviour at the expense of social and environmental factors; however, this perspective on behavioural science is inconsistent with how the field is typically positioned (cf.Van Bavel et al., 2020). Whilst behavioural science is indeed focused on individual behaviour as a key outcome of interest, behavioural science is specifically concerned with supporting individual behaviour and behaviour change not only by individual factors, but also by considering the social, physical and historical environment in which they live. Behavioural science is not synonymous with perspectives that put the onus of behaviour only on the individual enacting the behaviour, but rather much of behavioural science is specifically focused on factors external to the individual that drive (or indeed impede) on behaviour and behaviour change. In short, behavioural science does not assume that the onus of change is on the individual. Rather, behavioural science assumes that the path to health and well-being depends on the behaviours of individuals, groups and communities and seeks to understand what personal, social, environmental, and historical factors impact on behaviour.

With the present report, we aimed to reposition existing evidence for downstream health promotion strategies identified in the COVID-END rapid evidence profile to focus on how the strategies address the key drivers of behaviour and behaviour change: capability, opportunity, and motivation. To achieve this aim, we drew upon two perspectives from behavioural science:

Complementary behavioural science perspective 1: identifying the personal, social and environmental drivers of decisions and actions to inform tailored strategies

Consistency in how strategies are described can help to ensure building up a cumulative understanding of what works, for whom, under which circumstances. The use of different terms for the same strategy stymies our ability to draw links across health promotion efforts for pandemic preparedness and response. Achieving this consistency can be aided by leveraging comprehensive frameworks. In the present report, we used the Behaviour Change Wheel (Michie et al., 2011) as the basis for classifying and synthesising strategies and policy supports across evidence highlighted in the Rapid Evidence Profile.

At its foundation, the Behaviour Change Wheel highlights the three fundamental sources of behaviour: having the capability, the opportunity, and the motivation to engage in the behaviour. It further describes nine specific strategies (intervention functions) that can be used to support capability, opportunity, or motivation. Importantly, it identifies which strategies are (and are not) best suited to promoting capability, opportunity, or motivation, enabling an assessment of whether the strategies employed for pandemic response in a given setting are aligned with addressing the capability, opportunity or motivation factors impeding action. Finally, the Behaviour Change Wheel highlights seven policy categories that can each be leveraged to support intervention strategies, with some being better suited than others for enabling a given strategy to be enacted in support of behaviour. Taken as a whole, the Behaviour Change Wheel thus uniquely

links broad policy down to behaviour, providing a comprehensive approach to characterising health promotion efforts for pandemic preparedness and response.
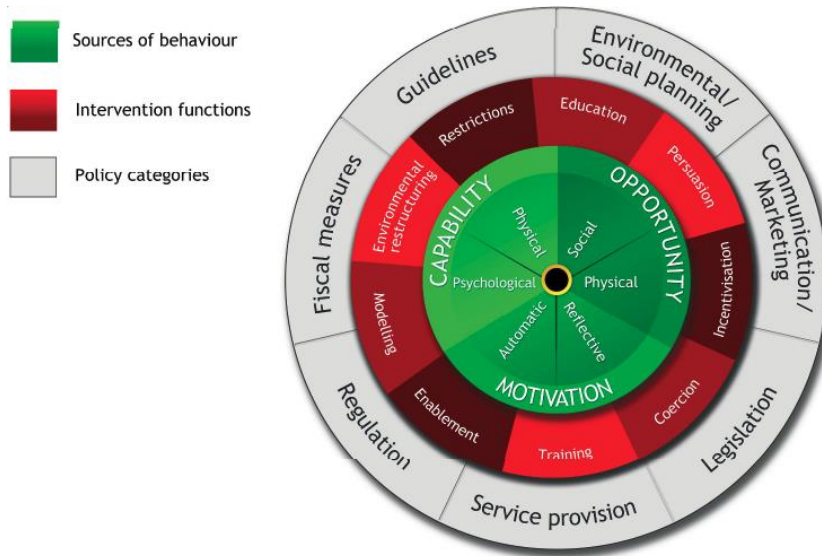

Figure 1. The Behaviour Change Wheel (Michie et al., 2011)

Complementary behavioural science perspective 2: Distinguishing between the factors that support taking on new behaviours from those that support sustaining behaviours over time

The strategies to support adopting new behaviours on the short term are not necessarily the same as the ones that should be used to promote the ongoing sustainment of that behaviour over time (Michie & West, 2021). At the time of writing, the COVID-19 pandemic has lasted over three years. The strategies used to support decisions and actions that may have worked at the start of the pandemic and for pandemics that may have a shorter duration may not necessarily be the same as those that work three years into a pandemic to support ongoing protective action. The ongoing response to the present pandemic and preparedness for the next pandemic would likely benefit from better consideration for the distinction between adoption-supportive strategies on the short term versus sustainment-promoting strategies on the long term, and the potential of the former to influence the latter in positive or negative ways. There is an opportunity to investigate how existing health promotion efforts have considered this distinction to date to inform further response and preparedness.

The science of factors promoting maintenance of behaviour change is not one that has yet been directly applied to the health promotion literature as it relates to the COVID-19 pandemic, but insights offer some important considerations. During the process of adopting behaviours, influencing behaviour perceptions and intentions through cognitive and affective processes is important (e.g., about increasing desire for the behaviour, increase knowledge about the behaviour, evaluating pros and cons of the behaviour, emotional processes in wanting to engage in the behaviour, prioritising the behaviour, engaging in conscious effort to translate the desire into action). There are also social and environment processes in adopting behaviour, though they usually involve evaluating how the behaviour aligns with the current social and physical environment (e.g., considering how behaviour fits with social identity; evaluating the impact of the behaviour on environment in terms of consequences, costs, benefits, losses, gains, or harm to others; evaluating whether there are positive norms around the behaviour). During this phase, accurate information and information

processing (both in terms of knowledge and experience of performing the behaviour) is required to evaluate the desirability and feasibility of adopting the behaviour (Keller et al., 2020).

During the process of sustaining behaviours (i.e. once engaged in over a period of time), gathering and processing information about the behaviour are less important as the decision to act has been made (Keller et al., 2020). Factors that are most influential in sustaining behaviours involve shielding the behavioural from potential interferences. The focus needs to be less on increasing desire or intention to perform the behaviour, and more on processes that allow the behaviour to be enacted more automatically on an ongoing basis (e.g., continued behaviour cues and prompts in the environment, relapse prevention, ongoing environmental supports).

Kwasnicka et al. (2016) synthesize key conceptual factors across a wide behavioural science literature on maintenance of change, highlighting five key factors that can drive sustained behaviour change over time, outlined in Table 1. This is also consistent with a health promotion approach, highlighting the importance of communities, infrastructures, and resources for enabling communities and individuals within them to keep engaging in each behaviour. Further, the use of some health promoting strategies may provide short term effectiveness gains but also have longer-term side effects, which are now better known (for example, see the recent COVID-END Living Evidence Synthesis on adherence to public health and social measures). Thus, long-term sustaining of change should consider mitigating support for some of the consequences of some strategies designed for shorter-term change. Policies and strategies that do not seek to promote factors listed in Table 1 or make change that remove these factors may impact on whether successfully initially adopted behaviours are sustained. If behaviours that we hope to support people in adopting and sustaining do not have these characteristics, there may be opportunities for developing and delivering supportive strategies that leverage these principles.

Table 1. Factors associated with maintenance of behaviour change over time (Kwasnicka et al., 2016)

Main factors	**Description (People continue engaging in behaviours that:)**
Maintenance motives	- they enjoy
	- are satisfied that doing the behaviour achieves a benefit
	- feel are aligned with their values and identity
Self-regulation	- have strategies in place to get around barriers in their control that might side track them
	- have strategies in place to keep track of how often and last time they engaged in the behaviour
Resources	- have ongoing resources to enable continued behaviour
Habit	- are supported where relevant by social and physical cues and prompts in the settings of engaging in the behaviour
Environmental and social influences	- account for changes to the physical environment that risk breaking an existing habit - are socially modelled by others in the settings that they engage in the behaviour
	- have ongoing support from and connection with trusted people and groups that they do or want to belong to

- enable them to keep a positive social identity

- are aligned with the social norms and informal rules of the groups that they do or want to belong to

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Health promoting interventions and policies informed by behavioural science principles can account for the various internal and external factors that support health-promoting behaviour change. Considering how the components of pandemic preparedness and responses align with behavioural science principles may therefore help to draw in additional supportive perspectives in health promotion efforts for future pandemic preparedness. We aimed to conduct a 'deep dive' into literature on downstream health promotion approaches that focus on individual behaviour change as part of COVID-19 pandemic preparedness and response to identify intervention components that aimed to support the Capability, Opportunity, and Motivation to take up and maintain health promoting behaviours as part of COVID-19 pandemic preparedness and response efforts.

