COVID-19 Living Evidence Synthesis 19.1: Effectiveness of interventions for promoting adherence to PHSMs for preventing COVID-19 and other respiratory infections in non-health care community-based settings

Executive summary

Questions

1. What is the best available evidence about strategies and interventions that promote adherence to the six PHSMs (quarantine and isolation, masks, physical distancing and reduction of contacts, hand hygiene and respiratory etiquette, cleaning, and disinfecting, and ventilation) in preventing transmission of COVID-19 and other respiratory infections in non-healthcare, community-based settings?
   a. Within studies testing the effectiveness of strategies and interventions that promote adherence to the six PHSMs, how is adherence being measured?
   b. Within studies testing the effectiveness of strategies and interventions that promote adherence to the six PHSMs, what factors (in terms of Capability, Opportunity, and Motivation) were changed by the intervention that could explain adherence?
   c. Within studies testing the effectiveness of strategies and interventions that promote adherence to the six PHSMs, is effectiveness moderated by any sociodemographic factors?
2. Within studies testing the effectiveness of strategies and interventions that promote adherence to the six PHSMs, what are the spillover effects to PHSM behaviours and other health behaviours that were not targeted by the intervention?

Background

- Public health and social measures (PHSMs) are a cornerstone of limiting the transmission of SARS-CoV-2 during the COVID-19 pandemic. These PHSMs include: quarantining and isolating, masking, physical distancing and reducing contacts, hand hygiene and respiratory etiquette, cleaning and disinfecting objects and surfaces, and improving ventilation. Whether, and the extent to which, a given PHSM is effective in preventing transmission of SARS-CoV-2 and impacting on other health and societal outcomes is the focus of other living evidence syntheses. However, evaluating the effectiveness of PHSMs in preventing transmission depends at least in part on individuals, groups and populations engaging in (and being supported to engage in) behaviours that are consistent with adhering to PHSMs. This living evidence synthesis seeks to identify the best evidence available about which strategies and interventions are effective in supporting adherence to each of the six PHSMs listed above on their own (or in combination, where evidence is available).

Key points

- We included 50 studies. Most studies evaluating strategies and interventions to promote adherence to PHSMs to date have focused on strategies to promote physical distancing, hand-hygiene and respiratory etiquette, and masking, with relatively few (quarantine and isolation, and cleaning/disinfecting) or none (ventilation) for the other PHSMs.
- Most studies were conducted in 2020 and 2021. The applicability of the findings should therefore be interpreted in a manner that considers whether strategies tested earlier in the COVID-19 pandemic remain fit to address factors that might act as barriers or enablers to adhering to these PHSMs at present.
- Most studies had moderate risk of bias, while a smaller but notable number of studies had serious risk of bias. Few studies were rated as low risk of bias or critical risk of bias. There remain opportunities to conduct higher quality evaluations to inform the effectiveness of PHSMs and the supports available to individuals and populations to engage in them. That said, many evaluations were conducted under real-world conditions, where randomized trials would not be feasible for pragmatic and ethical reasons, and therefore provide the best available evidence.
- *Quarantine and isolation (1 study)*: users of a contact tracing app were more likely to report entering self-quarantine and started self-quarantine on average 1 day early when notified of a possible exposure by the app compared to manual contact tracing.
- *Masking (11 studies)*: population-level interventions show that masking recommendations and mask mandates were effective at increasing adherence. Interventions that provided education and addition of objects within the community context (e.g., education plus free masks provided to villages vs education-only, persuasive messages at point-of-use locations to prompt performance of the behaviour) were effective at increasing adherence. Specific forms of persuasive messages that prompt mask wearing via SMS messages may be effective. Individual-level interventions (e.g., persuasive messages through email, receiving antibody status test results) tended to be ineffective at increasing adherence.

Executive summary (continued)

Key points (continued)

- *Physical distancing and reducing contacts (29 studies)*: Population-level measures to restrict contacts were associated with greater adherence. There was some evidence that the longer that restrictions continued, adherence began to wane over time. Community-level interventions providing situational prompts and adding the means to perform the behaviour to the environment (e.g., floor markers to demonstrate appropriate distance) were effective in increasing adherence to physical distancing. Forming if-then plans with situational cues may be effective for avoiding crowds. Persuasive messaging from sources perceived to be more credible (i.e., those with expertise) delivered frequently, over a longer time, may be effective. Individual-level interventions with persuasive messaging alone, delivered over short time frames, were ineffective at promoting adherence. Receiving antibody status (and whether that status was seropositive or seronegative) had no effect on adherence to physical distancing.
- *Hand hygiene and respiratory etiquette (20 studies)*: interventions with specific forms of persuasive messages alone were not effective. Situational prompts, adding the means to perform the behaviour to the environment (e.g., hand sanitizer dispensers), and persuasive messages when provided at the point-of-use, were effective in increasing adherence. Forming if-then plans with situational cues, when bolstered with tailored feedback and advice on handwashing technique from medical professionals, also promoted greater adherence to hand hygiene. Two interventions with theory-based components (e.g., implementation intentions, model behaviour, information about health consequences, evoking social norms, form a habit) delivered over 1-3 months demonstrated that increased hand hygiene could be maintained.
- *Cleaning and disinfecting (2 studies)*: Activities aiming to persuade adherence (e.g., writing a letter to vulnerable persons about following PHSMs to protect them, reading about economic arguments, forming a plan for a meaningful activity, or reading and rating agreement with scenarios of people violating guidelines) were each shown to be ineffective at increasing disinfecting of packages or foods brought into the house. Receiving information about protective behaviours and follow-up emails with persuasive messages decreased adherence to self-reported cleaning in the subsequent 7 days.
- *Multiple PHSMs (2 studies)*: inducing cognitive dissonance was effective at increasing reported engagement in a range of behaviours across PHSMs. Providing educational messages that were tailored to emphasise the increased risk of COVID-19 for people in Black communities did not increase performance of self-reported precautionary behaviours.
- *Ventilation (0 studies)*: we did not identify any studies meeting the criteria to be included in this living evidence synthesis.
- *Spillover effects (6 studies)*: a CDC mask recommendation resulted in immediate (within 2 days) increases in a self-reported handwashing, tissue use, disinfecting home/workspaces, stopping close contact, reducing sharing transport, limiting visits to places of worship, preparation to stay home, and keeping children home, though longer-term effects are unknown. Physical distancing was higher during a state-wide mask mandate than after the mandate was removed. Another study of a mask mandate had no effect on staying 2 metres distant in public. Physical distancing also increased during a campaign to provide free masks, education about masks, public promotion of mask use and role modelling. Receiving SMS messages to promote physical distancing had no effect on reported handwashing, and vice versa. Lockdown measures were related to less physical activity, shorter sleep duration, and later bedtime.
- *Effect on capability, opportunity, or motivation (10 studies)*: Some persuasive messaging interventions were effective at changing capability, opportunity, and motivational precursors to adherence. In some but not all cases, changes in these factors (e.g., increased positive attitudes toward behaviour, increased intentions, increased self-monitoring) explained increased adherence.
- Using Behaviour Change Wheel categorization of adherence-promoting intervention strategies, we identified evidence supporting many strategies. Restriction-based strategies were particularly effective at reducing mobility, a proxy for physical distancing and reducing contacts. Persuasion-based strategies did not consistently promote adherence; while persuasive messages alone do not appear sufficient, persuasive messaging was most effective when provided at point-of-use, when bolstered by delivery from credible sources, and when the means to perform the behaviours are provided alongside. Interventions which restructure the environment (i.e., walking directions, hand sanitizer is available, masks are provided for free) and that better enable individuals (i.e., mobile apps with motivating activities) to adhere to PHSMs may be particularly impactful for individuals who have the greatest barriers to performing the behaviours.

Date of last literature search: 3 March 2023

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Contents

Please note: This living evidence synthesis (LESs) is part of a suite of LESs of the best-available evidence about the effectiveness of six PHSMs (masks, quarantine and isolation, ventilation, physical distancing and reduction of contacts, hand hygiene and respiratory etiquette, cleaning, and disinfecting), as well as combinations of and adherence to these measures, in preventing transmission of COVID-19 and other respiratory infectious diseases in non-health care community- based setting. This first full version was developed after two interim versions, which are available upon request. The next update to this and other LESs in the series is to be determined, but the most up-to-date versions in the suite are available on the COVID-END website. We provide context for synthesizing evidence about public health and social measures in Box 1 and an overview of our approach in Box 2.

Box 1: Context for synthesizing evidence about public health and social measures (PHSMs)

This series of living evidence syntheses was commissioned to understand the effects of PHSMs during a global pandemic to inform current and future use of PHSMs.

General considerations for identifying, appraising and synthesizing evidence about PHSMs

- PHSMs are population-level interventions and typically evaluated in observational studies.
  - Many PHSMs are interventions implemented at a population level, rather than at the level of individuals or clusters of individuals such as in clinical interventions.
  - Since it is typically not feasible and/or ethical to randomly allocate entire populations to different interventions, the effects of PHSMs are commonly evaluated using observational study designs that evaluate PHSMs in real-word settings.
  - As a result, a lack of evidence from RCT's does not necessarily mean the available evidence in this series of LESs is weak.
- Instruments for appraising the risk of bias in observational studies have been developed; however, rigorously tested and validated instruments are only available for clinical interventions.
  - Such instruments generally indicate that a study has less risk of bias when it was possible to directly assess outcomes and control for potential confounders for individual study participants.
  - Studies assessing PHSMs at the population level are not able to provide such assessments for all relevant individual-level variables that could affect outcomes, and therefore cannot be classified as low risk of bias.
- Given feasibility considerations related to synthesizing evidence in a timely manner to inform decision-making for PHSMs during a global pandemic, highly focused research questions and inclusion criteria for literature searches were required.
  - As a result, we acknowledge that this series of living evidence syntheses – about the effectiveness of specific PHSMs (i.e., quarantine and isolation; mask use, including unintended consequences; ventilation, reduction of contacts, physical distancing, hand hygiene and cleaning and disinfecting measures), interventions that promote adherence to PHSMs, and the effectiveness of combinations of PHSMs – does not incorporate all existing relevant evidence on PHSMs.
  - Ongoing work on this suite of products will allow us to broaden the scope of this review for a more comprehensive understanding of the effectiveness of PHSMs.
  - Decision-making with the best available evidence requires synthesizing findings from studies conducted in real-world settings (e.g., with people affected by misinformation, different levels of adherence to an intervention, different definitions and uses of the interventions, and in different stages of the pandemic, such as before and after availability of COVID-19 vaccines).

Our approach to presenting findings with an appraisal of risk of bias (ROB) of included studies

To ensure we used robust methods to identify, appraise and synthesize findings and to provide clear messages about the effects of different PHSMs, we:

- acknowledge that a lack of evidence from RCTs does not mean the evidence available is weak
- assessed included studies for ROB using the approach described in the methods box
- typically introduce the ROB assessments only once early in the document if they are consistent across sub-questions, sub-groups and outcomes, and provide insight about the reasons for the ROB assessment findings (e.g., confounding with other complementary PHSMs) and sources of additional insights (e.g., findings from LES 20 in this series that evaluates combinations of PHSMs)
- note where there are lower levels of ROB where appropriate
- note where it is likely that risk of bias (e.g., confounding variables) may reduce the strength of association with a PHSM and an outcome from the included studies
- identify when little evidence was found and when it was likely due to literature search criteria that prioritized RCTs over observational studies.

Implications for synthesizing evidence about PHSMs

Despite the ROB for studies conducted at the population level that are identified in studies in this LES and others in the series, they provide the best-available evidence about the effects of interventions in real life. Moreover, ROB (and GRADE, which was not used for this series of LESs) were designed for clinical programs, services and products, and there is an ongoing need to identify whether and how such assessments and the communication of such assessments, need to be adjusted for public-health programs, services and measures and for health-system arrangements.

Box 2: Our approach

We retrieved candidate studies by searching: 1) PubMed via COVID-19+ Evidence Alerts; 2) Embase via OVID; 3) CINAHL; 4) APA PsycINFO; and 5) pre-print servers. Searches were conducted for studies reported in English, conducted with humans and published since 1 January 2020 (to coincide with the emergence of COVID-19 as a global pandemic) up to March 3rd, 2023. Our detailed search strategy is included in **Appendix 1**. Studies were identified up to three weeks before the version release date. A full list of included studies is provided in **Tables 2-9**. Studies excluded at the last stages of reviewing are provided in **Appendix 2**.

Population of interest: All population groups that report data related to any COVID-19 variants and sub-variants.

Intervention and control/comparator: The interventions included were any intervention designed to increase adherence to behaviours inherent to one or more of the PHSMs (i.e., quarantine and isolation, masking, physical distancing and reduction of contacts, hand hygiene and respiratory etiquette, cleaning and disinfecting, and ventilation). The comparators included were groups or time periods with an absence of the specific adherence-promoting intervention or strategy (e.g. wait-list control condition, baseline period).

Primary outcome: The primary outcome measure was a measure of adherence or performance of a behaviour inherent to each PHSM (either self-reported or objectively assessed).

Study designs: Studies that reported on empirical data with a comparator, provided that they were conducted in community/natural-living conditions (as opposed to laboratory), were considered for inclusion. Modelling studies, simulation studies, cross-sectional studies, case reports, case series, and press releases were excluded. Relevant reviews were hand-searched to identify primary studies that met our inclusion criteria.

Data extraction: Data extraction was conducted by one team member and checked for accuracy and consistency by another using the template provided in **Appendix 3**.

Critical appraisal: Risk of Bias (ROB) of individual studies was assessed using validated ROB tools. For RCTs and quasi-experimental trials we used ROB-2, and for observational studies, we used ROBINS-I. Judgements for the domains within these tools were decided by consensus within the synthesis team. To ensure a consistency of critical appraisal judgment across PHSM LESs, an approach for making judgements within domains was reached by consensus of all LES teams. When a study was deemed to meet at least one criterion, placing it at "critical" risk of bias, it was judged as "critical" without completing the remaining ROB assessment. Our detailed approach to critical appraisal is provided in **Appendix 4**.

Summaries: We presented narrative evidence profiles across studies for each PHSM and spillover effects. The results were stratified by whether interventions were delivered at population, community, or individual levels. Population level interventions were considered interventions that were applied to a whole population (e.g. a whole province). Community level interventions were considered interventions that were applied to a community setting (e.g. grocery store, workplace) that participants happen to be a part of or attend. Individual level interventions were considered interventions where participants were recruited on an individual basis and the intervention was applied to individuals. We additionally synthesised across PHSMs by intervention type, as categorized by the Behaviour Change Wheel. Coding of interventions (source, method of dissemination, behaviour change strategies, and intervention type) were guided by existing behavioural science frameworks. Future versions may include statistical pooling of results if appropriate.