Methods

As source material for our analysis, we drew from sources identified in a recent COVID-END rapid evidence profile on health promotion approaches that focus on individual behaviour change as part of COVID-19 pandemic preparedness and response. This yielded eleven full systematic reviews, eight rapid reviews, and 28 primary studies. Additionally, case studies of behavioural science informed interventions and policies were identified within reports from select OECD countries and from WHO. These were identified by hand searching the OECD website and the WHO's IRIS database, and government websites of countries with behavioural/implementation insight units.

Synthesis

The evidence was synthesized in three separate sections. First, primary and secondary evidence of behavioural science informed interventions and policies for pandemic response and preparedness were synthesised (see Table 2) by their components (i.e. Capability, Opportunity, and Motivation) and whether the response focuses on adopting behaviours and/or sustaining them over time (See appendix 1 for coding). Interventions and policies were synthesised separately by whether they targeted pandemic responses or pandemic preparedness. Second, case studies of behavioural science informed health promotion strategies and policies from selected jurisdictions are summarised (see Table 3). Third, community engagement efforts with equity-deserving groups to promote COVID-19 pandemic preparedness and responses were synthesized (see Table 4).

For each section, a summary descriptive synthesis is presented on components of interventions and policies (in terms of Capability, Opportunity, and Motivation), a description of the interventions or strategies that were identified, and identification of intervention functions (from the Behaviour Change Wheel) of the strategies by component (i.e. Capability, Opportunity, and Motivation). See appendix 2 for Intervention functions/policy categories.

RESULTS

<u>Summary of key findings from highly relevant studies about components of behavioural science informed interventions and policies for pandemic response and preparedness</u>

Pandemic preparedness

Two systematic reviews reported strategies relevant to pandemic preparedness. One review examined strategies to decrease vaccine hesitancy in healthcare providers. In terms of capability (*knowledge*), vaccine hesitancy was proposed to be reduced by increasing knowledge of respiratory illnesses, understanding vulnerability to catch and spread respiratory illness given close contact with patients, and addressing vaccine trust by increasing knowledge on vaccine safety, efficacy, necessity, and the governing bodies/health authorities who regulate vaccines. In terms of motivation (*beliefs about consequences; reinforcement*), risk communication must sufficiently communicate vulnerability to respiratory illnesses but also address other health beliefs, such as promoting perceived benefits to vaccination, addressing barriers to vaccination, and highlighting cues to act. Furthermore, focusing on past successful experiences of getting vaccinated may be influential in reducing vaccine hesitancy. Healthcare professionals may be more likely to get vaccinated if a strong sense of professional duty is evoked, particularly through the distribution of guidelines which state expectations around vaccination (motivation *professional/social role identity*).

A second review examined factors in pandemic preparedness regarding hand hygiene. The study suggested that taking the following steps prior to a respiratory illness outbreak is more effective than implementing them after and outbreak: providing educational materials (capability *knowledge*) on respiratory illnesses and the role of hand hygiene in reducing transmission; providing materials which demonstrate how to perform the behaviour (Motivation *beliefs about capabilities*); and providing soap and hand sanitizer to the point-of-use (Opportunity *environmental resources and context*).

Pandemic response

There were 17 systematic reviews and rapid reviews that identified strategies for the pandemic response. There was consensus that in terms of Capability (*knowledge*), accurate, accessible, timely, and trusted information was necessary for communication of risks, reducing transmission, and promoting vaccination. Developing *physical skills* (capability) was also deemed a necessary factor in handling mental health, bereavement, and wellbeing during crises. For example, healthcare professionals need to be upskilled in how to relate to patients during a pandemic. Specific training needs to be delivered to ensure that therapists, counsellors, and peer supporters can adequately support people through the unique difficulties of a pandemic, and that healthcare professionals can remain resilient.

Motivational factors (e.g*., beliefs about consequences; social/professional role*) were also considered to be important in influencing vaccine hesitancy, risk perceptions, and reducing transmission.

There was consensus that the most common factor that influenced the pandemic response was opportunity, particularly *environmental resources and context.* The most common strategies across vaccination, risk communication, mental health support, reducing transmission, and hygiene practices, involved increasing access to information by making it more accessible and tailored to the circumstances; increasing access to services through digital methods; providing resources and support to connect people; providing financial and practical infrastructure to enable the pandemic response, and implementing the sharing of information and persuasive messages in the most useful contexts.

Summary of case studies of behavioural science informed health promotion strategies and policies from selected jurisdictions

Case studies of pandemic responses that used behavioural science informed health promotion approaches were gathered from Canada, Australia, France, New Zealand, the United Kingdom, the United States, and the World Health Organization (WHO). There were 25 unique strategy or policy types identified across jurisdictions, as summarised in Figure 2 (see Table 3 for more details).
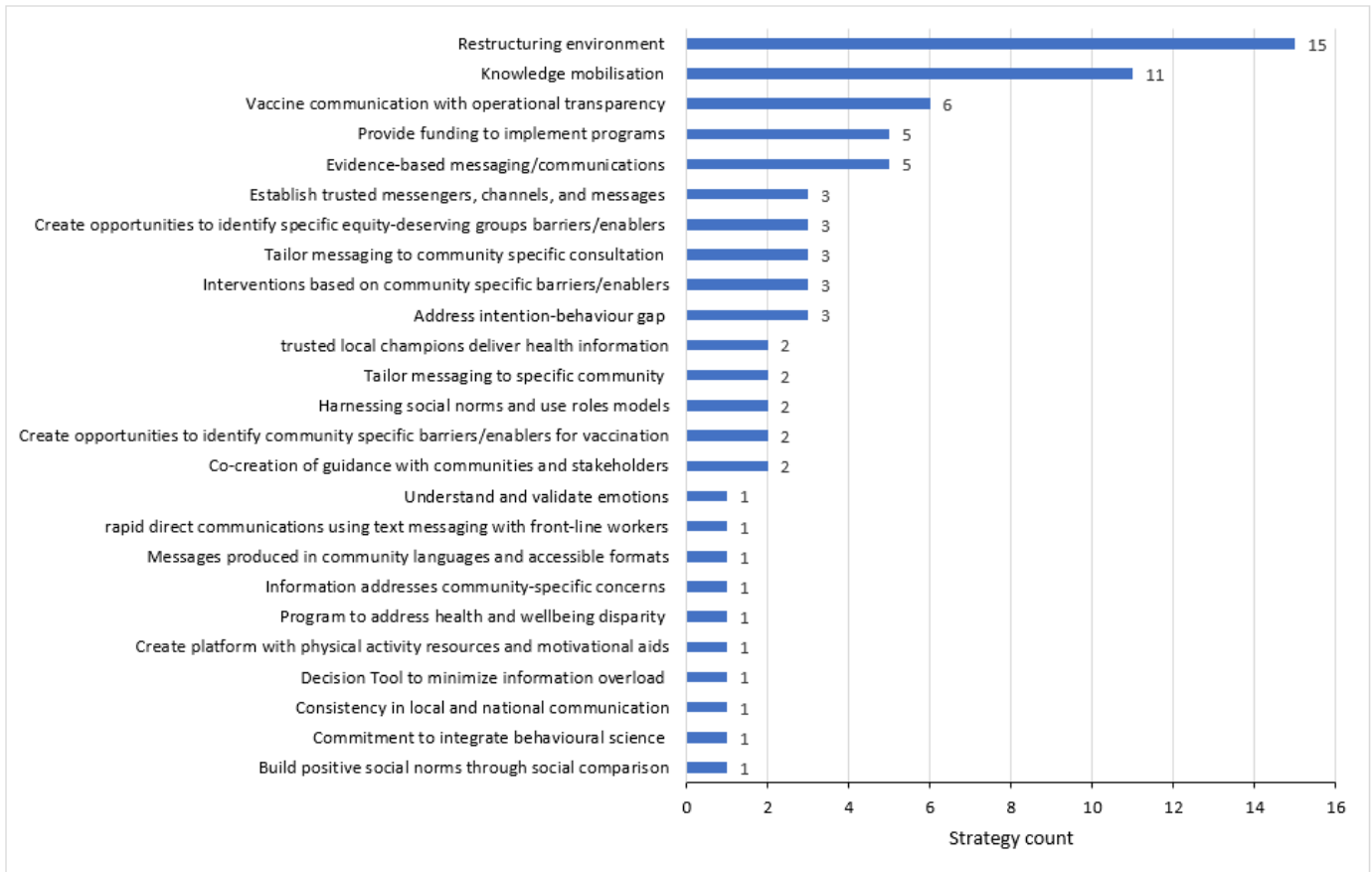
Figure 2. Summary of behavioural science informed health promotion strategies and policies across jurisdictions

The most common strategy identified was restructuring the physical or social environment to make uptake of pandemic responses easier (*physical and social opportunity*). Some examples include: developing a behavioural science informed mobile application (ArriveCAN) to implement contact tracing and adherence to COVID guidelines for travellers; promoting physical distancing using circle markers in parks, bench markings, highly-visible floor markers, one-way routes to; increasing online access to COVID-19 lab results; encouraging staggered start times or simplifying processes around flexible work arrangements; harnessing social norms by using senior management as role models for remote and flexible working. Additional strategies that influenced opportunity for the uptake of pandemic responses were providing funding to implement programs, and creating opportunities to involve the public and specific communities in identifying barriers and enablers to the uptake of protective behaviours and in informing advice and interventions.

Many identified strategies that influence *capability* involved the gathering, dissemination, and effective use of knowledge about COVID-19, vaccines, and risk. The most frequently observed strategy for *capability* was knowledge mobilisation (e.g. gathering behavioural science evidence to inform pandemic responses, producing toolkits to help countries understand factors in vaccine intention and how to collect data to inform response, developing online training course on collecting behavioural data). Additional strategies that would influence capability are ensuring consistency in information between local and national communication; establishing and leveraging trusted messengers, channels, and messages; enabling trusted local champions to deliver health information; and use of a COVID-19 Decision Tool that helped minimize overload of irrelevant information by individual tailoring and using plain language.

The majority of identified strategies that would influence *motivation* involve the framing of messages. The most common recommended message framing strategy was use of operational transparency around vaccines. Operational transparency refers to revealing "behind-the-scenes" steps and processes in vaccine development to enhance trust around vaccine development, safety, vaccine confidence, and adverse events. Some examples include: that the COVID-19 vaccine was not "new" as a vaccine for similar strains of the SARS-CoV virus had been in development for years; that the same standards for rigorous testing of efficacy and safety had been applied, but the process was expedited due to prioritising the COVD-19 vaccine; that Health Canada held all the same evaluation standards as any other vaccine; why additional boosters are helpful. An additional recommended messaging strategy to enhance trust in vaccines is the use of personal narratives from close friends, which improved vaccine perceptions.

A number of evidence-based behavioural science principles were instilled in messaging about protective behaviours, including: harnessing social norms; highlighting social/moral responsibility, collective action, and civic duty; tapping into the public's identity (e.g. using essential workers in media campaign); simple and clear messaging about the benefits of the behaviour and adherence; demonstrate efficacy of behaviours; positive messaging emphasising adaptiveness and behavioural control; make the message short and catchy; ensure the right messenger; and personalised messaging demonstrating appreciation for sacrifices.

Additional strategies for influencing motivation were consistently using trusted messengers and messages, consulting with specific communities and tailor messaging to their needs (e.g., through collecting data via population surveys, focus groups, behavioural experimentation of different messages, or the development of a rapid segmentation tool to deliver tailored messaging to specific groups in situ). Finally, addressing the intention-behaviour gap with proactive strategies was recommended, for example through training healthcare workers to create if-then plans (implementation intentions) for getting vaccinated.

<u>Summary of key findings for community engagement strategies with equity-deserving groups for COVID-19 pandemic preparedness and response</u>

There were 28 primary studies that reported strategies from community engagement activities. In addition, Box 1 below presents a case study of community engagement activities in promoting vaccine uptake in equity-deserving groups in Canada that applies a behavioural science approach.

In terms of *capability*, many community engagement strategies identified focused on developing health information, materials, and resources that address community-specific barriers, are accessible to a wide audience (e.g. use of visual material), was provided in the languages of the communities, was culturally relevant and sensitive. Health messages and interventions that were co-created with members of the community were likely to have the most impact. Additionally, to ensure reach of information, strategies focused on mobilising knowledge sharing within communities by being present within communities and at community events, or by using established networks or methods of communication (e.g. WhatsApp, door-to-door contact). Ongoing suggested efforts to increase capability include to develop literacy, provide opportunities to learn English (if desired), support to navigate systems and access services, and training of healthcare providers and community workers communicate in culturally sensitive ways.

Many community engagement strategies involved trusted community leaders influencing *capability* by acting as communicators and sources of information for their communities and for health authorities, co-creating interventions, supporting their communities' decisions to follow pandemic guidance, and acting as roles models for COVID protective behaviours.

Trusted community leaders also influenced *opportunity* by providing necessary items to prevent COVID transmission, provide basic necessities (e.g., food, financial assistance), and provide social support and enhance social connectedness. The role of community leaders as trusted sources is vital to support equity-

deserving communities and to implement pandemic responses. Additional community engagement strategies that influenced *opportunity* were co-ordinating vaccine rollouts with communities accounting for social vulnerability, enabling partnership between academic and community teams, identifying barriers to access to resources, improving access to services by pivoting to online, restructuring environments to meet community needs (e.g. access to cycle routes to reduce need for public transport), and providing basic necessities such as food and housing security.

There were fewer identified strategies that aimed to influence *motivation* in equity-deserving communities. Examples include community members setting priorities for communications and resources, and modelling of behaviours by members of community.

Box 1 : Case example: the OPTimise platform: a behavioural science platform for amplifying community voices and supporting public health units

Creating bridges between communities, researchers and public health units can amplify the lived realities of equity-deserving groups and offer complementary expertise to public health units. The OPTimise platform is an example of such a partnership, where behavioural scientists have partnered with three public health units in Ottawa, Peel and Toronto to identify priority areas and subgroups within their jurisdictions that might benefit from complementary insight from behavioural science in how to support COVID-19 vaccination uptake. In OPTimise, each public health unit identified a priority aspect of vaccination (e.g., getting 1st or 3rd dose of the COVID-19 vaccine) and priority groups. Ottawa Public Health identified five 5th-quintile socioeconomic status neighbourhoods where uptake of 3rd doses was lower than other areas of the city. Peel Region Public Health identified 1st and 3rd doses amongst people of Eastern European descent as a community they hoped to connect with and support by drawing from behavioural science perspectives. Toronto Public Health identified 1st and 3rd doses amongst members of Black, African, and Caribbean communities in five low-uptake areas of Toronto. The OPTimise team then forged trusting relationships with community partners from the priority groups to form a Community Partner Advisory Group in each city. We worked closely with these partners to identify and establish trust with every-day community members with whom to have behavioural science-informed interviews to surface their specific barriers and enablers to getting the 1st or 3rd dose of COVID-19 vaccine. These findings were then synthesized for each city, and unique barriers in each city linked to behavioural-science informed strategies that were vetted and considered by community partners in each city. The result were policy briefs for each city that serve to amplify the challenges and behavioural-science informed solutions specific to each city's priority areas and groups, to help support the specific capability, opportunity and motivation barriers to vaccine decisions and action. Such a platform exemplifies how a behavioural science research unit can serve to complement expertise in public health units while acting as an amplifying bridge for community voices to be heard without requiring direct connection to public health units per se; a particular consideration amongst communities where trust in institutions may be lacking. Pandemic response and preparedness rooted in community partnerships, drawing on rigorous behavioural science and providing complementary expertise to public health units represents a model to consider for further preparedness and response.

** Note: an author of the present review is the PI on this project

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Summary of pandemic preparedness and response possible policy recommendations across sources

We categorised strategies in terms of the Behaviour Change Wheel intervention functions and policy categories. The purpose of this was to identify the intervention functions and policy categories that will be most effective in future pandemic responses when aiming to influence capability, opportunity, or motivation.

In addition, we categorised whether the strategies were most useful for adopting behaviours or sustaining behaviours. There were similar strategy and policy themes across secondary research of pandemic preparedness and responses, case studies of behaviourally informed health promotion approaches from selected jurisdictions, and primary research of community-engagement efforts.