The next update to this document is to be determined

Findings

There were 50 relevant included studies on interventions that promote adherence to quarantine & isolation (n=1), masking (n=11), physical distancing and reducing contacts (n=29), hand hygiene and respiratory etiquette (n=20), cleaning and disinfecting (n=2), and multiple PHSMs (n=2). Six of the 50 included studies reported on spillover effects. No studies were identified for ventilation. Further details of the identification and screening of records are presented in a PRISMA diagram in Figure 1.

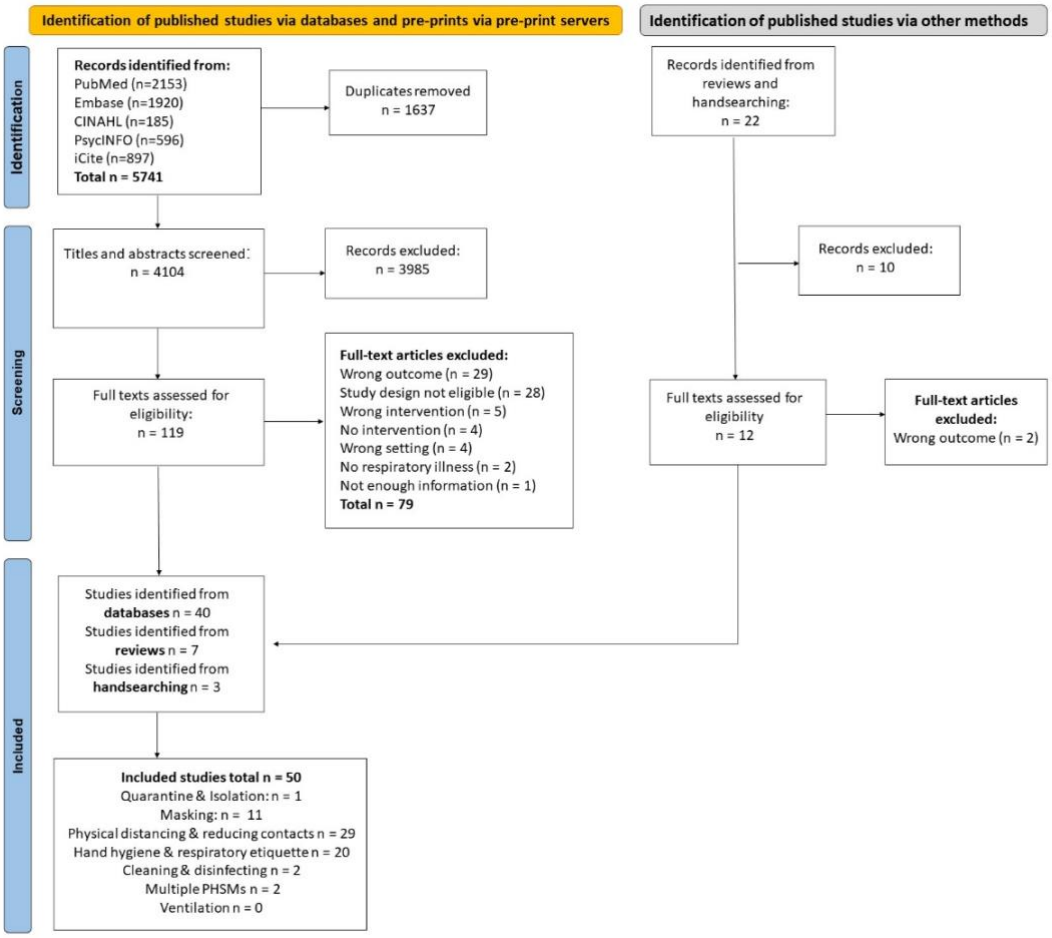

Figure 1. PRISMA diagram demonstrating records identified, screened, and excluded with reasons
Note: Some full-texts had more than one relevant study and some studies were included for more than one PHSM, meaning the number of studies included per PHSM add up to more than the total number of included studies.

We included 24 randomized trials, one with a low risk of bias (37), eight with a moderate risk of bias (7, 27, 30, 35, 39, 41, 42, 50), 14 with a serious risk of bias (4, 8, 10, 12, 31-35, 36, 43-45, 49), and one at critical risk of bias (11). There were 26 observational studies included, where one was judged as low risk of bias (18), 13 were judged as moderate risk of bias (1, 5, 9, 15-17, 20, 22, 25, 26, 38, 40, 48), eight were judged as serious risk of bias (6, 13, 14, 19, 24, 28, 29, 46), and one as critical risk of bias (2).

The outcomes reported in the included studies were diverse. The frequency of outcomes in the included studies are reported by PHSM in table 1.

Table 1. Table 1. Summaries of the frequency of behavioural outcomes across studies, by PHSM

Note. S=subjective/self-reported; O=objectively assessed

Quarantine and isolation		Masking		Physical distancing and reducing contacts		Hand hygiene and respiratory etiquette		Cleaning and disinfecting		Multiple behaviours		Ventilation	
Behavioural Outcome	**N**	**Behavioural Outcome**	**N**	**Behavioural Outcome**	**N**	**Behavioural Outcome**	**N**	**Behavioural Outcome**	**N**	**Behavioural Outcome**	**N**	**Behavioural Outcome**	**N**
Incidence of entering self-quarantine (S)	1	Frequency of mask-wearing (S)	4	Frequency of physical distancing (S)	7	Frequency of handwashing (S)	8	Frequency of cleaning frequently-touched surfaces over past 7 days (S)	1	Frequency of performing various precautionary measures (S)	1	-	
Time interval (in days) between exposure date and the beginning of quarantine among close contacts (S)	1	Incidence of mask-wearing in public (O)	5	Frequency of staying home (S)	5	Proportion of people observed washing hands/using hand sanitizer (O)	3	Incidence of respondents performing disinfecting behaviors (S)	1				
Incidence of app users who uploaded CovidCode from public health authority (O)	1	Incidence of mask-wearing in public (S)	2	Daily range of mobility/mobility changes (O)	5	Amount of sanitizer used daily (O)	3						
		Incidence of mask-buying (O)	1	Distance travelled (O)	4	Frequency of sneezing or coughing into elbow (S)	3						
		Incidence of mask being worn properly (O)	1	Number of unique contacts outside of home and work (O)	3	Frequency of using paper tissue (S)	3						
				Time spent outside home (S)	3	Handwashing/sanitizer ratio (number of people who washed/sanitized	2						

						hands divided by number of opportunities) (O)							
				Physical distancing observed by researchers (O)	3	Number of handwashing behaviors performed (O)	2						
				Frequency of avoiding vulnerable people (O)	3	Frequency of touching face with unwashed hands	2						
				Frequency of receiving as little visitors as possible (O)	3	Incidence of avoiding touching face with unwashed hands	2						
				Frequency of avoiding crowds (O)	3	Handwashing relative to pre-COVID-19	1						
				Average duration of contacts outside of home and work (O)	2	Proportion of people self-reporting hand washing/use of hand sanitizer (S)	1						
				Proportion of individuals staying at home/work/recreation (O)	2								
				Frequency of general outings (S)	2								
				Proportion of cell phone users commuting to work (O)	1								
				Proportion of cell phone users travelling between metropolitan areas (O)	1								
				Reduction in social contacts (O)	1								
				Incidence of working from home (S)	1								
				Incidence of avoiding of crowded areas (S)	1								

				Proportion of population working in a different county (O)	1								
				Number of vehicle miles travelled (O)	1								
				Degree of traffic congestion (proxy for overall mobility) (O)	1								
				Number of daily work trips per person (O)	1								
				Number of daily non-work trips per person (O)	1								
				Number of out-of-country trips per person (O)	1								
				Aggregate social distancing index (O)	1								
				Change rates of median home dwell time (O)	1								
				Maximum number of nearby contacts (via Bluetooth-enabled devices) (O)	1								
				Incidence of self-reported physical distancing (S)	1								
				Proportion of people violating physical distancing guidelines (O)	1								
				Frequency of avoiding social events (S)	1								
				Extent of physical distancing (S)	1								
				Distance travelled (S)	1								
				Number of physical activity outings (S)	1								

1. Summary of findings about interventions for promoting adherence to behaviours inherent to PHSMs

1.1 Summary: Interventions for promoting adherence to behaviours inherent to quarantine & isolation

One study (1) was identified that reported on increasing adherence to quarantine and isolation. The characteristics, findings, and risk of bias are presented in Table 2.

The study (1), which involved a quasi-experimental design nested within an observational study, had a moderate risk of bias. In this study, among people who used a contact tracing mobile application (app), users' adherence to uploading a code indicating a COVID positive test result (as confirmed by public health authorities) was very high (96%), thus providing other app users who had been in proximity with a notification of potential exposure. People who were notified by the app of exposure from someone outside their household were more likely to report entering self-quarantine and reported beginning self-quarantine on average 1 day earlier than those who were notified by manual contact tracing instead (comparator). For app users who were notified of exposure from someone inside their household, there was no difference in likelihood or time to self-quarantine. As app use was voluntary, effectiveness at the population scale is dependent on uptake and use of the app.

1.2 Summary: Interventions for promoting adherence to behaviours inherent to masking

Eleven studies (2-12) were included that report on increasing adherence to masking. The characteristics, findings, and risk of bias for each study are presented in Table 3. Three studies were judged as moderate risk of bias (5, 7, 9), five were judged as serious risk of bias (4, 6, 8, 10, 12), and three were judged as critical risk of bias (2, 3, 11).

Four studies (2, 3, 5, 9) evaluated the effect of mask recommendations or mask mandates on masking adherence at the population level. A non-randomized natural experiment (9) compared mask mandates to no mask mandates for selected streets of Amsterdam and Rotterdam. Observed face-mask wearing increased by 32% in areas with the mask mandate compared to no mandate (statistically significant difference). A study employing an interrupted time-series analysis (5) observed changes in mask-wearing and mask-buying before and after the announcement of a US CDC masking recommendation. After the announcement, there was an immediate increase in self-reported mask-wearing (21% increase in unadjusted analyses; 12% increase when adjusted for sociodemographic factors). There was also an immediate increase in self-reported mask-buying (16% increase in unadjusted analyses; 7% increase when adjusted for sociodemographic factors). These changes in masking behaviours were only measured in the days immediately before and following the recommendation (April 3-4 2020 vs April 5-7 2020). As such, the impact of the CDC recommendation on the maintenance of masking behaviours after this period is unclear.

A prospective, repeated cross-sectional study (2) observed that masking was more likely to occur during a state-wide mask mandate than after the removal of the mask mandate. Additionally, women were more likely to wear masks than men, Asian individuals were more likely to wear masks compared to White individuals. Compared to adults, masking was less likely in toddlers and children. However, young and middle-aged adults were more likely to wear masks than teenagers and seniors. An interrupted time-series (3) assessed changes in self-reported behaviour after "circuit breaker" measures that included all non-essential workplaces and organisations being mandated to close or implement work-from-home arrangements, requiring face mask-wearing in public areas, personal hygiene via handwashing or hand sanitizer use, avoiding crowded areas, and

financial penalties for non-adherence. Wearing a face mask significantly increased from 25% prior to the circuit breaker period, to 86% during circuit breaker measures.

One randomized controlled trial (4) evaluated an intervention at a population level, showing some evidence that sending SMS messages with persuasive messages (i.e. evoke a sense of civic duty, increase empathy through reciprocity, increase self-efficacy, increase risk perceptions, evoke social norms) to promote adherence to mask-wearing increased adherence to mask-wearing compared to not receiving any SMS messages. Particularly, respondents who received the 'civic duty' message framing, designed to prime a sense of duty to protect family and friends, had consistently better knowledge of appropriate behaviour and mask-wearing, although this difference is a small relative increase (2.3%).

Two cluster randomized trials and one single -arm pre- and post study evaluated interventions at the community level which aimed to enable adherence. One cluster randomized trial (7) evaluated an intervention at the community level that randomized the provision of masking-related education and a free mask, masking education only, or control (no education or free mask) to villages in Kenya. Additionally, half the villages were randomly assigned to have a trusted community role model advocating for mask use. Findings showed an increase in mask usage and knowledge about COVID-19 in villages receiving both education and free masks, compared to the control condition at 4-week follow-up. However, the increased levels of mask usage were not maintained at 5-8 week follow-up. Compared to the control condition, receiving education only or having a trusted community role model did not increase mask usage, knowledge, or positive attitudes to masking at either follow-up timepoint.

A cluster randomized controlled trial (8) also evaluated an intervention at the community level that randomized free mask provision to villages, though in Bangladesh. In addition to mask distribution to homes and other high traffic areas (e.g. markets, mosques), mask-use was also promoted in public spaces, and there was role modelling by community leaders in intervention villages, compared to no treatment in control villages. Within intervention villages, further supplemental interventions were randomized at the village level (i.e. receive reminder text message, certificate incentive, monetary incentive, public commitment) or household level (i.e. 100% or 50% of household receive reminder texts, altruistic or self-protective messaging, or verbal commitment). Across all intervention villages, mask-wearing significantly increased (28.8%, $p<.001$). The supplemental interventions did not further increase mask-wearing.

A single-arm pre- and post-intervention study (6). The study evaluated the effect on mask-wearing of installing signs to remind people entering a university building to engage in protective behaviours inside. Compared to the previous day when there was no sign (82%), observed adherence for adequate mask wearing when entering the building was significantly greater (99.7%).

Three studies (10, 11, 12) evaluated interventions at the individual level. A randomized controlled trial (10) evaluated an intervention at the individual level and focused on supporting adherence among equity-deserving groups including people from Black, Asian, and Minority ethnic communities. They evaluated whether engaging in visual imagery tasks improved self-reported adherence to mask-wearing. Imagining positive outcomes of mask wearing, imagining strategies to successfully wear a mask, or imagining a combination of both positive outcome and strategies did not increase self-reported adherence to mask-wearing compared to a control group. There was some evidence among the small subset of participants (n=81) that did not report always adhering, that greater mask-wearing 4 weeks later was related to greater intention to wear a mask and greater perception that consistent mask-wearing was a social norm. Women were more likely to report being fully adherent than sub-optimally adherent as compared to men.