Strategies that were identified by sources materials as most useful for adopting behaviours were generally those that influence psychological capability and motivation. The most frequently identified intervention function and policy lever for influencing capability was education via communication/marketing. Overall, providing clear, simple, and consistent information and educational media campaigns on risk and required protective behaviours across multiple communication channels, and with the right messengers, is an essential pandemic response for adopting behaviours. Consulting with the public and specific communities (particularly equity-deserving communities) to identify knowledge gaps and particular information needs will bolster the effectiveness of communications and will reduce inequity. In addition to providing education to the public, knowledge mobilisation from behavioural science units was identified as important for informing organizations about behavioural science approaches to health promotion.

Communication/marketing is also the most frequent policy lever for motivation, where the intervention intends to persuade. Persuasion interventions are recommended to implement evidence-based messaging and tailoring of messages to specific communities. An additional intervention function that influences motivation is modelling, which can be implemented via communication/marketing and service provision. Particularly, trusted and credible sources of health information and community leaders are recommended to act as role models.

Strategies that were most useful for sustaining behaviours were those that influenced *opportunity* by *environmental resources and context*. Using the policy lever of environmental/social planning, reconstructing environments to facilitate behaviours by continued cuing of behaviours and making them more automatic and less effortful to enact, makes sustaining behaviours more likely. Once behaviours have largely been adopted, education and persuasion are less useful than facilitating the development of habits via social and environmental cues. Additional policy categories that influence opportunity for sustaining behaviours are the training, development of guidelines, and regulation to make behaviours standard practice. Also important for sustaining behaviours is addressing factors that may interfere with sustaining behaviours, particularly pandemic fatigue and negative emotions and effects on mental help. Thus, interventions for enablement via environmental/social planning, regulation, and training may be most useful in establishing ongoing social supports in communities and at the organizational level for healthcare providers. To ensure the maintenance of protective behaviours, using environmental/social planning is also essential to create opportunities for specific communities to be involved in the creation of guidance and interventions in relation to their communities. When restructuring the environment via environmental/social planning, the needs of the specific communities must be kept in mind to reduce health inequalities.

Conclusion

In the present report, we used the Behaviour Change Wheel as an organising framework to classify and summarise strategies identified from evidence in the Rapid Evidence Profile 47. Behaviour science frameworks, like the Behaviour Change Wheel, are important tools for providing common terms to synthesise the key drivers (i.e. capability, opportunity, and motivation) of behaviour change and maintenance. By synthesising the documented health promotion approaches for pandemic preparedness and responses in this framework, we aimed to complement the Rapid Evidence Profile by identifying the most suited intervention functions and policy categories to influence these drivers. Strategies identified by source materials that targeted individual behaviour change largely focused on influencing capability and motivation by education and persuasion using communication/marketing. Creating supportive environments that address social determinants of health by influencing opportunity through environmental/social planning,

modelling, and enablement (e.g., mobile apps for contact tracing; promoting physical distancing using circle markers in parks, bench markings, one-way routes to; encouraging staggered start times or simplifying processes around flexible work arrangements; creating access to free active transport) were also identified as essential strategies in responding to the pandemic. In this way, we find that behavioural science approaches align with health promotion approaches to the pandemic response with both downstream and upstream efforts.

We additionally took consideration of what strategies are most suited for the adoption of behaviours and strategies that are most useful for sustaining behaviours, given the ongoing and dynamic nature of the COVID-19 pandemic. By doing so, we aimed to identify the drivers, strategies, and policies that should be leveraged to prepare and initially respond to a pandemic, and those that should be leveraged to adapt responses for longevity. Thus, identifying what works best for whom, and when. Generally, interventions that aimed to influence capability (particularly knowledge) and motivation by education and persuasion through communication/marketing are best suited to the phase of behaviour adoption. Meanwhile, strategies that aim to increase opportunity to enact behaviours by restructuring environments using social/environmental planning are best suited to the phase of behaviour maintenance.

Finally, community engagement strategies for equity-deserving groups are crucial to increase access to resources to reduce structural barriers and inequities. Ongoing co-ordination and partnerships with health and government institutions will expedite the provision of the right resources to meet community needs if another pandemic were to occur.

Overall, the alignment between health promotion perspectives and behavioural science approaches was well-exemplified in this behavioural-science deep dive, and points to opportunities for incorporating behavioural science perspectives into health promotion efforts for future pandemic preparedness and response.

Table 2. Summary of key findings from highly relevant studies about components of behavioural science informed interventions and policies for pandemic response and preparedness

Reference	Intervention purpose	Population	Response level	COM-B components	Strategies identified	BCW intervention functions	BCW policy categories	Possible policy recommendations
Pandemic preparedness								
Hall 2021	Decrease vaccine hesitancy	Healthcare providers	Adoption	Motivation (beliefs about consequences)	Increase perceived vulnerability to influenza and perceived severity of illness	Persuasion	Communication /marketing	Adding professional experiences of influenza impact and complications into vaccine promotional material
			Adoption	Capability (knowledge)	Increase trust in vaccine safety and efficacy, health authorities, governing bodies, information sources and data	Education	Communication /marketing	Provide clear, consistent, accurate vaccine information that is transparent about the development process.
			Adoption	Motivation (beliefs about consequences)		Modelling	Communication /marketing	Have media campaigns which demonstrate trusted sources and community leaders endorsing the vaccine and getting vaccinated.
			Adoption	Motivation (Professional/social role identity)	Increase sense of professional duty regarding vaccination	Persuasion	Guidelines	Highlight the importance of HCW professional duty toward patients within codes of practice, and how

							vaccination reinforces that professional duty. Include expectations of being up-to-date with vaccinations within HCW codes of practice.
			Adoption	Capability (knowledge)	Increase knowledge of seasonal respiratory illnesses	Education	Communication /marketing	Develop education materials highlighting the risks of seasonal respiratory illness and how to mitigate risk. Distribute materials at strategic times of year and repeat the message.
			Adoption	Motivation (reinforcement)	Increase positive expectancies of vaccination by making past successful instances of vaccination salient	Persuasion	Communication /marketing	Develop communication campaigns that leverage past successful vaccination experience. Include personalised experience where possible e.g. email campaign reminding HCWs of their last respiratory illness vaccination on record.

			Adoption	Motivation (beliefs about consequences)	Communication that highlights perceived susceptibility and severity, perceived benefits, and cues to action, and that reduced perceived barriers.	Persuasion	Communication /marketing	Develop communication campaigns that highlight the role of vaccines in reducing susceptibility and severity of respiratory illnesses. Prompt action cue and reduce perceived barriers by stating when, where and eligibility, and how to register for/book a vaccine appointment e.g. QR code that can be scanned on cell phone that redirects to vaccine booking website. Distribute communications in high traffic areas and in a range of formats e.g. posters, drink coasters.
Veys 2021	Hand hygiene	Any population	Adopting	Capability (knowledge)	Prior to influenza season, provide educational materials on the role of hand hygiene in	Education	Communication /marketing	Prior to influenza season, provide educational materials on the role of hand hygiene in reducing transmission.

					reducing transmission			
			Adopting	Motivation (Beliefs about capabilities)	Prior to influenza season, provide materials with hand washing demonstration	Modelling	Communication /marketing	Prior to influenza season, develop video materials demonstrating how to correctly wash hands with soap.
			Adopting and sustaining	Opportunity (environment resources and context)	Prior to influenza season, provide high traffic public areas with hand sanitizers. Provide soap and hand sanitizer to homes of socially vulnerable people.	Enablement	Environmental/social planning	Prior to influenza season, provide high traffic public areas with hand sanitizers. Provide soap and hand sanitizer to homes of socially vulnerable people.
Pandemic response								
McMillan, Ghio	Risk communication	Any population	Adopting	Motivation (beliefs about consequences)	Risk communication must increase awareness of risks, delivered by credible sources	Persuasion	Communication /marketing	Develop multi-channel and multi-institutional information and educational media campaigns highlighting the current risk of COVID-19. The messages should be consistent and co-ordinated across channels and sources. Where

						possible, use tailored message framing for different groups.
		Adopting	Capability (knowledge)	Risk communications need to increase understanding/ perceptions of perceived susceptibility and severity of illness	Education	Communication /marketing	Develop a communication campaign that uses message framing to increase both the perceived risk of *susceptibility to and severity* of COVID-19
	Any populati on	Adopting	Motivation (beliefs about consequences)	Risk communications need to include messaging that enhances feelings that protective behaviours are effective at controlling COVID e.g. increase perceived benefits and reduce perceived barriers, prompt cues to action, and increase self-efficacy	Persuasion	Communication /marketing	Develop risk communication campaigns that portray risk but also emphasise perceived benefits and value of protective behaviours and their efficacy, examples of how to reduce common barriers, and that enhances self-efficacy and cues to action e.g. through positive attitude and empowerment.
		Sustainin g	Capability (knowledge)	Continue providing information on current risk	Education	Communication /marketing	Provide regular public health briefings on the current risk level.

					level. mapping to stage of epidemic/ pandemic			Address uncertainty and changing information. Be transparent in identifying sources of information. Tell the public what they need to do for the current risk level.
Craws haw 2021, Craws haw 2022, Bhanu 2021	Vaccination	Any populati on	Adoptio n	Motivation (beliefs about consequences)	Increase trust in vaccine safety, efficacy, necessity, and development	Persuasion	Communication /marketing	Be consistent and co- ordinated/unified in messaging about vaccine safety across different sources. Frame messages with operational transparency around vaccine development. Address vaccine adverse events and their potential impact (e.g. short- term, long-term), but consistently highlight the level of risk of COVID- 19 compared to risk of serious adverse events from vaccines.