Another randomized controlled trial (11) evaluated whether receiving information about protective behaviours and follow-up emails with persuasive messages affected self-report mask-wearing adherence in the ensuing 7 days. Compared to the comparator group (who were provided information irrelevant to COVID-19), adherence was no different when framing messages about either personal benefits of protective behaviours, public benefits of protective behaviours, or combined personal and public benefits of protective

behaviours conditions. The personal benefits intervention increased perceived likelihood of infection (b=.20, SE=.05, p<.01), concern for self (b=.13, SE=.07, p<.05), concern for friends (b=.17, SE=.07, p<.05), and concern for community (b=.17, SE=.07, p<.05), compared to the comparator group. Perceived likelihood of infection was also significantly greater in the public benefits condition (b=.17, SE=.05, p<.01) and combined benefits condition (b=.17, SE=.04, p<.01).

One randomized controlled trial (12) assessed the effect of providing COVID-19 antibody test results (i.e. an indicator of immunity) either immediately (intervention group) or 4 weeks after testing (comparator group) on self-reported mask-wearing in university students. At 2 weeks after testing, there was no difference in mask-wearing adherence between groups and no difference in adherence when participants were seronegative or seropositive.

Overall, it appears that interventions that provide strong recommendations or enforcement to engage in masking, applied to whole populations or specific areas, were effective at increasing adherence. Additionally, interventions that provided education and enablement within the community context (e.g. education and free masks provided in villages, clear signage at strategic locations to prompt performance of the behaviour) were effective at increasing adherence to masking. There was some evidence that persuasive messages sent by SMS increased adherence to masking. Conversely, interventions delivered at the individual level with persuasive messages by email, visual imagery exercises for positive outcomes and strategies for mask-wearing, and feedback on COVID antibody status, did not find evidence for support at promoting adherence to masking.

1.3 Summary: Interventions for promoting adherence to behaviours inherent to physical distancing & reducing contacts

There were 29 studies (3, 4, 6, 11-36) included that report on interventions aiming to increase adherence to physical distancing and reducing contacts. The characteristics, findings, and risk of bias for each study are presented in Table 4.

Fourteen studies (3, 4, 13-24) evaluated interventions at the population level (1 low risk of bias, 5 moderate risk of bias, 5 serious risk of bias, 3 critical risk of bias).

One study (4) reported an intervention implemented at the population level; a randomized controlled trial which delivered persuasive messages to encourage staying home and keeping appropriate distance from others. The messages were delivered through SMS messaging to people of Sao Paulo, framed in 5 different ways (i.e. evoke a sense of civic duty, increase empathy through reciprocity, increase self-efficacy, increase risk perceptions, evoke social norms). There were no differences in adherence to staying home or keeping distance between people who received the SMS persuasive messages (all treatment arms combined) compared to those who received no SMS message.

Thirteen studies (3, 13-24) implemented interrupted time-series or pre-/post designs to evaluate the association of adherence to physical distancing with reducing contacts and the introduction of measures to restrict population contacts (e.g. stay-at-home orders, lockdowns, physical distancing orders, closures of non-essential businesses, work from home policy, and school closures). Across all thirteen studies, spanning several jurisdictions (i.e. Ontario, Singapore, US wide, India, Brazil, UK, Spain, the Netherlands, Denmark, Italy, Germany) the introduction of measures to restrict contacts resulted in reduced mobility and greater physical distancing (measured by e.g. observed traffic congestion, proximity to Bluetooth devices, GPS location data, observed and self-report distances travelled, observed and self-report time spent outside and inside of the residence, observed and self-report physical distancing) compared to baseline periods. During the periods following the end of measures to restrict contacts or easing of measures, trends were observed of increased mobility and less physical distancing. In some studies (e.g. 14, 15), trends were identified indicating that the longer lockdown or stay-at-home orders continued, adherence to physical distancing and reduction of

contacts started to wane. However, it is important to note that all of these studies were observational and the concomitant effects of other factors (e.g., trend in cumulative or average daily COVID case rates, a variety of measures being introduced and de-implemented at different times, and vaccination rates) all may have contributed to adherence during the studied periods of time.

Six studies (6, 25-29) evaluated interventions at the community level (3 moderate risk of bias, 3 serious risk of bias).

One of these six studies was randomized controlled trial (27), reported an intervention which delivered persuasive messaging to households by SMS messages had no effect on adherence to self-reported physical distancing.

Of the remaining community-level studies, three (25, 28, 29) were natural experiments, one was a randomized cross-over design (26), and another was a sequential pre-/post design (6). These five studies all evaluated interventions involving prompting physical distancing behaviour by restructuring the physical environment within contexts that required physical distancing (e.g. floor markers to demonstrate appropriate distance, walking directions, buzzer that provided immediate feedback of violating distance rules, people who modelled precautionary behaviors and gave verbal advice to keep distant at escalators, robot that activates persuasive messages, clear signage at strategic areas). These five studies resulted in greater observed adherence to physical distancing.

Nine studies (11, 12, 30-36) evaluated interventions at the individual level (2 moderate risk of bias, 6 serious risk of bias, 1 critical risk of bias). One of these randomized controlled trials (30) delivered persuasive messages over 9 weeks (via Facebook posts) to mothers. While self-reported adherence to physical distancing decreased over the course of the study, messages from sources rated as credible by study participants (e.g. government officials) increased adherence to physical distancing for mothers and their daughters, while messages from sources rated as less credible by study participants (e.g. peers) increased non-adherence to physical distancing. In another randomized controlled trial (31) where participants in the intervention condition created implementation intentions with situational cues (i.e., If an aisle at the grocery store is crowded, then I will avoid that aisle), adherence to avoiding crowds was significantly greater than in the control condition (no intervention). The intervention had no effect on other physical distancing behaviors (e.g. keeping 1.5m distance from others, staying home, working from home), but did increase perceived vulnerability of others to become infected with COVID-19 and higher perceived severity of becoming infected with COVID-19.

On the other hand, six randomized trials (11, 32-36) which delivered persuasive messaging (e.g., aiming to increase positive attitudes towards PHSM behaviours, increase motivation to perform behaviours, inducing empathy for others, increase the salience of the negative consequences of not performing the behaviours, increase authority of messages) within short time frames (e.g. intervention delivered in 1 session, maximum of 1 week follow-up) and in a variety of formats (e.g. text, videos, activities, visual information) did not increase self-reported adherence to physical distancing behaviours. One of these studies (35), which provided persuasive reminders of appropriate behaviours, reported a 46% increase in intention to stay home when the message was framed to make the health consequences of non-adherence for the self or one's family salient. However, this did not translate into self-reported staying home.

Lastly, one randomized controlled trial (12) assessed the effect of providing COVID-19 antibody test results (i.e. an indicator of immunity) either immediately (treatment) or 4 weeks after testing (control) on self-reported mask-wearing in university students. At 2 weeks after testing, there was no difference between the treatment or control in adherence to staying home from work and school, avoiding social events, or ensuring physical distancing. There was also no difference in adherence when participants were seronegative or seropositive.

Men reported having more social contacts and contacts for a longer duration than women (14). Men also reported less physical distancing than women (4). Having higher educational attainment was associated with making fewer social contacts (14) and spending more time at home (24) than those with less educational attainment. Participants aged 18–30 years in the Puducherry region of India had a significantly higher duration of social contacts when compared to elderly participants (14). In contrast (24), a different study observed that compared to older people, younger people spent more time at home in Italy, Spain, and the UK. On average, Black individuals in the US physically distanced significantly more than White individuals on average (21). Having more liberal political views meant greater physical distancing (21, 30), except when there had been exposure to information from government health agency sources (as opposed to information from near-peer parents or the news media), where there was then less self-reported physical distancing in those with more liberal views (30). Finally, participants who self-reported they were in bad health were more than twice as likely to report they would stay home more after receiving a reminder that emphasises risks for family, and the share of those who actually stay home increased by 80%.

Overall, measures to restrict contacts were associated with decreased mobility, reduction in contacts, and increased physical distancing. The easing of these restrictions was also associated with increased mobility, increasing contacts, and less physical distancing. Furthermore, across trials at the community level, interventions which involved providing situational prompts and adding the means to perform the behaviour to the environment, particularly those delivered within the context, were effective in increasing adherence to physical distancing. There was some evidence that creating implementation intentions with situational cues promoted adherence to physical distancing and reducing contacts, but not across all behaviors measured. Persuasive messaging from credible sources delivered frequently over a longer time frame promoted adherence to physical distancing. However, trials of interventions of persuasive messages alone, with short time frames, were not effective at promoting adherence to physical distancing. Finally, receiving feedback of COVID-19 antibody status (and whether that statis was seropositive or seronegative) had no effect on adherence to physical distancing and reducing contacts.

1.4 Summary: Interventions for promoting adherence to behaviours inherent to hand hygiene and respiratory etiquette

Twenty studies (3, 6, 11, 27, 31-33, 36-48) were included that report on interventions aiming to increase adherence to hand hygiene and respiratory etiquette, eighteen of which were related to COVID-19 and two studies (47, 48) were related to H1N1. The characteristics, findings, and risk of bias for each study are presented in Table 5a and 5b.

There were nine studies that evaluated interventions at the community level (6, 27, 37-42, 48), one of which was rated as low risk for bias (37), seven of which were rated as having moderate risk of bias (27, 38-42, 48), and one was rated at serious risk for bias (6).

Six studies (two cluster randomized trials (38, 48), one field experiment (40), one randomized cross-over trial (39), and two single-arm pre- and post-intervention (6, 37)) reported interventions delivered at the community level that involved restructuring the physical environment at strategic places to prompt and motivate handwashing or hand sanitizer use (e.g., adding lighting and other design elements to handwashing stations, adding hand sanitizer dispensers, adding signage beside hand sanitizer dispensers to prompt the behaviour and increase motivation through persuasive messaging, adding signage at building entrances). Four of these (6, 38, 40, 48) of these resulted in greater observed adherence to hand hygiene. One study (37) where signage with persuasive messages were placed next to hand sanitizer dispensers within university dormitories, observed increased hand sanitizer dispenser use compared to no sign, but this was not a statistically significant difference. A randomized cross-over trial (39) evaluated the efficacy of 14 different persuasive messages displayed on a digital screen above hand sanitizer dispensers within a hardware store. There was no

significant difference in hand sanitizer usage between baseline neutral message weeks and persuasive message weeks.

Conversely, a randomized trial (27) reported that an intervention which delivered persuasive messaging to households by SMS messages had no effect on self-reported uptake of handwashing.

Two cluster randomized trials (41, 42) evaluated an intervention delivered to children (4-8 years old) which involved education about the importance of handwashing to reduce germs using a book, a song, web-based games, and a fun interactive activity to demonstrate good handwashing. One of these studies delivered all components of the intervention (i.e., book, song, web-based games, fun handwashing demonstration) in an interactive workshop within schools, while the second of these studies delivered the song only to children at handwashing stations at a museum. The interventions in both studies were shown to increase the number of observed handwashing behaviours that indicate quality of handwashing technique (e.g., use of soap, rubbing with soap, cleaning wrists) performed immediately after the intervention, and at follow-up one week later. For both studies (41, 42), increased number of handwashing behaviours was explained by a greater number of children correctly identifying why we wash our hands (i.e., "germs") in the intervention group compared to the control group. The effect of increased knowledge in the intervention group compared to control additionally explained greater number of handwashing behaviours at 4-week follow-up (41). The study conducted at the museum demonstrated that the relationship between number of handwashing behaviours performed and correctly identifying why we wash our hands was more pronounced in older children.

Ten studies evaluated interventions that were delivered at the individual level (11, 31-33, 36, 43-47), one of which had moderate risk of bias (36), while the remaining studies were rated at serious (31-33, 41-47) or critical risk of bias (11).

Two randomized controlled trials and one sequential pre- and post-intervention study (31, 46, 47) evaluated interventions asking participants to form implementation intentions to engage in hand hygiene behaviours that included situational cues (i.e., If I go to the grocery store, then I will wash my hands as soon as I return home). In one of these studies (31) where participants were only asked to make implementation intentions, there was no evidence for higher self-reported sneezing/coughing into elbow, handwashing, or tissue use. While behaviour did not change, increased perceived vulnerability and perceived severity to COVID-19 infection were reported in the intervention group (31). In the second of these studies (47), participants were asked to form implementation intentions, for which tailored feedback was provided, as well as being provided with educational materials and advice by medical professionals, instructions for handwashing technique, and offer to pick up free hand sanitizer. Self-reported rates of handwashing were higher amongst the intervention group than the control group at 4-week and 12-week follow-ups. Women had greater handwashing intentions and behaviour throughout the study, but the frequency of handwashing for women did not change depending on the intervention or control. There was no effect of age or socioeconomic status on hand-washing frequency or intentions.

In the pre-/post study (46), forming implementation intentions was preceded by education, modelling of the correct way to perform the behaviour, pros and cons of performing the behaviour, information about health consequences of not performing the behaviour, and self-incentives. Handwashing increased from baseline (5.0 times) to 6.9 times per day at day 86 of the study, suggesting handwashing increases were maintained. Increased adherence to handwashing in these studies (31, 46, 47) was associated with greater perceived risk (31), greater intentions to wash hands and greater self-monitoring (46), and greater positive attitudes and intentions towards the behaviour (47).

A randomized trial (43) which compared the efficacy of three theory-informed interventions designed to increase adherence via either motivation, habit formation, or social norms, found that self-reported hand hygiene increased over the 34 days of the study period, but that there were no differences between the three

interventions. The lack of pure control group in this study makes it difficult to ascertain whether trends in hand hygiene were increasing even without receiving an intervention.

Five randomized controlled trials (11, 32, 33, 44, 45) reported interventions that involved delivering information about guideline recommendations for PHSMs as well as persuasive messaging (e.g., aiming to increase positive attitudes towards PHSM behaviours, increase intentions to perform behaviours, inducing empathy for others, make salient the benefits of the behaviours for the self and the public) in either text or video formats. These interventions generally were not effective in promoting adherence to handwashing or respiratory etiquette (e.g., avoiding touching face, coughing or sneezing into elbow, use of tissue) compared to control conditions. An additional randomized controlled trial (36) that evaluated an intervention involving participants assigned to activities to persuade adherence (e.g., write a letter to a vulnerable person about adhering to PHSMs to protect them; read text about economic argument for physical distancing) had no effect on handwashing. One exception (45) was found where for participants who had low perceived risk at Time 1, being assigned to the theory-based intervention group significantly increased behaviour from Time 1 to Time 2. Education-only and control conditions did not increase behaviour in those with low perceived risk. For participants who had high perceived risk, there were increases in behaviour from T1 to T2 across both intervention and control conditions.

Despite the lack of effect on adherence, changes were observed in theory-informed antecedents to behaviour for three studies (11, 44, 45). Receiving a message framed as personal benefits of protective behaviours, public benefits of protective behaviours, or combined public and personal benefits increased perceived likelihood of infection. Compared to control, only receiving messages framed as personal benefits of protective behaviours increased concern for self, concern for friends, and concern for community. Two studies (44, 45) observed increased action planning from T1 to T2 in the theory-based intervention group, but not control groups. Also reported was increased habit from T1 to T2 for the theory-based intervention group compared to control (45) and, conversely, decreased perceived behavioural control in the control group compared to the intervention group (44).

One interrupted time-series that evaluated a population-level intervention was rated at critical risk of bias (3). The study assessed changes in self-reported behaviour after "circuit breaker" measures, including all non-essential workplaces and organisations were mandated to close or implement work-from-home arrangements, required behaviour modifications such as face mask-wearing in public areas, personal hygiene via handwashing or hand sanitizer use, and avoidance of crowded areas, and financial penalties for non-compliance. Circuit breaker measures had no effect on the proportion of individuals washing hands and using hand sanitizer (84%) compared to before the circuit breaker measures (83%), likely due to the already relatively high adherence.

Overall, across trials at the community and individual levels, interventions of persuasive messages alone were generally not effective at promoting adherence to hand hygiene and respiratory etiquette. Trials of interventions which involved providing situational prompts, implementing interactive education or persuasive messages within the behaviour context, and adding the means to perform the behaviour to the environment, were effective in increasing adherence to hand hygiene and respiratory etiquette. Interventions with theory-based components (e.g., implementation intentions, model behaviour, information about health consequences, evoking social norms, form a habit) delivered over a long period (between 1-3 months) demonstrated that increases in hand hygiene could be maintained.

1.5 Summary: Interventions for promoting adherence to behaviours inherent to cleaning and disinfecting

Two studies (11, 36) were included that reported on interventions to promote adherence to cleaning and disinfecting. The characteristics, findings, and risk of bias for the studies are presented in Table 6. One

randomized controlled trial (36) had moderate risk of bias while the other randomized controlled trial (11) was judged at critical risk of bias.

Both studies evaluated interventions which aimed to persuade adherence. One study (36) assigned participants to one of four interventions or a control condition. Each intervention involved participants being assigned to activities to persuade adherence (either write letter to vulnerable person about complying with PHSMs to protect them; read text about economic argument for physical distancing; write a plan to start engaging in a meaningful activity; or reads multiple hypothetical scenarios of people violating behavioural guidelines and rate agreement with their actions). None increased self-reported disinfecting behaviours compared to the control condition.

The second study (11) evaluated whether receiving information about protective behaviours and follow-up emails with persuasive messages affected self-reported cleaning adherence in the past 7 days. Compared to the control (which provided information irrelevant to COVID-19), adherence was significantly lower (7% decrease) when messages were framed about personal benefits of protective behaviours. There was no difference when messages were framed as either public benefits of protective behaviours or combined personal and public benefits of protective behaviours conditions when compared to control. As reported above in section 1.2, perceived likelihood of infection, concern for self, concern for friends, and concern for community, increased in the personal benefits to control. Perceived likelihood of infection was also significantly greater in the public benefits condition and combined personal and public benefits condition.

1.6 Summary: Interventions for promoting adherence to behaviours inherent to multiple PHSMs

Two studies (49, 50) were included that reported on increasing adherence to behaviours across multiple PHSMs. The characteristics, findings, and risk of bias for each study are presented in Table 7.

One study was rated as being at serious risk of bias (49), while the second study was rated as being at moderate risk of bias (50).

One randomized controlled trial (49) assigned participants to one of three intervention conditions or a control condition. All conditions asked participants to watch a video about WHO recommendations for precautionary behaviors. Compared to the WHO video alone (control condition), engaging in an additional task to evoke positive attitudes toward precautionary behaviours, or an additional task to evoke memories of times when precautionary measures had been violated did not result in higher self-reported frequency of performing several COVID precautionary behaviours (i.e., mask-wearing, use of hand sanitizer, physical distancing) in the past 7 days. Engaging in an additional task to evoke cognitive dissonance (discomfort caused by increasing the salience of attitudes toward behaviors that are inconsistent with actions) resulted in the highest self-reported mean of frequency of performing COVID precautionary behaviours in the past 7 days compared to all other conditions. However, no inferential statistics were conducted.

One randomized controlled trial (50) aimed to identify the effectiveness of tailoring an intervention to increase adherence to COVID precautionary measures for people from Black communities. All participants were asked to watch three videos. The study randomly assigned participants to one of eight conditions in a 2 (tailored statement about systemic racism vs placebo statement) x 2 (videos tailored to risk for Black community vs placebo video about health behaviours generally) x 2 (Black physicians in videos vs White physicians in videos) design. In the tailored intervention conditions, the videos explained COVID-19, common symptoms, as well as asymptomatic transmission, reminded viewers of the high case rates, and described physical distancing guidelines, and physicians additionally explained the increased risk of transmission and mortality in the Black community. When comparing placebo conditions to any intervention (tailored messages or videos), the intervention conditions did not increase incidence of performing COVID

precautionary behaviours. The effect of intervention relative to control on knowledge gaps was stronger for participants with at least a high school education.

1.7 Summary: Interventions for promoting adherence to behaviours inherent to ventilation

No studies were identified to date reporting interventions to promote adherence to ventilation-supportive practices.

2.0 Summary: Behaviour change interventions to promote adherence, by intervention type

All included studies, organised by intervention type, are presented in Table 8. We used the typology of intervention types described in the Behaviour Change Wheel as a means to categorise intervention strategies (i.e., Education, Restrictions, Environmental Restructuring, Modelling, Enablement, Training, Coercion, Incentivization, and Persuasion).

The *restriction* intervention type was most commonly evaluated to promote adherence to physical distancing and reducing contacts. Across 13 studies, restriction interventions (i.e., lockdowns, mandatory business closures) promoted greater adherence to physical distancing and reducing contacts. There was one restriction intervention implemented for the masking PSHM (i.e., mask mandate). There was greater adherence to masking where it was mandated compared to no mandate. One study observed the implementation of a series of restrictions including mandatory adoption of behaviours inherent to PHSMs (e.g., handwashing, masking). The study demonstrated that physical distancing and reducing contacts and masking were greater during restrictions, but that handwashing was no different before and during restriction interventions. This was likely because of high self-reported adherence prior to the restrictions.

There were six studies that recorded *environmental restructuring* intervention types. The addition of walking directions, standing point stickers marking appropriate distance, and buzzers that indicated physical distancing violations, promoted adherence to physical distancing. Redesigning handwashing stations to increase motivation for handwashing promoted greater adherence to handwashing. Adding objects to the environment that facilitate the behaviour (e.g. free masks, mobile application that prompts self-quarantine) promoted greater adherence to masking and quarantining.

The *enablement* intervention type was most commonly implemented for interventions to promote hand hygiene. Five studies demonstrated greater adherence to hand hygiene for enablement interventions (i.e., mobile apps activities, web sessions with activities, educational workshop with song, behavioural commitment). One study evaluated the effect of action planning on three hand hygiene and respiratory etiquette behaviours and six physical distancing and reducing contacts behaviours. Action planning significantly promoted greater avoidance of crowds, but did not promote adherence for any other hand hygiene and respiratory etiquette or physical distancing and reducing contacts behaviours.

The *persuasion* intervention type was the mostly frequently implemented intervention type across PHSMs (Cleaning and disinfecting N=2; Hand hygiene and respiratory etiquette N= 12; Masking N=4; Physical distancing and reducing contacts N=13; Multiple behaviours N=1). Across PHSMs, persuasion interventions consistently tended not promote adherence when they occurred outside the context of behaviour performance, and when the intervention durations were brief (e.g., 1 session with 7-day follow-up). That said, persuasion interventions that employed persuasive messages at point-of-use (i.e., signage beside hand sanitizer, signage in front of building entrance, robot with persuasive message display at lecture hall entrance) tended to promote adherence. Additionally, there was some evidence that persuasion interventions that reinforced persuasive messaging with credible/authority sources, or that provided continuous reinforcement of the persuasive message over a longer period (e.g., 9 weeks), also promoted greater adherence.

There were three interventions that used *education* as an intervention type. Two studies demonstrated that for masking and physical distancing and reducing contacts, adherence was greater after the release guidelines from the government and the Center for Disease Control on recommended behaviours to adopt.
A third intervention provided tailored education messages about the greater risks of COVID-19 for Black communities than White communities. The tailored educational message did not promote greater adherence to multiple PHSM behaviours compared to a generic educational message.

3.0 Summary: Spillover effects of interventions in promoting adherence to PHSMs

Six studies (2, 5, 8, 9, 24, 27) were included that reported on spillover effects to a behaviour that is different from the adherence behaviour targeted by the intervention. The characteristics, findings, and risk of bias for the studies are presented in Table 9.

There was one randomized controlled trial (27) with moderate risk of bias that reported an intervention at the population level. SMS messages were delivered to households aiming to promote physical distancing. There was a small, but significant, effect of a neutrally-framed message about physical distancing on handwashing where participants who received a neutrally framed message about physical distancing (i.e. stating recommendations for physical distancing and encouraging uptake) were less likely to self-report handwashing uptake (34.2%) compared to the control group (35%; $p<.05$).

One non-randomized natural experiment (9), with a moderate risk of bias, reported a community-level intervention. A masking mandate enforced in certain streets of Amsterdam and Rotterdam had no effect on observed physical distancing, even when accounting for crowding.

One interrupted time-series (5), with moderate risk of bias, observed a population-level intervention. The study observed changes in additional protective behaviours from prior to a CDC masking recommendation being announced, to after the announcement. After the CDC masking recommendation, there was also an immediate increase in self-reported handwashing, tissue use for coughing and sneezing, disinfecting home or workspaces, stopping hugging and kissing, limiting public transport use, reducing visiting places of worship, preparing to stay home, and keeping children home. These changes in protective behaviours were only measured in the days immediately before and following the recommendation (April 3-4 2020 vs April 5-7 2020). As such, the impact of the CDC recommendation on the maintenance of protective behaviours after this period is unclear.

A cluster randomized controlled trial (8) evaluated an intervention at the community level that randomized free mask provision to villages in Bangladesh. Intervention villages received mask distribution to homes and other high traffic areas (e.g., markets, mosques), mask-use was also promoted in public spaces, and there was role modelling by community leaders in intervention villages. Within intervention villages, further supplemental interventions were randomized at the village level (i.e., receive reminder text message, certificate incentive, monetary incentive, public commitment) or household level (i.e. 100% or 50% of household receive reminder texts, altruistic or self-protective messaging, or verbal commitment). Across all intervention villages, physical distancing significantly increased (5.1%, $p<.001$). There was heterogeneity in change to physical distancing at different locations, where the largest increase was observed in markets (7.4%, $p<.001$), while there was no change to physical distancing inside mosques (0%, $p>.05$). Provision of surgical masks led to an increase of 5.4% in physical distancing ($p<.001$) compared to control villages. While cloth masks increased physical distancing by 4.4% ($p<.001$) compared to control villages.

Another interrupted time-series (24), with serious risk of bias, observed behaviour changes in sleep and physical activity prior to national lockdowns compared to during lockdown in 2020. Compared with pre-lockdown, participants in Italy, Spain, Denmark, the UK, and the Netherlands walked less steps per day (gathered with Fitbit data) than during lockdown. Later bedtimes and longer sleep durations (also gathered from Fitbit data) were also observed during lockdown compared with pre-lockdown for participants from Italy, Spain and the UK (sleep variables were not measured for Denmark or the Netherlands).

A prospective, repeated cross-sectional study (2), observed that physical distancing was more likely to occur during a state-wide mask mandate than after the removal of the mask mandate. That said, there is a lack of confidence in these findings due to the study design and judgment of the study being at critical risk of bias.

Table 2. Summary of studies reporting on effectiveness of interventions in promoting adherence to quarantine and isolation

Reference	Date released	Setting and time covered	Study characteristics	Intervention mode of delivery	Behaviour change strategy	Summary of key findings in relation to the outcome	Risk of bias
Community level interventions							
(1) Ballouz, T., Menges, D., Aschmann, H. E., Domenghino, A., Fehr, J. S., Puhan, M. A., & Von Wyl, V. (2021). Adherence and association of digital proximity tracing app notifications with earlier time to quarantine: results from the Zurich SARS-CoV-2 cohort study. *International journal of public health*, 62. https://doi.org/10.3389	16th August 2021	Zurich, Switzerland, between August 07, 2020 and September 30, 2020	**Design**: Prospective longitudinal design with nested quasi-experimental element (app notified vs non-app notified). **Sample**: Individuals diagnosed with SARS-CoV-2 infection and their close contacts were identified through mandatory laboratory reporting of positive cases to and routine contact tracing by the Cantonal Health Directorate. 328 cases (65 cases that converted from originally being traced as a close contact and 261 close contacts) were included. Median age of cases and close contacts at time of identification was 38 and 35 years, respectively. Approximately 50% of the participants in both groups were female.	***Exposure*** **Source:** Cantonal Health Directorate **Method of dissemination:** Mobile digital device mode of delivery ***Comparator*** **Source:** Cantonal Health Directorate **Method of dissemination:** Call mode of delivery	***Exposure*** Prompt protective action by providing knowledge of exposure to COVID. **Behaviour change wheel intervention type**: Environmental restructuring ***Comparator*** Prompt protective action by providing knowledge of exposure to COVID. **Behaviour change wheel intervention type**: Environmental restructuring	**Primary outcome results summary:** Among 243 cases using SwissCovid, 92% (n = 224) reported to have received a CovidCode from public health authorities. Of those, 96% (n = 215) uploaded the code in the app, thus triggering a notification to potentially exposed contacts. A higher percentage of app notified non-household contacts reported entering self-quarantine compared to those not notified by the app (47% vs. 31%). Non-household contacts who were app-notified entered quarantine on average 1 day earlier than those not notified by the app (HR 1.53, 95% CI 1.15–2.03; p = 0.004). Household contacts (people exposed to COVID by someone within their own household) entered quarantine the same or the following day after exposure. There was no evidence for a difference in the time from exposure to quarantine between app notified (median 0.5 days, IQR0.5–2.0) and non-app notified household contacts (median 1 day, IQR 0.5–2.0;	Moderate