				Adoption	Opportunity (social influences)	Increase trust in government/public health units' response	Modelling	Communication /marketing	Involve trusted community leaders to endorse information and government/public health unit response. Be transparent by admitting unknowns and errors where appropriate.
				Adoption	Opportunity (environment resources and context)	Increase access in terms of time, convenience, and cost	Enablement	Environmental/ social planning	Increase access to credible information by using consistent messaging across a variety of media channels (e.g. television broadcasts, social media, news media, communication networks such as WhatsApp). Address issues of access to vaccines (e.g. not a priority group for rollout) through structural/policy means e.g. by increasing staff, locations, and times that vaccines are available, not

						requiring OHIP, insurance, or paying out-of-pocket. Booking a vaccine appointment should be simple and fast (i.e. doesn't include lots of complex information, doesn't require lots of personal information to book).
		Adoption	Capability (knowledge)	Increase knowledge about COVID vaccines from reputable sources	Education	Communication /marketing	Increase access to credible information by using consistent messaging across a variety of media channels (e.g. television broadcasts, social media, news media, communication networks such as WhatsApp). Be consistent and co-ordinated/unified in messaging about vaccine safety across different sources. Frame

				Adoption	Motivation (social/professional identity)	Increase sense of social responsibility	Persuasion	Communication /marketing	messages with operational transparency around vaccine development.
				Adoption	Motivation (social/professional identity)	Increase sense of social responsibility	Persuasion	Communication /marketing	Use message framing that emphasizes collective action, altruism/moral responsibility and civic duty.
				Adoption	Motivation (beliefs about consequences)	Increase perceived susceptibility and severity of COVID	Persuasion	Communication /marketing	Develop a communication campaign that uses message framing to increase both the perceived risk of *susceptibility* to and *severity* of COVID-19. Use tailored messaging for different demographics who may perceive lower risk.
				Adoption	Opportunity (social influences)	Recommendation from trusted healthcare provider	Modelling	Service provision	Leverage healthcare providers as trusted and credible community leaders. Ensure visibility of healthcare providers endorsing

								vaccinations and their safety. Ensure information is clear and transparent for different patient groups (e.g. those with chronic health conditions)
Kunzler 2021, Buselli, Ottisova, Sierra-Garcia, Harrop	Mental health & bereavement support	Healthcare staff	Sustaining	Capability (physical skills)	Increase resilience for pandemics with crisis training	Training	Service provision	Develop training to educate HCWs to recognise triggers and symptoms of mental health crisis. Normalise the potential to have difficulty coping during a crisis (e.g. with contact, comfort, calm, concern, care, connection, coping, and collaboration). Train HCWs in stress-reduction techniques and help-seeking for if needed.
		Any population	Sustaining	Capability (physical skills)	Psychoeducation about stressors and mental health problems	Training	Service provision	Develop training that is tailored to the specific challenges of HCWs during a pandemic. Provide education for HCWs to recognise symptoms of stress

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								and mental ill health. Normalise the potential to have difficulty coping, such that mind and body processes in stress and resilience are recognised rather than pathologized. Train HCWs in stress-reduction techniques and help-seeking for if needed.
		Any population	Sustaining	Capability (physical skills)	Increase access to therapies to avoid trauma, depression, and anxiety (e.g. CBT, behavioural activation, relaxation techniques)	Training	Service provision	Create time and space for HCWs to attend training and practice skills e.g. provide access at work, provide many time slots, reduce costs (e.g. discount for staff), flexibility in schedules, provide assurances of confidentiality.
		Healthcare workers	Adopting and sustaining	Opportunity (environmental resources and context)	Online psychoeducation	Enablement	Environmental/ social planning	Dedicate resources to pivoting psychoeducation online and provide easy access e.g. through Employee Assistance Program

		Healthcare workers	Sustaining	Opportunity (social influences)	Peer psychological support programs for emotional fatigue and enhancing resilience	Modelling	Service provision	Dedicate resources to training peers to identify warning signs of mental health problems and crises, and to provide social support. Support peer supporters with space for debriefing.
		Healthcare workers	Sustaining	Opportunity (environmental resources and context)	Provide organizational support	Enablement	Regulation	Establish an organizational climate of resilience, community connectedness and social support through developing codes of practice. Distill the philosophy of organizational support down to managers, supervisors, and staff.
		Healthcare workers	Sustaining	Opportunity (environmental resources and context)	Increase access to information sources on psychological resources and clinical practice	Enablement	Environmental/ social planning	Have information on psychological resources and clinical practice online through organizational intranet.
		Healthcare workers	Adopting	Capability (physical skills)	Offering training and	Training	Service provision	Develop and deliver specific trauma-informed

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				clear instructions on the approach to patients with COVID-19			training to support HCWs interactions with patients
Healthcare workers	Sustaining	Opportunity (environmental resources and context)	Ensure safe working conditions and providing optimal protective material	Enablement	Regulation	Ensure the availability of specialized protective equipment. Regulate adherence to use of protective equipment through strict infection control guidelines and organizational climate.
Any population	Sustaining	Opportunity (environmental resources and context)	Proactive outreach to community members to provide bereavement support, particularly in rural and under-served communities	Enablement	Service provision	Recruit outreach workers who are trained in specific trauma-informed principles to support communities and individuals through the pandemic. Outreach workers should be present and visible within communities.
Any population	Sustaining	Capability (physical skills)	Provide crisis-specific bereavement support that is tailored to the particular	Training	Service provision	Develop and deliver specific trauma-informed training to support HCWs interactions with patients

					challenges of the crisis			
Drury 2021	COVID status	General population	Sustaining	Opportunity (environmental resources and context)	Covid-status certification for those who test negative for COVID, test positive for antibodies, or who have been vaccinated against COVID.	Enablement	Environmental/ social planning	Provide COVID status certification and co-ordinate with organizations, workplaces, communities, and businesses to implement standard practice around their use
Gold 2021	Hygiene practices	Any population	Adoption	Opportunity (environmental resources and context)	Increase access to healthcare professionals' knowledge and teaching hygiene practices through group chats in messaging application (e.g. WeChat)	Enablement	Environmental/ social planning	Create community-based group chats for knowledge sharing and hygiene practice training with trusted healthcare sources. Particularly in harder to reach communities.
		Any population	Adopting and sustaining	Opportunity (environmental resources and context)	Increase access to structured program with education, forming implementation plans, reinforcement of positive attitudes and norms, and get tailored feedback on	Enablement	Environmental/ social planning	Create website and mobile application with free structured program with education, forming implementation plans, reinforcement of positive attitudes and norms, and get tailored feedback on implementation plans.

				implementation plans.			
		Any population	Adopting	Opportunity (environmental resources and context)	Increase access to knowledge and reminders to perform behaviour through WeChat group chat.	Enablement	Environmental/ social planning	Create community-based group chats for knowledge sharing and hygiene practice training with trusted healthcare sources. Particularly in harder to reach communities.
		Any population	Adopting	Opportunity (environmental resources and context)	Increase access to persuasive messages with tailored messages based on health risk assignments (e.g. vaccine reminders, respiratory illness advice, influenza alerts, weekly influenza risk maps, and monthly educational bulletins).	Enablement	Environmental/ social planning	Develop email/text campaigns with tailored messaging based on health risk assignments (e.g. vaccine reminders, respiratory illness advice, influenza alerts, weekly respiratory illness risk maps, and monthly educational bulletins).
		Any population	Adopting and sustaining	Opportunity (environmental resources and context)	Add persuasive messages on electronic billboards at point-of-use	Enablement	Environmental/ social planning	Add persuasive messages on electronic billboards at point-of-use (e.g. at the entrance