/ijph.2021.1603992			**Intervention**: Notification of exposure to a COVID positive case through the SwissCovid mobile application. SwissCovid is a COVID-19 contact tracing app used for digital contact tracing. Whenever an app user tests positive for SARS-CoV-2 (case), this person receives an activation code (CovidCode) from the public health authorities, which has to be uploaded in the app to trigger notifications to other app users. **Comparator:** Notification of exposure to COVID positive case by manual contact tracing. **Target Behaviour:** Uploaded the CovidCode (thereby triggering a warning of contacts) and quarantine upon notification of being in proximity to a COVID positive case. **Key outcome**: Subjective outcomes: Self-reported incidence of entering self-quarantine. Self-reported time interval (in days) between exposure date and the			p=0.11). ***COM-B outcomes results summary:*** None ***Differences by demographics:*** Age, education level, and employment status were not associated with a shorter time to quarantine.	

			beginning of quarantine among close contacts. Objective outcome: incidence of app users who uploaded CovidCode from public health authority. **COM-B outcomes measured:** None				

Table 3. Summary of studies reporting on effectiveness of interventions in promoting adherence to masking

Reference	Date released	Setting and time covered	Study characteristics	*Intervention mode of delivery*	*Behaviour change strategy*	Summary of key findings in relation to the outcome	Risk of bias
Population level interventions							
(2) Trevas, S., Manuel, K., Malkani, R., & Hoelscher, D. (2023). Mask Adherence and Social Distancing in Houston, TX from January to April 2021. International Journal of Environmental Research and Public Health, 20(3), 2723. https://doi.org/10.3390/ijerph20032723	03 February 2023	Texas, US, From 20 January to 30 April 2021.	**Design**: Prospective, serial, cross-sectional observational study **Sample**: People in public spaces that were observed for the study: (1) an urban park; (2) an urban park with a trail; and (3) a farmer's market. Sociodemographic information based on observations: Out of the 7778 observations, 62.7% of individuals were White, 11.2% were Black, 16.4% were Latino, and 9.7% were Asian. Most (53.4%) of the individuals observed were female, and the age distribution was as follows: 0.50% of individuals were toddlers (0–2 years old), 6.2% were children (3–12 years old), 1.2% were teens	***Exposure*** **Source:** Texas Governor Greg Abbott **Method of dissemination:** Informational mode of delivery ***Comparator*** N/A	***Exposure*** Enforcing required behaviour with changes to law; coerce compliance with behaviour with financial penalty for non-compliance. **Behaviour change wheel intervention type:** Restriction; coercion ***Comparator*** N/A	**Primary outcome results summary:** People were more likely to wear a mask while the mask mandate was in effect compared to after the mask mandate ended (OR = 1.60, 95% CI 1.40–1.84). The likelihood of mask use was greater in the urban park than in the urban park with a trail (OR = 13.33). ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** Women were more likely to wear masks than men (OR = 1.35, 95% CI 1.18–1.54). Asian individuals were more likely to wear masks compared to White individuals (OR = 1.84, 95% CI 1.48–2.30). There was no difference in mask use in either Black and Latino individuals compared to	Critical

			(13–19 years old), 80.3% were adults (20–59 years old), and 11.9% were seniors (60+ years old). **Intervention**: Mask mandate (in place since July 2020) and issuance of $250USD fines to anyone not wearing a mask or face covering (in place since August 2020). Intervention period was 20th February to March 9th. **Comparator:** Removal of mask mandate. Comparator period was March 10th to April 30th. **Target Behaviour:** Masking **Key outcome**s: Incidence of observed mask wearing (defined as an individual wearing a mask that completely covered both their mouth and nose). Objective outcome. **COM-B outcomes measured:** None.			White individuals. Compared to adults, the likelihood of mask wearing was lower among toddlers (OR = 0.01, 95% CI 0.00–0.10) and children (OR = 0.24, 95% CI 0.19–0.31). However, adults were more likely to wear masks than teenagers (OR = 1.54, 95% CI 0.91–2.61) and seniors (OR = 1.54, 95% CI 1.24–1.91).	
	8		**Design**:	***Exposure***	***Exposure***		Critical

(3) Tan, A. L., Ng, S. H. X., & Pereira, M. J. (2021). Singapore's COVID-19 "circuit breaker" interventions: A description of individual-level adoptions of precautionary behaviours. *Annals of the Academy of Medicine, Singapore*, *50*(8), 613–618. https://doi.org/10.47102/annals-acadmedsg.2020597	August 2021	Singapore February 21, 2020 to May 1, 2020	Interrupted time-series **Sample**: General population in Singapore residing in the community, not including foreign workers or imported cases. **Intervention**: Circuit breaker (CB) measures in Singapore that included various forms of mandatory behavioural modifications (e.g. all non-essential workplaces and organisations were mandated to close or implement work-from-home arrangements, required behaviour modifications such as face mask-wearing in public areas, personal hygiene via handwashing or hand sanitizer use, and avoidance of crowded areas) with legal penalties such as fines. **Comparator:** Outcomes were compared between the periods before, during	**Source:** Singapore government **Method of dissemination:** Informational mode of delivery ***Comparator*** N/A	Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Behaviour change wheel intervention type:** Coercion; Restriction ***Comparator*** N/A	**Primary outcome results summary:** Before CB, the proportion of individuals wearing face masks in public was on average 25% (standard deviation [SD] 5.4%). During the CB, it increased to 86% (SD 7.7%). The difference in average proportion before and during CB was statistically significant (46.9%, 95% CI 34.9–58.8, P<0.01). ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	

			and after CB. **Target Behaviour:** Face mask usage **Key outcome**: Proportion of participants wearing face-mask in public. Subjective outcome. **COM-B outcomes measured:** None.				
(4) Boruchowicz, C., Lopez Boo, F., Finamor Pfeifer, F., Russo, G.A., Souza Pacheco, T. (2020) Are Behaviorally Informed Text Messages Effective in Promoting Compliance with COVID-19 Preventive Measures?: Evidence from an RCT in the	Oct 2020	São Paulo, Brazil	**Design**: Randomized controlled trial **Sample**: N = 75,351 enrolled from the general adult population of Sao Paulo **Intervention**: Receive a series of four text messages (SMS) that informed, instructed and motivated to stay at home, to properly wear a mask, and to maintain distance from others (the first SMS contained information and call for action, the second one was a motivational message, the third contained specific	***Exposure*** **Source:** Researchers **Method of dissemination:** Mobile digital device mode of delivery ***Comparator[a]*** Not applicable	***Exposure*** Increase empathy and reciprocity towards health workers, provide social norms, evoke a sense of civic duty, increase salience to risk perception, increase self-efficacy, prompt behavior, increase motivation. **Intervention Type:** Persuasion ***Comparator*** Not applicable	**Primary outcome results summary:** Receiving a text message significantly increases the probability of having reported using a mask when leaving their home in the last seven days compared to control. Yet, when the five different treatment groups are compared with the control, respondents who received the 'civic duty' frame, designed to prime a sense of duty to protect family and friends, were consistently more likely to always wear a mask, although this difference is small. Also, on average, 77% of people report that they always wore a mask in public during the previous seven days. However, respondents	Serious

City of São Paulo. *Inter-American Development Bank*. http://dx.doi.org/10.18235/0002722			instructions for one particular action (for example, how to properly wear face masks), and the fourth was also a motivational message but with a different call for action) Five different intervention groups with motivational messages modified to reflect: civic duty, self-efficacy, social norms, reciprocity, risk perceptions **Comparator:** Did not receive any messages **Target Behaviour:** Mask wearing **Key outcome**: Subjective outcome. Self-reported frequency of mask wearing on a 4-point scale from (1=Never to 4=Always). **COM-B outcomes measured:** Beliefs about the social distancing policies (specific item not given). Awareness about appropriate behavior measured by			who received the 'civic duty' frame were 3% more likely to report always wearing a mask (an increase of 2.3 percentage points). ***COM-B outcomes results summary:*** When the five different treatment groups are compared with the control, respondents who received the 'civic duty' frame, designed to prime a sense of duty to protect family and friends, were consistently better informed, although this difference is small. ***Differences by demographics:*** None reported	

			Awareness index (i.e. additive index that ranges from 0 to 3 and combines whether the respondent provided the right answer to the questions "What distance must you keep from others in public?", "If I am wearing a mask and the other person too, do we need to keep distance?", and "If I am wearing a mask for 1 hour and it gets humid do I need to change it?").				
(5) Goldberg MH, Gustafson A, Maibach EW, Ballew MT, Bergquist P, Kotcher JE, Marlon JR, Rosenthal SA and Leiserowitz A (2020) Mask-Wearing Increased After a Government Recommendation: A Natural Experiment in the U.S.	June 17th 2020	United States, April 3rd - 7th 2020	**Design**: Interrupted time-series. Comparison of before and after a CDC recommendation was announced. **Sample**: 4493 US respondents recruited by Climate Nexus Polling from April 3 to 7, 2020 → final sample of 3933 after excluding incomplete surveys/dropouts **Intervention:** CDC recommendation (classified as days after	***Exposure*** **Source:** Centers for Disease Control and Prevention (CDC) **Method of dissemination:** Informational mode of delivery ***Comparator[a]*** N/A	***Exposure*** Increase knowledge of required behaviours **Behaviour change wheel intervention type**: Education ***Comparator*** N/A	**Primary outcome results summary:** There was no difference in mask-wearing (+2 pts, 95% CI[−2, 5]) or mask-buying (+2 percentage points, 95% CI[−2, 5]) from April 3 to April 4 (days before CDC guidelines announcement). Once the CDC recommendation had been in place for at least one full day (i.e., comparing the April 3-4 period to the April 5-7 period), there were large increases in reported mask wearing (+21pts, 95% CI[16, 27]; 48 to 69%) and mask buying (+16 pts, 95% CI[11, 21]; 43 to 59%).	Moderate

During the COVID-19 Pandemic. Front. Commun. 5:44. https://doi.org/10.3389/fcomm.2020.00044			announcement from April 5-7) **Comparator:** Time period preceding CDC recommendation (3-4 April) **Target Behaviour:** Masking wearing, mask buying **Key outcome**: Participants' responses to the question, "Which, if any, of the following actions have you taken because of the spread of the coronavirus?" (Yes = 1; No, I prefer not to = 0; No, I'm not able to = 0; Don't know = missing; Does not apply to me = missing)" in reference to buying protective masks, and wearing a mask in public to protect oneself or others from getting sick. **COM-B outcome measures**: Trust in various sources for			The significant increase in mask-wearing (+12 pts, 95% CI[7, 18]; 49 to 61%) and mask buying (+7 pts, 95% CI[2, 13]; 44 to 51%) between April 3-4 period to the April 5-7 period remained after controlling for income, race/ethnicity, political party, and geographic region, albeit of a smaller magnitude. **COM-B secondary outcome results**: Significantly greater increases in mask-wearing between April 3-4 and April 5-7 were associated with more trust in infectious disease experts (b = 0.07, SE = 0.03), p = 0.023, 95% CI[0.01, 0.14]. Greater increases in mask-wearing were not associated with more trust in the CDC (b = 0.06, SE = 0.03), p = 0.068, 95% CI[−0.00, 0.12], trust in President Trump (b = 0.00, SE = 0.02), p = 0.946, 95% CI[−0.04, 0.05], Levels of mask-buying was unrelated to people's trust in infectious disease experts (b = 0.04, SE = 0.03), p = 0.248, 95% CI[−0.03, 0.10], trust in the CDC (b = 0.04, SE = 0.03), p = 0.166, 95% CI[−0.02, 0.10], or trust in President Trump (b = −0.02,	

			information about COVID-19 as measured by How much do you trust or distrust the following organizations or people as a source of accurate information about the coronavirus? From 1=Strongly distrust to 4=Strongly trust. In reference to Infectious disease experts; The U.S. Centers for Disease Control (CDC); President Trump.			SE = 0.02), p = 0.499, 95% CI[−0.06, 0.03]. ***Differences by demographics:*** None reported	
Community level interventions							
(6) Davies R, Weinman J, Rubin GJ. (2023) Observed and self-reported COVID-19 health protection behaviours on a university campus and the impact of a single simple intervention. J Public Health. doi: 10.1093/pubmed/fdac1	January 23 2023	London /England 1 December 2020 and 22 March 2021.	**Design**: Single-arm pre- and post-intervention **Sample**: 311 people were observed on day one and 375 people were observed on day two.; All students and staff of the University. **Intervention**: Installation of clear signage to university building entrance stating the mandatory policy for mask wearing, hand-hygiene	***Exposure*** **Source:** Researchers; university **Method of dissemination:** 1) Informational mode of delivery 2) Visual information mode of delivery 2)Public notice mode of delivery ***Comparator*** N/A	***Exposure*** Increase knowledge and salience of appropriate behaviours **Behaviour change wheel intervention type:** Persuasion; environmental restructuring ***Comparator*** N/A	**Primary outcome results summary:** Observed adherence for adequate mask wearing when entering the building was significantly greater on day two of the experiment, after the signage was in place (99.7% vs. 82%; $\chi 2=68.8$, p=0.00001). ***COM-B outcomes results summary:*** None ***Differences by demographics:*** Not reported	Serious

47. Epub ahead of print. PMID: 36694345.			and social distancing within the building. **Comparator:** No signage was erected at the entrance. **Target Behaviour:** Mask-wearing **Key outcome**: Objective outcome Mask-wearing directly observation by the researchers. **COM-B outcomes measured:** None				
(7) Egger, D., Jakubowski, A., Nekesa, C., & Walker, M. (2022). Mask up! Testing strategies to increase mask usage in Kenya*. *MedRxiv*, 2022.02.16.22270815. https://doi.org/10.1101/2022.02.16.22270815	17 February 2022	72 villages in Ugunja subcounty, Kenya January 2021 – April 2021	**Design**: Cluster randomized trial **Sample**: 72 villages in Ugunja subcounty, Kenya **Intervention**: 72 villages randomized equally to (i) free mask and education on mask usage (24 villages); (ii) only education on mask usage (24 villages) In addition, half of the villages were assigned to a "role model" treatment, in which trusted community	***Exposure*** **Source:** Researchers, SafeHands Kenya **Method of dissemination:** Human interactional mode of delivery; Environmental change mode of delivery ***Comparator*** Not applicable	***Exposure*** Masks were distributed to educate villagers on both the proper use of the mask to prevent COVID-19 transmission, as well as enable role modelling by trusted community members. **Behaviour change wheel intervention type:** Education, Environmental restructuring, Modelling ***Comparator*** Not applicable	**Primary outcome results summary:** The free mask and education arm increased mask usage by 3.1 percentage points (p = 0.037; 95% CIs [1.9, 6.0]) from a mean correct mask usage rate in control villages of 6.8%. Mask usage in the education only (M=1.5% increase; 95% CIs [1.2, 4.4]) and role model (2.3% increase; 95% CIs [0.5, 5.2]) interventions were not significantly greater than the control condition. The increase in mask usage in the free mask and education arm compared to control was	Moderate

			members served as advocates for mask usage. Masks for the intervention were provided by SafeHands Kenya, a private sector consortium deploying masks, soap and sanitizer across Kenya, and state #tibanisisi (We are the cure!) on the mask **Comparator:** 24 villages were randomized to no mask or education as a control group. **Target Behaviour:** Masking **Key outcome**: Objective measure. Main outcome measures are direct observations on a) whether a mask is visible and b) whether a mask is being worn properly (covering mouth and nose). Pre-treatment (baseline) visits were conducted 4 months and 1 month prior to the intervention, 2 midline waves were conducted 1-4 weeks after the intervention, and 1 endline waves were conducted 5-8			not maintained at 5-8 week follow-up. ***COM-B outcomes results summary:*** The free mask and education treatment resulted in a large increase in knowledge of COVID-19 (b=0.21, SE 0.054, p<.001), while the education and role model treatment did not change knowledge of COVID-19. Additionally, the education-only arm significantly increased positive attitudes toward masking. ***Differences by demographics:*** None reported	

			weeks after the intervention. **COM-B outcomes measured:** A COVID-19 knowledge index, comprised of questions about coronavirus spread, severity, and actions to reduce transmission; and b) an index of attitudes about masks, namely their comfort level, social desirability and enforcement perceptions.				
(8) Abaluck J, Kwong LH, Styczynski A, Haque A, Kabir MA, Bates-et al. (2022) Impact of community masking on COVID-19: A cluster-randomized trial in Bangladesh. Science. 375(6577):eabi9069. doi: 10.1126/science.abi9069.	14 January 2022	Bangladesh, November 2020 to April 2021	**Design:** Cluster Randomized Controlled Trial. **Sample:** 572 Bangladeshi villages. No sociodemographic information given. **Intervention:** Intervention period lasted 8 weeks. The basic intervention package consists of five main elements: 1) One-time mask distribution and information provision (about masks) at households in video	***Exposure*** **Source:** The Honorable Prime Minister of Bangladesh Sheikh Hasina, the head of the Imam Training Academy, and national cricket star Shakib Al Hasan. WHO from brochure materials. Local leaders, including imams. **Method of dissemination**: Face to face mode of delivery; Playable electronic storage mode of delivery; Human	***Exposure*** Masks were distributed to educate villagers on both the proper use of the mask to prevent COVID-19 transmission; prompt mask-wearing at point-of-use with face-to-face interaction; enable role modelling by trusted community members; prompt mask wearing with reminder texts; persuade mask wearing with messages of altruism or self-protection; increase motivation to wear mask with verbal/public commitments; increase mask-wearing social norms; incentivization.	Mask-wearing was 13.3% in control villages and 42.3% in intervention villages. Adjusted regression estimates indicate a significant overall increase of 28.8 percentage points (95% CI [0.26, 0.31] for all intervention villages. Considering only observations conducted when no mask distribution was taking place, mask-wearing increased 27.9 percentage points, from 13.4% in control villages to 41.3% in intervention villages (regression adjusted estimate = 0.28 [0.26, 0.30]). Analysis was also run separately for	Serious

			format and WHO information brochure. 2) Mask distribution in markets for 3 to 6 days per week during all 8 weeks of the intervention. 3) Mask distribution at mosques on three Fridays during the first 4 weeks of the intervention. 4) Mask promotion in public spaces and markets where non–mask wearers were encouraged to wear masks (weekly or biweekly). 5) Role modeling and advocacy by local leaders, including imams discussing the importance of mask-wearing at Friday prayers in Mosques. There was also cross-randomization of additional intervention components within intervention arms. At the village level, villages were randomized to receive: 1) Either cloth or surgical masks; 2) public commitment (asking households to place provided signage on doors that declares	interactional mode of delivery; Printed material mode of delivery. ***Comparator*** N/A	**Behaviour change wheel intervention type:** Environmental restructuring; Enablement; Education Modelling ***Comparator*** N/A	mosques, markets, and other locations such as tea stalls, the entrance of restaurants, and the main road in the village. The increase in mask wearing was largest in mosques (37.0 percentage points), whereas in all other locations it was 25 to 29 percentage points. None of the additional village cross-randomizations (i.e. receive reminder text message, certificate incentive, monetary incentive, public commitment) or household cross-randomizations (i.e. 100% or 50% of household receive reminder texts, altruistic or self-protective messaging, or verbal commitment) significantly increased mask-wearing beyond the increase accounted for by the basic intervention package. ***COM-B outcomes results summary:*** None reported.	

			they are a mask-wearing household) to encourage formation of social norms or no public signage; 3) No incentive, nonmonetary incentive, or monetary incentive of $190 given to the village leader for a project benefitting the public. Monetary or non-monetary incentives were awarded if village-level mask-wearing among adults exceeded 75% at 8 weeks after the intervention started; 4) 100% of households receiving twice-weekly text message reminders about the importance of mask-wearing or no households receiving text reminders. At the household level, further randomizations included: 1) receive messages emphasizing either altruism or self protection; 2) adults in the household make a verbal commitment to be a mask-wearing household or not; 3) receive twice-weekly				

			text reminders or not. Text message saturation was randomly varied to 0, 50, or 100% of all households receiving texts, and in the 50% villages, the specific households that received the texts was also random. **Comparator:** The control villages did not receive any interventions. **Target Behaviour:** Masking **Key outcome:** Prevalence of proper mask wearing through direct observation (objective). Surveillance was conducted using a standard protocol that instructed staff to spend 1 hour at each of the following high-traffic locations in the village: market, restaurant entrances, main road, tea stalls, and mosque; the location and timing changed so that the mask wearing and physical distancing				

			practices of as many individuals as possible could be recorded. In rural Bangladeshi villages, observations were conducted outside except at the mosque. **COM-B outcomes measured**: None.				
(9) Liebst, L.S., Ejbye-Ernst, P., de Bruin, M. et al. No evidence that mask-wearing in public places elicits risk compensation behavior during the COVID-19 pandemic. Sci Rep 12, 1511 (2022). https://doi.org/10.1038/s41598-022-05270-3 **Study 2**	10 January 2022	Amsterdam and Rotterdam	**Design**: Non-randomized controlled natural experiment. Three treatment areas and three comparable control areas, which had the best-quality public security cameras installed. **Sample**: Eligible participants were those who were in area of the eight particularly crowded streets (i.e., tourist and shopping areas) where intervention was implemented. **Intervention**: Masking mandate. Practically, the mask mandate was	***Exposure*** **Source:** Amsterdam and Rotterdam municipal governments. **Method of dissemination:** Informational mode of delivery; Pull mode of delivery; Public notice mode of delivery. ***Comparator*** N/A	***Exposure*** Enforcing required behaviour with mandate; prompt mask-wearing with signage; negative reinforcement with fines for non-compliance. **Behaviour change wheel intervention type:** Coercion; Restriction ***Comparator*** N/A	**Primary outcome results summary:** In areas with the mask mandate, proportion of mask-wearing increased by more than 30 percentage points (second difference = 0.32, $p < 0.001$). The predicted probability of mask-wearers in the pre-intervention treatment condition was 3% and 39% in the post-intervention condition. ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** Not reported	Moderate

			announced by onsite signs, municipal workers informing visitors and handing out masks during the first weeks, and police reprimanding or fining non-compliers for 1 day during the third week. **Comparator:** No mask mandate. **Target Behaviour:** Wearing a face-mask **Key outcome**: Objective measure. Binary measure of whether individuals wore a face mask (included respirators (e.g., N95), surgical masks, cloth masks) or not. Excluded were persons with insufficient masking e.g. face shields and improvised face coverings (e.g., bandanas, scarves), wearing masks covering neither the nose nor the mouth (e.g., hanging under				

			the chin), or who changed the mask's placement (i.e., between facial areas or putting it on/off). **COM-B outcomes measured:** None.				
Individual level interventions							
(10) Conroy, D., Smith, D.M. & Armitage, C.J. (2022) Very small effects of an imagery-based randomised trial to promote adherence to wearing face coverings during the COVID-19 pandemic and identification of future intervention targets, Psychology & Health. https://doi.org/10.1080/088	11 Jan 2022	London, England September 2020 and February 2021.	**Design**: Randomized controlled trial. A factorial trial design was adopted. Participants were randomised to one of four groups (outcome, process, outcome and process, control) **Sample**: The final sample consisted of 297 individuals. Most participants lived in London (54%, N=159) and self-identified as White British (58%, N=171). The final sample included a high proportion of individuals from equity-seeking group including Black, Asian, and Minority ethnic communities. (individuals (22.6%, n=67) relative to the proportion of	***Exposure*** **Source:** Researchers, UK government. **Method of dissemination:** Informational mode of delivery; Pull mode of delivery (a mode of delivery that requires action from participants) ***Comparator*** **Source:** UK government. **Method of dissemination:** Informational mode of delivery	***Exposure*** **Content of Intervention:** increase knowledge of masking guidelines, increase positive attitudes toward the behavior, increase behavioural control, increase self-efficacy. **Behaviour change wheel intervention type:** Education; Persuasion ***Comparator*** **Content of Intervention:** increase knowledge of masking guidelines **Behaviour change wheel intervention type:** Education	**Primary outcome results summary:** Compared to the control condition, mask-wearing adherence was not statistically significantly different than the outcomes imagery condition (b = .294, Wald $\chi2(1) = .441$, p = .507), process imagery condition (b = −.234, Wald $\chi2(1) = .303$, p = .582) or combined imagery condition (b = −.340, Wald $\chi2(1) = .285$, p = .594) at 4 week follow-up. ***COM-B outcomes results summary:*** On analyses on the full sample, attitudes, subjective norms, perceived behavioural control, intention, and barrier self-efficacy were not related to adherence after accounting for experimental group, sociodemographic and personality variables.	Serious

70446.2021.2012574			individuals from equity-seeking backgrounds in the overall UK population. The final sample included 54 men (Mage = 36.4, SD=15.1) and 241 women (Mage = 34.6 years, SD=12.7). more typically younger (65% vs 29% aged 18–39 years nationally), Occupationally, most participants self-identified as part- or full-time students (64%), and otherwise self-defined as part or full-time employed (29%) or 'other' (6.5%). **Intervention**: One imagery intervention group was asked to imagine positive outcomes of having successfully worn face coverings (i.e. outcome imagery, N=107); another intervention group was asked to imagine strategies involved in successfully wearing face coverings (i.e. process imagery, N=110); and a third imagery intervention group was asked to complete outcome and			In an analysis of suboptimal adherers (n=81), defined as any response on the 1-5 scale below 'full adherence', greater mask-wearing at four-week follow-up was predicted by greater intentions predicted (b=1.452, $p < .05$) and greater perception that consistent mask-wearing was a social norm (b=0.307, $p < .05$). ***Differences by demographics:*** Women were more likely to report being 'fully adherent' at T2 than 'suboptimally adherent' (80% vs 20%) than compared to me (50% vs 50%), (b = −1.172, Wald $\chi2(1) = 9.139$, $p = .003$).	

			process imagery exercises N=110. All intervention groups received information about wearing face masks in indoor public places. **Comparator:** Viewed a social media image from August 2020 showing a UK Government public health message about the importance of wearing face masks while in public places. **Target Behaviour:** Increased and sustained wearing of face masks **Key outcome**: Subjective outcome. Self-reported the frequency of face mask adherence using one item: 'In the past week, when you have gone outside your home for work, grocery shopping, or other activities that involved using public transport, visiting shops/supermarkets, being in enclosed public spaces where physical distancing may be difficult, or being in public spaces where you came into contact with people do				

			not normally meet, how often did you wear a cloth face covering1 that covered your nose and mouth?' on a scale from 1 (never) to 5 (always). **COM-B outcomes measured:** For wearing a mask in the next 7 days, intention to mask was measured on a scale from 1 (strongly disagree) to 5 (strongly agree), attitudes toward masking was rated form 1 (not worthwhile) to 5 (worthwhile), subjective norms was rated from 1 (strongly disagree) to 5 (strongly agree), perceived behavioural control was rated on a scale from (e.g.) 1 (no control at all) to 5 (complete control), and barrier self-efficacy was on a scale from 1 (cannot do at all) to 5 (highly certain can do).				
(11) Blackman A, Hoffmann B (2022) Diminishing returns:	22 December 2022	Bogota, Colombia, May to June, 2020	**Design**: 2x2 factorial randomized controlled trial	***Exposure*** **Source:** Researchers	***Exposure*** Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase	**Primary outcome results summary:** Compared to the control, there was no significant	Critical