					(e.g. at the entrance to service station restrooms)			to service station restrooms)
Mardi 2022	Vaccination		Adopting	Motivation (goals)	Provide financial incentives to get vaccinated (higher sums of money most effective)	Incentivization	Fiscal measures	Provide financial incentives to get vaccinated (higher sums of money most effective)
Regmi 2021	Controlling COVID with NPIs		Adopting	Capability (knowledge)	Increase access to clear, transparent, and trustworthy information	Education	Communication /marketing	Running multi-channel and multi-institutional information and education campaigns tailored to different groups
Silva 2021	Reduce transmission		Adopting	Capability (knowledge)	Increase knowledge by using multiple dissemination strategies, rather than one	Education	Communication /marketing	Running multi-channel and multi-institutional information and education campaigns tailored to different groups
Michie et al 2021	Reduce transmission	Any population	Adopting	Capability (knowledge)	Running multi-channel and multi-institutional information and education campaigns tailored to different groups	Education	Communication /marketing	Running multi-channel and multi-institutional information and education campaigns tailored to different groups

				Sustaining	Opportunity (environmental resources and context)	Providing practical, regulatory and financial support for the creation of work, leisure and transportation	Enablement	Regulation	Providing practical, regulatory and financial support for the creation of work, leisure and transportation
				Adopting and sustaining	Opportunity (environmental resources and context)	Environments that enable physical distancing	Enablement	Environmental/social planning	Restructuring physical environment to make adherence easier for example: circle markers in parks, bench markings, highly-visible floor markers, one-way routes
				Sustaining	Opportunity (environmental resources and context)	Providing support and resources to help sustain mutual-aid groups that provide care to communities	Enablement	Environmental/social planning	Providing support and resources to help sustain mutual-aid groups that provide care to communities
				Sustaining	Opportunity (environmental resources and context)	Ensuring that individuals have sufficient and sustained financial resources including employment protection to	Enablement	Regulation	Ensuring that individuals have sufficient and sustained financial resources including employment protection to enable them to behave in ways that

						enable them to behave in ways that mitigate risk (i.e., remain at home when ill)				mitigate risk (i.e., remain at home when ill)
				Adopting	Motivation (social identity)	Increase motivation by targeting information to strengthening social-identities, values and emotional responses around infection prevention and mitigation	Persuasion	Communication /marketing	Use messaging campaigns messaging about protective behaviours that : harness social norms; highlight social/moral responsibility, collective action, and civic duty; tap into the public's identity (e.g. using essential workers in media campaign); simple and clear messaging about the benefits of the behaviour and adherence; demonstrate efficacy of behaviours; positive messaging emphasising adaptiveness and behavioural control; make the message short and catchy; ensure the right messenger;	

							and personalised messaging demonstrating appreciation for sacrifices

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Table 3. Case studies of behavioural science informed health promotion strategies and policies from selected jurisdictions

Sources	COM-B components	BCW intervention functions	BCW policy categories	Response level	Summary of policy interventions or recommendations
Canada					
Impact Canada	Motivation	Persuasion	Communication/ marketing	Adopting	• Evidence-based messaging/communication that: o demonstrates efficacy of protective behaviours, evokes emotional responses with care, emphasizes collective action, altruism/moral responsibility and civic duty, make social norms salient, emphasize adaptiveness and instill a sense of control to support mental health, and address pandemic fatigue o uses personal narratives from close friends enhances messaging on vaccine perceptions o uses risk communication strategies for adverse events after vaccination o uses operational transparency around vaccine development and framing of 'vaccine confidence' ensures better understanding of vaccine messaging (including on adverse events after

					immunization, on those who are unvaccinated) • Tailor messaging to the community (e.g. vaccine messaging to support different socio-demographic groups)
	Physical opportunity	Environmental restructuring	Environmental/social planning, regulation	Sustaining	• Restructuring physical or social environment to make adherence easier for example: develop a behavioural science informed mobile application (ArriveCAN) to implement contact tracing and adherence to COVID guidelines for travellers • Consult with community to determine barriers to adhering to guidelines and develop interventions to address barriers
BC Behavioural Insights Group (BC BIG)	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Restructuring physical or social environment to make adherence easier for example: o circle markers in parks, bench markings, highly-visible floor markers, one-way routes) o Practical support of local economy - tips and checklists, WorkSafeBC resources, providing flexibility such using parking spaces and sidewalks to use as patio seating, fun incentives and games

					o Created a checklist email to help people who are unemployed to access support through WorkBC
	Psychological capability	Education	Communication/ marketing	Adopting	• Knowledge mobilisation by behavioural science organisations (e.g. Behavioural Science and COVID-19 blog series)
	Motivation	Persuasion	Communication/ marketing	Adopting	• Evidence-based messaging/communication that is: o short and catchy, sense of duty, right messenger, highlighting adherence, personalized messaging showing appreciation o Communicates positive stories to support local economy
Ontario's Behavioural Insight Unit (BIU)	Physical opportunity	Environmental restructuring	Environmental/social planning	Adopting	• Restructuring physical or social environment to make adherence easier such as: o Improved a COVID-19 self-assessment tool o increase online access to COVID-19 lab results o develop COVID-19 Exposure Notification mobile phone app
	Motivation	Persuasion	Communication/ marketing	Adopting	• Rapid direct communications using text messaging with front-line workers
Ontario COVID-19	Motivation	Persuasion	Communication/ marketing	Adopting	• Consult with community to determine barriers to adhering

Science Advisory Table					• to guidelines and tailor messaging • Establish trusted messengers, channels, and messages • Communication that uses operational transparency around vaccine development and framing of 'vaccine confidence' ensures better understanding of vaccine messaging (including on adverse events after immunization, on those who are unvaccinated) • Understand and validate emotions • Address short and long-term risk perceptions regarding COVID and vaccines
		Enablement	Service provision	Sustaining	• Address vaccination intention-behaviour gap by providing support to HCWs to create action plans for when, where, and how to get vaccinated
	Physical opportunity	Environmental restructuring	Environmental/social planning	Adopting	• Restructuring physical or social environment to make adherence easier (e.g. communicate where, when, eligibility, how often, defaults, reminders, and financial supports) • Enable timely vaccination with centralised online registry to stay informed
	Social opportunity	Modelling	Communication/ marketing	Sustaining	• Build positive social norms through social comparison

Australia					
New South Wales (NSW) Behavioural Insights Unit	Motivation	Persuasion	Communication/ marketing	Adopting	• Messaging is produced in community languages and accessible formats • Evidence-based messaging/communications such as: o harnessing social norms, highlighting social responsibility and identity by keeping the message positive and reinforcing that we can do this together, and using essential workers in the campaign to tap into the public's identity, simplifying the benefits through simple messaging about why the behaviour is required while being as clear as possible on how to comply with the desired behaviour
	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Restructuring physical or social environment to make adherence easier such as: o work flexibly by encouraging staggered start times or simplifying processes around flexible work arrangements o drawing attention to active transport routes to work such as walking and cycling paths o making COVID-19 testing easy by highlighting that testing is free and does not require ID

	Social opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Restructuring physical or social environment to make adherence easier (e.g. encourage businesses to allow employees to work remotely)
	Social opportunity	Modelling	Communication/ marketing	Sustaining	• Harnessing social norms and use roles models such as: ○ Use senior managers to encourage businesses to allow employees to work remotely ○ stimulating a sense of achievement and community by using leader boards to show the performance of local health districts against targets
Australian Federal government	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Consult with community to determine barriers to adhering to guidelines and develop interventions to address barriers
The Victorian government	Psychological capability (memory, attention, and decision processes)	Enablement	Environmental/social planning	Adopting	• COVID-19 Decision Tool that helped minimize information overload by tailoring information to individuals. The tool helped streamline information by removing information that isn't relevant to the individual and using plain language and user-centered examples. The tool minimized the effort of relating abstract rules or conditions to the user's personal situation.

The Rapid Response Engagement Team from the Victorian Department of Health	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with indigenous/at-risk communities to identify specific barriers/enablers (e.g. a program to help inform community members about changes to the COVID-19 testing system and distribution of rapid antigen testing and subsequently sourced feedback from community members and organizations to help adapt the program)
France					
France's Inter-ministerial Directorate for Public Transformation, alongside the Ministry of Sport and the Behavioural Insights Team	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with public to identify specific concerns and tailor messaging around that (e.g. a 35-person citizen panel was developed to help address concerns and queries that the public had identified about COVID-19 vaccines and present them to the national government) • Create platform with physical activity resources and motivational aids
The Behavioural Insights Team, the French public health agency and Ministry of Health	Social opportunity	Modelling	Communication/ marketing	Sustaining	• Address intention-behaviour gap for vaccination with HCWs (e.g. such as 'I am vaccinated' pins and social media posts to harness perceived norms and notions of reciprocity)

New Zealand					
New Zealand Government	Psychological capability (knowledge)	Education	Communication/ marketing	Adoption	• Consistency between the local services' information provision and national health system level communication (e.g. via daily government press briefings to inform behaviour change)
	Physical opportunity	Environmental restructuring	Fiscal	Sustaining	• Provide funding to implement programs (e.g New Zealand Government approved $23.5 million for eight Māori organisations and tribes (iwi) to help boost vaccination rates. The funding was designated for Māori and iwi-led initiatives to help improve vaccine uptake among Māori community members)
Waka Kotahi New Zealand Transport Agency	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with indigenous/at-risk communities to identify specific barriers/enablers (e.g. establishing needs of community and supporting program design)
Evaluation and Behavioural Science team	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with public to identify specific concerns and tailor messaging around that (e.g. inform the COVID-19 response with data on public beliefs and perceptions via national and population surveys that measure knowledge, attitudes, and behaviours related to, and at

					various stages of, the COVID-19 pandemic)
United Kingdom					
Local councils	Motivation	Persuasion	Communication/ marketing	Adopting	• Tailor messaging to the community (e.g. creation of a rapid segmentation tool to target communications among different groups) • Establish trusted messengers, channels, and messages
	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Restructuring physical or social environment to make adherence easier (toolkits for small businesses to encourage preventative behaviours) • Create opportunities to consult with public to identify specific concerns and tailor messaging around that (e.g. conduct of focus groups to test vaccine hesitancy messaging)
	Physical opportunity	Enablement	Service Provision	Sustaining	• Development of a program to address health and wellbeing disparity among equity-deserving populations
The Local Government Association	Psychological capability	Education	Communication/ marketing	Adopting	• Health information (e.g. for vaccine uptake) addresses community-specific concerns and dispel misinformation
The Community Champions initiative	Psychological capability	Education	Communication/ marketing	Adopting	• trusted local champions deliver health information to local networks about COVID-19 and vaccines
	Social opportunity	Modelling	Service provision		
The Scientific Pandemic	Psychological capability	Education	Communication/ marketing, Guidelines	Adopting and sustaining	• Knowledge mobilisation by behavioural science

Influenza group on Behaviour (SPI-B)					organisations (e.g. released 32 documents about behavioural and social interventions such as school closures, home isolation, quarantine, and social distancing during COVID-19 to advise the Scientific Advisory Group for Emergencies (SAGE))
Behavioural and Cultural Insights (BCI) Hub	Psychological capability	Education	Communication/ marketing, Guidelines	Adopting and sustaining	• Knowledge mobilisation by behavioural science organisations (e.g. a repository of best practices for using behavioural and cultural insights and contains 32 potentially relevant documents related to COVID-19)
United States					
Department of Health & Human Services (HHS)	Physical opportunity	Environmental restructuring	Guidelines	Adopting	• Co-creation of guidance to prevent inequities with communities and stakeholders
	Physical opportunity	Environmental restructuring	Fiscal	Sustaining	• Provide funding to implement programs (e.g. improve health literacy to enhance COVID-19 vaccinations among equity-deserving populations)
Hip Hop Public Health	Physical opportunity	Environmental restructuring	Guidelines	Adopting	• Co-creation of guidance to prevent inequities with communities and stakeholders (e.g. educational resources to improve vaccine literacy, confidence, and uptake among ethno-racial communities)
	Physical opportunity	Environmental restructuring	Fiscal	Sustaining	• Provide funding to implement programs such as:

The National Institutes of Health (NIH)					○ outreach and engagement efforts for equity-deserving populations ○ to improve the vaccination rates of 18 primary care clinics by coaching, data, and community partnerships with equity-deserving communities
	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with indigenous/equity-deserving communities to identify specific barriers/enablers (e.g. to improve vaccination uptake)
World Health Organisation (WHO)					
The behavioural sciences for better health initiative report, The WHO Regional Office for Europe published a technical document, The behavioural sciences for better health initiative report, WHO published data for action: achieving high	Physical capability, psychological capability	Training	Guidelines, communication/ marketing	Adopting and sustaining	• Knowledge mobilisation by behavioural science organisations such as: ○ Report describing the creation of tools to support the collection of data on social and behavioural insights, such as the WHO tool for behavioural insights on COVID-19 and the WHO social and behavioural insights COVID-19 data collection tool for Africa. ○ Guidance to setting up behavioural insights units for improved health outcomes, which highlights several examples of BI units supporting countries' responses to COVID-19

uptake of COVID-19 vaccines: gathering and using data on the behavioural and social drivers of vaccination: a guidebook for immunization programmes and implementing partners: interim guidance, World Health Organization. (2022). Behavioural and social drivers of vaccination: tools and practical guidance for achieving high uptake. World Health Organization. https://apps.who.int/iris/handle/10665/354459, An interim guidance					o Technical assistance and capacity-building such as through an online training course on collecting social and behavioural data on COVID-19 through the OpenWHO knowledge-transfer platform o Guidance documents to help countries better understand social processes, thoughts and feelings and motivations that shape vaccine intention and behaviour, and practical issues with several steps – Make a research plan, select data collection tools, collect and analyse data, use findings to design interventions, continue to monitor and improve o Report that provides risk communication and community-engagement strategies proposing four objectives for people-centred and community-led approaches to improve trust and social cohesion, and reduce negative impacts of COVID-19: 1) Be community-led, 2) Be data driven, 3) Reinforce capacity and local solutions, 4) Be collaborative

document from WHO				
WHO's technical advisory group on behavioural insights and sciences for health produced a meeting report on behavioural considerations for acceptance and uptake of COVID-19 vaccines	Physical opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Restructuring physical or social environment to make adherence easier • Create opportunities to consult with communities to identify specific barriers/enablers for vaccination
	Social opportunity	Environmental restructuring	Environmental/social planning	Sustaining	• Create opportunities to consult with communities to identify specific barriers/enablers for vaccination
	Motivation	Persuasion	Communication/ marketing	Adopting	• Communication that uses operational transparency around vaccine development and framing of 'vaccine confidence' ensures better understanding of vaccine messaging (including on adverse events after immunization, on those who are unvaccinated) • Establish trusted messengers, channels, and messages
European regional action framework for behavioural and cultural insights for health, 2022–2027	Motivation	Incentivization	Guidelines	Adopting	• Commitment to a resolution and action framework to drive work in behavioural and cultural insights and better integrate behavioural science into policy decision-making processes

Table 4. Summary of key findings for community engagement activities with equity-deserving groups for COVID-19 pandemic preparedness and response

Reference(s)	Strategies	COM-B (TDF domains)	Response level	BCW intervention functions	BCW policy categories
Bernstein 2022	Community involvement in health messaging tailored for the needs of the community	Opportunity (environment context and resources)	Sustaining	Enablement	Environmental/social restructuring
Alizadeh 2020, Baba 2022, Banerjee 2022, Brewer 2020, Essa-Hadad 2022, Guruge 2022, Huang 2022, Nawaz 2023, Wijesinghe 2022, Roy 2022, Vierra de Souza 2020	Community leaders act as trusted sources of COVID information for communities	Capability (knowledge)	Adopting	Education	Service provision
					Communication/ marketing
Nawaz 2023, Torres 2021, Alizadeh 2020, Baba 2022, Feinberg 2021, Guruge 2022, Roy 2022, Vierra de Souza 2020, Wijesinghe 2022	Health information addresses community-specific concerns and dispel misinformation	Capability (knowledge)	Adopting	Education	Service provision
		Motivation (goals)		Persuasion	Communication/ marketing
Feinberg 2021	Health messages outline what people need to do to avoid COVID	Capability (knowledge)	Adopting	Education	Communication/ marketing
Alizadeh 2020, Banerjee 2022, Essa-Hadad 2022, Mayfield 2021,	Knowledge sharing is taken to communities and uses established	Capability (knowledge)	Adopting	Education	Communication/marketing