Nudging Covid-19 prevention among Colombian young adults. PLOS ONE 17(12): e0279179. https://doi.org/10.1371/journal.pone.0279179			**Sample**: 1349 students aged 18+ studying at more than 40 universities in Bogota. 318 in private arm, 327 in public arm, 346 in combined arm, 230 in pure control arm **Intervention** All participants attended an information session in a zoom meeting where they watched a pre-recorded slide deck presentation with information about health risks of COVID-19 and appropriate non-pharmacological interventions to reduce transmission. Then, participants were sent 3 email messages over the course of 7 days with either a control or treatment intervention. All three interventions had common contextual information and recommended five non-pharmacological interventions (NPI), only differed in	**Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery ***Comparator*** **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	knowledge of benefits of protective behaviours **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	change in masking compliance in the personal benefits (b=.30, SE=.89, p>.05), public benefits (b=-1.14, SE=1.10, p>.05), or combined private and public benefits (b=-1.00, SE=.96, p>.05) conditions. **COM-B results summary:** The personal benefits treatment increased perceived likelihood of infection (b=.20, SE=.05, p<.01), concern for self (b=.13, SE=.07, p<.05), concern for friends (b=.17, SE=.07, p<.05), and concern for community (b=.17, SE=.07, p<.05). Perceived likelihood of infection significantly increased in the public benefits condition (b=.17, SE=.05, p<.01) and combined benefits condition (b=.17, SE=.04, p<.01). There was no difference in intended compliance across conditions. ***Differences by demographics:*** Not reported	

			motivation for complying: - Personal benefits - Public benefits - Combined personal and public benefits - Neither (pure control) **Comparator:** Information on irrelevant subject **Target Behavior:** Masking **Key outcome:** Self-reported rates of compliance with masking as measured by % of times over past 7 days wore a mask while outside. **COM-B outcomes measured:** Using a four-point Likert scale (from 1 to 4), with one being the lowest level and four the highest, respondents indicated the following: likelihood of infection, their self-assessed likelihood of contracting Covid-19; concern self, their				

			level of concern about getting seriously ill from Covid-19; concern friends, their level of concern about infecting friends who then become seriously ill; concern household, their level of concern about infecting members of their household who then become seriously ill; and finally, concern community, their level of concern about infecting members of their community other than family and friends who then become seriously ill. Intended compliance: % of times over next 7 days intend to wear a mask while outside				
(12) Ludema C, Rosenberg MS, Macy JT, Kianersi S, Luetke M, et al. (2022) Does receiving a SARS-CoV-2 antibody test result change COVID-19	20 December 2022	Indiana University's Bloomington campus, Fall 2020	**Design**: Randomized controlled trial **Sample**: 1397 undergraduate students (>18 years, current IU students, and residents of Monroe County, Indiana) → results reported from 1076 (77%) who completed baseline and baseline	***Exposure*** **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery ***Comparator*** **Source:** COVID-19 lab testing staff	***Exposure*** Increase awareness of COVID-19 immunity, make risk salient **Behaviour change wheel intervention type:** Persuasion ***Comparator*** Increase awareness of COVID-19 immunity, make risk salient	**Primary outcome results summary:** Participants who received antibody test results immediately did not report significantly higher or lower engagement in wearing face masks in the following 2 weeks compared to participants who did not receive their test results for 4 weeks.	Serious

protective behaviors? Testing risk compensation in undergraduate students with a randomized controlled trial. PLOS ONE 17(12): e0279347. https://doi.org/10.1371/journal.pone.0279347			antibody test. The median age of participants was 20 years (IQR 19–21) and the ages of study participants largely aligned with traditional undergraduate student ages of 18–21 (90.6%). The majority of study participants identified as women (64%). 79% white (8% Asian, 1% Black)), 64% women, 32% lived on-campus, 24% affiliated with Greek student organizations. **Intervention**: Receive baseline Sars-Cov-2 antibody test results immediately **Comparator:** Receive results after 4 weeks **Target Behaviour:** Masking **Key outcome**: Engagement in wearing a face mask in the past 7 days in public on a scale of 1-5: Never =1 to Always=5.	**Method of dissemination:** Email mode of delivery (delayed for 4 weeks)	**Behaviour change wheel intervention type:** Persuasion	Furthermore, for seronegative participants, receiving antibody test results was not associated with higher or lower face mask engagement [RR (95% CI): 1.01 (1.00, 1.03)]. Similar results were observed for our smaller sample of seropositive participants [RR (95% CI): 0.91 (0.80, 1.04)]. **COM-B outcome results summary:** None ***Differences by demographics:*** None reported	

			COM-B outcomes measured: None				

Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.

Table 4. Summary of studies reporting on effectiveness of interventions in promoting adherence to physical distancing and reduction in contacts

Reference	Date released	Setting and time covered	Study characteristics	*Intervention mode of delivery*	*Behaviour change strategy*	Summary of key findings in relation to the outcome	Risk of bias
Population level interventions							
(13) Klein, B., LaRock, T., McCabe, S., Torres, L., Friedland, L., Kos, M., ... & Chinazzi, M. (2022). Characterizing collective physical distancing in the US during the first nine months of the	17 December 2022	United States	**Design**: interrupted time-series **Sample**: US population **Intervention**: Updated CDC Non-pharmaceutical intervention guidelines: stay home if sick, whole household stay home if one person tests positive, work from home where possible, avoid social gatherings >10 people, avoid eating inside restaurants, avoid discretionary travel, do not visit nursing homes, school closures, practice respiratory etiquette.	**Exposure** **Source:** Center for Disease Control/US government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Increase knowledge of required behaviours **Behaviour change wheel intervention type:** Education **Comparator** N/A	**Primary outcome results**: By early May 2020, the United States there has been a reduction of approximately 65% of the typical daily values. The aggregate trend in commute volume remained relatively stable from early May, at about a 60–70% reduction, though it began to trend upwards again as of early September. At its peak, the amount of transits between metropolitan areas among participants had decreased by almost 50%, on average. By early May, the average daily mobility decreased by between 45–55% relative	Serious

COVID-19 pandemic. arXiv preprint arXiv:2212.08873.			**Comparator:** period before updated guidelines **Target Behaviour:** Physical distancing and reducing contacts **Key outcome**: Objective outcome using mobility data. Collective patterns of physical distancing emerging in a society through several measures of mobility and physical proximity: 1) the daily range of mobility for each user; 2) the fraction of users that commute to work; 3) the fraction of users that travel between metropolitan areas; 4) the number of unique contacts outside of home and work (close contact as someone who was "within 6 feet of an infected person for at least 15 minutes"); and 5) the average duration of those contacts. **COM-B outcomes measured:** None.			to a typical weekday. The range of distance traveled increased steadily from May to June, and by early July returns to about 95% of the typical behavior. Participants had 75% fewer distinct contacts per day by mid-April. Unique contacts increased steadily starting in May and through June, leveling off for the remainder of the summer at approximately 40–50% reduction compared to typical contacts. This increased trend in contacts coincided with loosening of restrictions. By mid-April, the duration of contacts was reduced by about 75% compared to typical behavior before physical distancing measures took effect. Then, from May to June, there was a steady increase up to about a 45% reduction from typical. ***COM-B outcomes results summary:*** None	

						Differences by demographics: Not reported	
(14) Kar, S. S., Krishnamoorthy, Y., Sivanantham, P., Anandraj, J., & Gnanadhas, J. (2022). Effect of COVID-19 driven lockdown on social contact pattern in Puducherry, India: A longitudinal study. Journal of postgraduate medicine, 68(3), 138–147. https://doi.org/10.4103/jpgm.jpgm_1085_21	June 7, 2022	March 2020-February 2021, Puducherry, India	**Design:** Longitudinal study (retrospective cohort) **Sample:** 441 of 550 individuals approached via telephone interview Pre-lockdown: 441, 1st week of lockdown: 429, 4th week of lockdown: 376, 1st week post-lockdown: 436, 7 months post-lockdown: 399 **Intervention:** District wide lockdown. 1st week of lockdown (25-31 Mar 2020), 4th week of lockdown (15-21 Apr 2020), 1st week post lockdown (10-16 Jun 2020), 7 months post-lockdown (10-16 Feb 2021) **Comparator:** pre-lockdown period (18-24 Mar 2020) **Target Behavior:** Physical distancing	**Exposure** **Source:** Puducherry government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** The incident number of social contacts significantly reduced from 90% during 1st week of lockdown to 40% during the 4th week, and returned to pre lockdown levels in the immediate post lockdown weeks (91%), a significant increase from during lockdown. Similar trends were observed in duration of social contacts. The level of compliance to lockdown in terms of relative reduction in social contact rate during and post lockdown periods in comparison to the pre-lockdown phase is given in. Over four out of five people (82.4%) in the district of Puducherry were adherent to a high level of compliance to lockdown during the first week of lockdown. However, by the fourth week of nationwide lockdown, high levels of compliance declined to less than half (45.2%). Then, again the level of	Serious

			Main Outcomes: Number of contacts where contacts were defined as a two-way conversational encounter between the participant and another person lasting for ≥5 minutes or with whom the participant had the conversation in proximity (less than one meter). Duration of contacts measured as average time spent (in minutes) per day by the participant in close contact at each social setting. Level of compliance with lockdown was measured as reduction in social contact rate of an individual by ≥75%, 25–74%, or <25% during and post lockdown periods compared to the pre-lock down period, in comparison to the pre-lockdown state were classified as high, moderate or low level of compliance respectively. Subjective outcomes. **COM-B outcomes measured:** None			compliance has increased to more than 80% even after the withdrawal of nationwide lockdown (1st week post-lockdown). However, seven months post-lockdown, the compliance to the high level of reduction in social contact rate declined to about 11.9%. **COM-B outcomes results summary:** None ***Differences by demographics:*** Men had significantly higher incident number of contacts and duration of social contacts when compared to women. Participants who had primary education and secondary/higher secondary level of education had fewer incident number of contacts compared to those with no formal education. Participants aged 18–30 years had a significantly higher duration of social contacts when compared to those elderly participants.	

(15) Navazi F, Yuan Y, Archer N (2022) The effect of the Ontario stay-at-home order on Covid-19 third wave infections including vaccination considerations: An interrupted time series analysis. PLOS ONE 17(4): e0265549. https://doi.org/10.1371/journal.pone.0265549	April 6, 2022	March 7, 2021 to May 31, 2021, Ontario, Canada	**Design:** Interrupted time series (quasi-experimental research) **Sample:** No information on number of devices used for mobility indices, but baseline population was derived from Statistics Canada's estimate of Ontario's population in 2020: 14,734,014 **Intervention:** Lockdown and stay-at-home order during the period of Ontario's third wave of COVID-19 (March 7 to May 30, 2021) **Comparator:** No lockdown during pre-COVID-19 period (Jan 3 to Feb 6, 2020) **Target Behavior:** Physical distancing **Main Outcomes:** Mobility changes as reported by Google LLC for Ontario residents in that period (residential or non-residential) **COM-B outcomes measured:** None	**Exposure** **Source:** Ontario government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcomes results summary:** Mobility data indicated that time spent in residence increased slightly over the course of one month after the stay-at-home order announcement in April. Then, time spent in residence decreased in May. People were more likely to adhere to time spent in residence on weekdays than on weekends. There was a decrease in mobility outside of residence for at least 3 weeks after the stay-at-home order announcement. Although people seemed to adhere to the second stay-at-home order in April, mobility outside of residence significantly increased in May compared to April. The increase in mobility outside of the residence is related to the mobility increase in public parks due to good weather. **COM-B outcomes results summary:** None ***Differences by demographics:***	Moderate

						None reported	
(16) Jiang DH, Roy DJ, Pollock BD, et al Association of stay-at-home orders and COVID-19 incidence and mortality in rural and urban United States: a population-based study. BMJ Open 2022;12:e055791. doi: 10.1136/bmjopen-2021-055791	March 8, 2022	Jan 22, 2020 - June 10, 2020	**Design:** interrupted time series analysis **Sample:** 1976 rural and 1166 urban counties in USA, home to over 46 million and 282 million people respectively **Intervention:** During, and after stay home orders were implemented by each respective county ("during period" = Jan 3 to Feb 6, 2020) **Comparator:** Baseline period before stay home orders were implemented **Target Behavior:** Mobility/staying at home **Main Outcomes:** Mobility indices for grocery and pharmacy, retail and recreation, work place, and residential areas. **COM-B outcomes**	**Exposure** **Source:** US government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** There was an approximately 25% increase in grocery/pharmacy mobility prior to implementation of stay-at-home orders, potentially reflecting anticipatory shopping prior to sheltering in place. This was preceded by a 15% increase and subsequent decline in retail/recreation mobility. The increase in grocery/pharmacy mobility coincided with a 25% decrease in workplace mobility and a 10% increase in residential mobility, consistent with transition to working from home. After implementation of stay-at-home orders, mobility in grocery/pharmacy, retail/recreation and workplace decreased 10%–40%, while residential mobility increased 10%–20%. These reductions in mobility were significantly more pronounced in urban compared with rural counties,	Moderate

			measured: None			After stay-at-home orders elapsed, all mobility began to increase toward baseline levels, more rapidly in urban than rural areas. Grocery/pharmacy mobility ultimately exceeded baseline mobility in rural areas. **COM-B outcomes results summary:** None ***Differences by demographics:*** None reported	
(3) Tan, A. L., Ng, S. H. X., & Pereira, M. J. (2021). Singapore's COVID-19 "circuit breaker" interventions: A description of individual-level adoptions of precautionary behaviours. *Annals of the Academy*	8 August 2021	Singapore February 21, 2020 to May 1, 2020	**Design**: Interrupted time-series **Sample**: General population in Singapore residing in the community, not including foreign workers or imported cases. **Intervention**: Circuit breaker (CB) measures in Singapore that included various forms of mandatory behavioural modifications (e.g. all non-essential workplaces and organisations were mandated to close or implement work-from-home arrangements, required behaviour modifications such as face mask-wearing in	***Exposure*** **Source:** Singapore government **Method of dissemination:** Informational mode of delivery ***Comparator*** N/A	***Exposure*** Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Behaviour change wheel intervention type:** Coercion; Restriction ***Comparator*** N/A	***Primary outcome results summary:*** Individuals reported a high tendency to avoid crowded public areas even prior to the CB (69%, SD 12%, P=0.80), and so there was no significant difference between before and during CB (85%, SD 1.1%, P=0.80). Before CB, the proportion of individuals reporting work-from-home arrangements was 17% (11–31%). During CB, it significantly increased (20.4%, 95% confidence	Critical

of Medicine, Singapore, *50*(8), 613–618. https://doi.org/10.47102/annals-acadmedsg.2020597			public areas, personal hygiene via handwashing or hand sanitizer use, and avoidance of crowded areas) with legal penalties such as fines. **Comparator:** Outcomes were compared between the periods before, during and after CB. **Target Behaviour:** Avoidance of crowded areas, work-from-home arrangements **Key outcome**: Proportion of participants working from home and proportion of participants avoiding crowded areas **COM-B outcomes measured:** None.			interval [CI] 11.7–29.2, *P*<0.01). There was no statistically significant difference between periods during and after CB. ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	
(17) Harris, Mallory J.; Tessier-Lavigne, Ella; and Mordecai, Erin (2021) "The Interplay of Policy, Behavior, and Socioecono	April 2021	Counties in Georgia, USA - time covered not reported outside of number of days	**Design:** Pre-post time series analysis **Sample:** All residents from Georgia, USA, based on US Census Bureau (no numbers or breakdown based on age, sex, race, etc. provided) **Intervention:**	**Exposure** **Source:** Georgia government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** Mobility decreased by 19% (P<0.001) in the ten days following the introduction of a social distancing order. Mobility was significantly reduced two to five days after shelter-in-place orders were passed. However, a sustained marginal effect of	Moderate

mic Conditions in Early COVID-19 Epidemiology in Georgia," Journal of the Georgia Public Health Association: Vol. 8: No. 2, Article 4. DOI: 10.20429/jgpha.2021.080204 Available at: https://digitalcommons.georgiasouthern.edu/jgpha/vol8/iss2/4		prior to and following statewide shelter in place order on May 21, 2020	Public health orders: introduction of social distancing or shelter-in-place legislation **Comparator:** Baseline period ten days prior to the legislation's introduction **Target Behavior:** Physical distancing **Main Outcomes:** Proportion of each county's population working in another county Daily county-level mobility data from mobile phone data - max distance travelled from initial point on each day - normalized daily mobility **COM-B outcomes measured:** None			shelter-in-place orders on mobility was not detected after accounting for the effects of social distancing orders already in place (all counties had social distancing orders prior to shelter-in-place orders). Therefore, the event study involving shelter-in-place orders indicates the marginal effect of shelter-in-place orders after accounting for social distancing orders. **COM-B outcomes results summary:** None ***Differences by demographics:*** None reported	
(18) Bourassa K. J. (2021). State-Level Stay-at-Home Orders and Objectively	March 1 to May 7, 2020	2858 counties in the USA	**Design:** Non-randomized cohort study **Sample:** 2858 counties, covering approximately 98.2% of the	**Exposure** **Source:** US government **Method of dissemination:** Informational mode of delivery	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:**	**Primary outcome results summary:** Counties in states that enacted a stay-at-home order had significantly fewer people remaining within 1 mile of home (26.3% compared to	Low