Nawaz 2023, Roy 2022, Siyabi 2021, Vierra de Souza 2020	networks/methods for communication	Opportunity (environment context and resources)	Sustaining	Enablement	Environmental/social planning
Blignault 2022, Rosenberg 2022, Budd 2022	Programs, materials, guidance, and resources are to be culturally relevant to target community	Capability (knowledge)	Adopting	Education	Service Provision
Budd 2022, Feinberg 2021, Naidu 2021	Programs, materials, guidance, and resources are to be produced in community languages	Capability (knowledge)	Adopting	Education	Service Provision
Feinberg 2021, Haidar 2021, Siyabi 2021	Programs, materials, guidance, and resources are to be provided in accessible formats alternative to print word	Capability (knowledge)	Adopting	Education	Service Provision
Feinberg 2021, Naidu 2021, Nawaz 2023	Provide language, literacy and digital literacy services within communities	Capability (knowledge)	Adopting	Education	Service provision
Guruge 2022	Community leaders train community members how to perform behaviours	Capability (physical skills)	Adopting	Training	Service provision
Feinberg 2021	Increase paid community healthcare workers who represent each diverse community	Capability (physical skills)	Sustaining	Training	Service provision
Feinberg 2021, Naidu 2021	Train healthcare workers who serve these communities in communication, health literacy and intercultural sensitivity	Capability (physical skills)	Sustaining	Training	Service provision

Alizadeh 2020, Budd 2022, Guruge 2022	Co-creation of interventions/implementation tools with communities and stakeholders	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
			Sustaining	Environmental restructuring	Guidelines
			Sustaining	Environmental restructuring	Regulation
Essa-Hedad 2022, Vierra de Souza 2020	Community leaders act as trusted sources of information about communities for health professionals/system	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
Alizadeh 2020, Essa-Hedad 2022, Feinberg 2021, Siyabi 2021, Wijesinghe 2022	Community leaders facilitate provision of resources to follow COVID guidelines (e.g. free masks)	Opportunity (environmental contexts and resources)	Adopting	Enablement	Environmental/social planning
Brewer 2020	Community leaders facilitate provision essential resources/material resources (e.g., food, medicine, financial assistance)	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Environmental/social planning
Banerjee 2022	Community leaders identify barriers specific to the community	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
Bernstein 2022, Essa-Hedad 2022, Wijesinghe 2022,	Community leaders model health behaviours	Opportunity (social influences)	Adopting	Enablement	Modelling
Brewer 2020	Community leaders provide social support	Opportunity (social influences)	Sustaining	Enablement	Environmental/social planning

den Broeder 2022	Community organised way to share bids and offers for help-giving	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
Ahlers 2021, den Broder 2022	Community-led efforts to enhance social connectedness	Opportunity (social influences)	Sustaining	Enablement	Environmental/social planning
Huang 2022	Co-ordinate with communities to ensure more equitable vaccine rollout - based on social vulnerability	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Regulation
Alizadeh 2020, Baba 2022, Mathias 2022	Enable implementation of COVID response with partnerships between academic and community teams	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Environmental/social planning
Hassen 2021, Mayfield 2021	Identify barriers for communities to access to resources	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
Alizadeh 2021, Baba 2022, Bernstein 2022, Banerjee 2022, Huang 2022	Increase access between health professionals/system for community leaders (to become mediators to their community)	Opportunity (environmental contexts and resources)	Sustaining		
Ahlers 2021	Increase access to skill development	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Service provision
Alizadeh 2021, Roy 2022, Vierra de Souza 2020	Increase awareness within marginalised communities about where to access health information	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Environmental/ social planning
Budd 2022	Intervention delivery by community leaders	Opportunity (social influences)	Adopting	Modelling	Service provision
Ahlers 2021, Alizadeh 2021,	Participation by community members in help-giving/services	Opportunity (social influences)	Sustaining	Modelling	Service provision

Arora 2022, Bowe 2022, Siyabi 2021					
Naidu 2021	Pivot services to provide tele-interventions	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/social planning
Hassen 2021	Restructure environments to meet community needs	Opportunity (environmental contexts and resources)	Sustaining	Environmental restructuring	Environmental/ social planning
Alizadeh 2021, Mathias 2022	Provide funding for community-led response efforts	Opportunity (environmental contexts and resources)	Sustaining	Enablement	Fiscal measures
Banerjee 2022	Community leaders co-create health messaging tailored for the needs of the community	Motivation (goals)	Adopting	Persuasion	Communication/marketing
Feinberg 2021	Ongoing work in communities to ensure pandemic preparedness - e.g. have materials ready faster	Motivation (goals)	Sustaining	Persuasion	Communication/marketing
Guruge 2022, Haidar 2021, Hassen 2021, Morgan 2021, Siyabi 2021	Participation by community members in prioritising needs	Motivation (goals)	Adopting	Enable	Environmental/ social planning
Alizadeh 2021, Siyabi 2021, Hassen 2021, Mathias 2022, Mayfield 2021, Morgan 2021, Naidu 2021, Nawaz 2023	Provide essential resources/material resources (e.g., food, medicine, financial assistance)	Motivation (goals)	Sustaining	Enable	Environmental/ social planning
				Enable	Fiscal measures
Nawaz 2023	Representation of social identities among community health workers	Motivation (goals)	Adopting and sustaining	Modelling	Service provision

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A coding scheme for determining whether strategies were either for adopting behaviours or sustaining behaviours was developed based on literature on phases and stages of change and matching of strategies to stages and phases (Keller et al., 2020; Prochaska & Velicer, 1997).

Adopting factors	*Sustaining factors*
Did the strategy aim to increase knowledge of the behaviour and why the behaviour is necessary?	Did the strategy aim to emphasise continued benefit of the behaviour? E.g. once risk reduces, why is masking still necessary?
Did the strategy aim to create positive attitudes and perceptions of the behaviour?	Did the strategy aim to prevent relapse?
Did the strategy aim to evoke emotions that will encourage adoption of the behaviour?	Did the strategy aim to develop skills to prevent relapse?
Did the strategy aim to influence motives for behaviour change? (e.g. beliefs about consequences)	Did the strategy aim to decrease emotions and mental states (e.g. fatigue) that could interfere with behaviour maintenance?
Did the strategy aim to increase skills to start performing the behaviour?	
	Did the strategy aim to contribute ongoing resources to support behaviour?
Did the strategy aim to increase the priority of the behaviour?	Did the strategy aim to contribute ongoing relevant social and physical cues and prompts in the settings of engaging in the behaviour?
Did the strategy aim to create a positive outcome expectancy of the behaviour?	
	Did the strategy aim to decrease environmental factors that interfere with the behaviour?
Did the strategy aim for individuals to evaluate whether the behaviour has an impact on the social environment (e.g. cost, benefits, loss, gains, or harm to others)?	Did the strategy aim to restructuring the environment to make maintaining the behaviour easier, automatic, and doesn't require effort?
Did the strategy aim for individuals to evaluate whether the behaviour is supported in the social environment (e.g. others have positive attitudes toward the behaviour and perform the behaviour)?	Did the strategy aim to continue reduced constraints to enact the behaviour?
Did the strategy aim to increase behavioural intentions or translate intention into action?	Did the strategy aim to promote ongoing social norms of performing the behaviour?
Did the strategy aim to provide reinforcements for adopting the behaviour?	Did the strategy aim to facilitate ongoing support and connection from trusted people and groups to support behaviour maintenance? E.g. community leaders
Did the strategy aim to remind individuals to perform the behaviour?	

Appendix 2

Behaviour Change Wheel Intervention Functions and Policy Category Definitions

Intervention functions	Definition
Education	Increasing knowledge or understanding
Persuasion	Using communication to induce positive or negative feelings or stimulate action
Intentivisation	Creating expectation of reward
Coercion	Creating expectation of punishment or cost
Training	Imparting skills
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)
Environmental restructuring	Changing the physical or social context
Modelling	Providing an example for people to aspire to or imitate
Enablement	Increasing means/reducing barriers to increase capability or opportunity[1]
Policy categories	
Communication/marketing	Using print, electronic, telephonic or broadcast media
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision
Fiscal	Using the tax system to reduce or increase the financial cost
Regulation	Establishing rules or principles of behaviour or practice
Legislation	Making or changing laws
Environmental/social planning	Designing and/or controlling the physical or social environment
Service Provision	Delivering a service

[1]Capability beyond education and training; opportunity beyond environmental restructuring