Measured Movement in the United States During the COVID-19 Pandemic. *Psychosomatic medicine*, *83*(4), 358–362. https://doi.org/10.1097/PSY.0000000000000905			American population (~328.2 million) **Intervention:** County-wide stay-at-home order **Comparator:** Baseline period without stay-at-home orders **Target behavior:** Physical distancing **Key outcome:** Daily movement (% of people staying within 1 mile of home, vehicle miles travelled) **COM-B outcomes measured:** None	**Comparator** N/A	Restriction **Comparator** N/A	27.9%, $t = 6.13$, $p < .001$) and significantly more vehicle miles being traveled at baseline (5.5 million compared to 2.4 million, $t = 4.63$, $p < .001$) during the first week of March. Similarly, counties in states that enacted a stay-at-home order were more populated ($t = 4.66$, $p < .001$) and less rural ($t = 4.28$, $p < .001$). From the first week of March to the first week of April, counties in states that enacted a stay-at-home order had 3.1% more people remain within 1 mile of home (95% CI [2.6%, 3.6%], p < .001) and 1.6% fewer vehicle miles traveled (95% CI [0.6%, 2.6%], p = .002) compared to counties in states that did not enact a stay-at-home order. From the first week of April to the first week of May, counties in states that ended their stay-at-home orders by May 7 saw 1.2% fewer people remain within 1 mile of home (95% CI [1.0%, 1.4%], p < .001) and 6.2% more vehicle miles traveled (95% CI [4.6%, 7.9%], p < .001) compared to counties in states that maintained their stay-at-home orders.	

						COM-B outcomes results summary: None ***Differences by demographics:*** None reported	
(19) Shearston, J. A., Martinez, M. E., Nunez, Y., & Hilpert, M. (2021). Social-distancing fatigue: Evidence from real-time crowd-sourced traffic data. The Science of the total environment, 792, 148336. https://doi.org/10.1016/j.scitotenv.2021.148336	January 1 to December 31, 2020	Manhattan, USA	**Design:** Interrupted time series **Sample:** People within Manhattan during the study period **Intervention:** Time periods: COVID period 1 (Mar 14-May 19), COVID period 2 (May 20-June 16) which corresponds with stay-at-home orders (NY on PAUSE), COVID period 3 (June 17-Dec 31) during reopening. **Comparator:** pre-COVID (Jan 1-Mar 13) baseline period. **Target Behavior:** Physical distancing **Key Outcomes:** Traffic congestion as measured by 12 tiles from Google traffic maps to view Manhattan's entire street network every three hours in	**Exposure** **Source:** Government of New York **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcomes results summary:** Percent area with red traffic congestion was highest during the pre-COVID time period, and then decreased abruptly during COVID Period 1 (from a mean of 0.99% to 0.41%) before steadily increasing for COVID Periods 2 and 3. By COVID Period 3, the mean percent area with red traffic congestion had rebounded to about 75% of the pre-pandemic average. During the Pre-COVID period rush hour peaks were highest, with weekdays demonstrating a clear bimodal distribution with peaks around 9 am and 5 pm, and weekends a clear unimodal peak around 5 pm. However, during COVID Period 1, both weekday and weekend traffic peaks were greatly dampened, and the bimodal weekday distribution shifted to nearly unimodal, becoming very similar to	Serious

			real time. Color-coded road segments for traffic flow categories (free-flowing, medium, traffic congestion, severe traffic congestion) as a proxy for mobility and as an indicator for social distancing measures. **COM-B outcomes measured**: None			the weekend distribution. During COVID Period 2 and 3 the daily traffic peaks were greater than for Period 1, but still lower than pre-pandemic levels. Even as overall traffic increased during these periods, the weekday distribution remained altered, such that the morning peak was much smaller than the evening peak. **COM-B secondary outcome results:** None ***Differences by demographics:*** Not reported	
(4) Boruchowicz, C., Lopez Boo, F., Finamor Pfeifer, F., Russo, G.A., Souza Pacheco, T. (2020) Are Behaviorally Informed Text Messages Effective in	Oct 2020	São Paulo, Brazil	**Design**: Randomized controlled trial **Sample**: N = 75,351 enrolled from the general adult population of Sao Paulo **Intervention**: Receive series of four text messages (SMS) that informed, instructed and motivated to stay at home, to properly wear a mask, and to maintain distance from others (the first SMS contained information and call for action, the second one was a motivational message, the third contained specific instructions for one	***Exposure*** **Source:** Researchers **Method of dissemination:** Mobile digital device mode of delivery ***Comparator[a]*** N/A	***Exposure*** Increase empathy and reciprocity towards health workers, provide social norms, evoke a sense of civic duty, increase salience to risk perception, increase self-efficacy, prompt behavior, increase motivation. **Intervention Type:** Persuasion ***Comparator*** N/A	**Primary outcomes results summary:** Compared to the control group, receiving SMS messages was not associated with differences in the frequency with which individuals left their homes, or reported keeping distance. **COM-B secondary outcome results:** Those who received the 'civic duty' message were 12.75% more likely to choose the right keeping distance from others	Serious

Promoting Compliance with COVID-19 Preventive Measures?: Evidence from an RCT in the City of São Paulo. *Inter-American Development Bank*. http://dx.doi.org/10.18235/0002722			particular action (for example, how to properly wear face masks), and the fourth was also a motivational message but with a different call for action) Five different intervention groups with motivational messages modified to reflect: civic duty, self-efficacy, social norms, reciprocity, risk perceptions **Comparator:** Did not receive any messages **Target Behaviour:** Going out, keeping distance from others **Key outcome**: Subjective outcome. Self-reported Going out and self-reported Distance Keeping. Measurement scale unclear. **COM-B outcomes measured:** Beliefs about the social distancing policies (specific item not given). Awareness about appropriate behavior measured by Awareness index (i.e. additive index that ranges from 0 to 3 and combines whether the respondent provided the right answer to the questions "What distance must you			answer, i.e., an increase from 25% to almost 29%, or 3.7 percentage points. ***Differences by demographics:*** Women were more likely to physically distance than men. Older individuals were also more likely to report wearing a mask more often than their younger people.	

			keep from others in public?", "If I am wearing a mask and the other person too, do we need to keep distance?", and "If I am wearing a mask for 1 hour and it gets humid do I need to change it?").				
(20) Pan, Y., Darzi, A., Kabiri, A. et al. Quantifying human mobility behaviour changes during the COVID-19 outbreak in the United States. Sci Rep 10, 20742 (2020). https://doi.org/10.1038/s41598-020-77751-2	February 2, 2020 – May 30, 2020	Aggregated mobile device location data from >100 million devices across the USA (contiguous USA + Alaska + Hawaii)	**Design:** Non-randomized cohort study **Sample:** Integrated dataset of real-time mobile device location data involving 100 million devices in the contiguous United States (plus Alaska and Hawaii) **Intervention:** Declaration of national emergency on March 13 (which coincided with the White House coronavirus task force is advising Americans to avoid social gatherings of >10 people, non-essential travel for at least 15 days, advice for governors of states with evidence of community transmission to close bars, restaurants, food courts, gyms and other indoor and outdoor venues) and partial reopening and stay-at-home order lifting (April 27 to May 30, 2020).	**Exposure** **Source:** US Government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** The states are sorted in descending order by their SDI scores on the last weekday (May 29). The top five regions that are performing more social distancing are the District of Columbia, Hawaii, New York, New Jersey, and Maryland, all of which issued stay-at home orders. Meanwhile, the states practicing less social distancing are Wyoming, North Dakota, South Dakota, Arkansas, and Montana, most of which did not issue stay-at-home mandates. On the East and West Coasts, it is possible that people practiced more social distancing because they were exposed to the infection risk for a longer	Moderate

			4 intervention periods defined as: behaviour change (March 14 to March 22), government orders and holding steady (March 23 to April 12), quarantine fatigue (April 13 to April 26), and partial reopening and stay-at-home order lifting (April 27 till now). **Comparator:** Before national emergency declaration baseline period (February 2nd to March 12th, 2020). **Target Behavior:** Social distancing **Key Outcome:** Basic mobility metrics (% residents staying home, daily works trips per person, daily non-work trips per person, distances travelled per person, out-of-county trips in thousands) Social Distancing Index (SDI) – score based index which gives a 0–100 score to each geographical area, e.g., a state or a county, and measures to what extent area residents and visitors practice social distancing. Zero indicates no social distancing and one hundred indicates perfect social			period and are aware of the higher infection risk with higher population density. ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** None reported	

			distancing compared with the benchmark days before the COVID-19 outbreak. Objective outcome. **COM-B outcomes measured:** None				
(21) Huang, V., Sutermaster, S., Caplan, Y., Kemp, H., Schmutz, D., & Sgaier, S. K. (2020). Social distancing across vulnerability, race, politics, and employment: How different Americans changed behaviors before and after major COVID-19 policy announcements. MedRxiv, 2020.06.04.20119131. https://doi	February 24 – May 10, 2020	County-level social distancing data from Unacast, all around USA	**Design:** Pre-post intervention analyses **Sample:** 2500 mobile phone applications across USA counties Data were analyzed by race, 2016 presidential election voting choice, employment sectors **Intervention:** Three different policy changes based on key events: WHO declaration of global pandemic on March 11, 2020 + release of national guidelines for reopening on April 16, 2020 + states' first relaxation of social distancing policies **Comparator:** Each of the three key event periods had their own control period which preceded the key event	**Exposure** **Source:** US government, WHO **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law, providing guidelines for recommended behaviours. **Behaviour change wheel intervention type:** Coercion; Restriction **Comparator** N/A	**Primary outcome results summary:** Throughout March, mobility declined, indicating that social distancing was increasing with the number of confirmed cases. However, the magnitude of the decline in mobility peaked nationally on April 12th, with 56.1% less mobility recorded than prior to the pandemic. Following this peak, social distancing decreased, despite a continued increase in new cases. During the week of March 16th, following the WHO declaration of a COVID-19 pandemic on March 11th and President Trump's declaration of a national emergency on March 13th, national social distancing significantly increased both on weekdays – with a 18.6% decline in mobility ($p<0.05$) compared with the week of March 2nd – and	Critical

.org/10.1101/2020.06.04.20119131			**Target behavior:** Physical distancing **Key outcome:** Percent mobility (inverse of social distancing) at a national level **COM-B outcomes measured:** None			weekends – with a 41.3% decline ($p<.05$) This increase in social distancing occurred before the CDC announced specific social distancing guidelines on March 16th. In the week beginning April 20th, after the White House had released the OUAA guidelines, individuals socially distanced significantly less on weekdays (1.1%, $p<0.05$ less social distancing) and on the weekends (5.3%, $p<0.05$) than during the week prior to the week of the guideline release. This decline (i.e., increase in mobility) occurred before any states officially relaxed social distancing policies, which were not implemented until the week of April 27th. Following the first state reopening's, during the week of May 4th, national social distancing significantly declined further, with 10.0% ($p>0.01$) less social distancing on weekdays and 20.9% ($p>0.01$) less on weekends, compared with the week prior to relaxed social distancing mandates. ***COM-B outcomes results summary:***	

						None ***Differences by demographics:*** On average, Black individuals in the US physically distanced significantly more than the average white individual. On average, people who voted for Trump in 2016 physically distanced significantly less than the average Clinton voter.	
(22) Bönisch, S., Wegscheider, K., Krause, L., Sehner, S., Wiegel, S., Zapf, A., Moser, S., & Becher, H. (2020). Effects of coronavirus disease (COVID-19) related contact restrictions in Germany, March to	January 13 to May 17, 2020	Germany	**Design:** Interrupted time series **Sample:** Daily average of 2014 participants in Germany aged 16-89 years, resulting in 16,730,065 time-stamped latitude/longitude WGS84 coordinate pairs and were stored and processed using the spatial database system PostGIS N=930 female, N=1084 male N=431 aged 16-29 years, N=1283 aged 30-59, N=300 aged >60 years. N=280 in Bavaria, N=165	**Exposure** **Source:** German government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** At the beginning of the investigation period (13 January−8 March), we observed an overall median of traveled distances measured through mobile tracking of 15.33 km. The individual distances show large variation with quartiles 3.75 km (25% quantile) and 41.25 km (75% quantile). Those values decreased considerably after mobility restrictions were implemented. Comparing the beginning of the investigation period to the period 23 March to 17 May, the median decreased 46% to 8.22 km. The quartiles decreased to 1.28 km (25%	Moderate

May 2020, on the mobility and relation to infection patterns. Frontiers in Public Health, 8. https://doi.org/10.3389/fpubh.2020.568287			in Berlin-Hamburg, N=480 in North Rhine-Westphalia **Intervention:** Suite of restriction measures: Closure of schools, universities, selected nurseries, mobility restrictions (i.e. lockdown), non-essential business closures (period between Mar 9 to 17 May) **Comparator:** Reference period without restriction measures (Jan 13 to Mar 8) **Target Behavior:** Physical distancing **Main Outcomes:** Relative mobility reduction **COM-B outcomes measured:** None			quantile) and 26.6 km (75% quantile). **COM-B outcomes results summary:** None ***Differences by demographics:*** None reported	
(23) Gao S, Rao J, Kang Y, et al. Association of Mobile Phone Location Data Indications of Travel and Stay-	March 11 to April 10, 2020	USA	**Design:** Cross-sectional survey **Sample:** >45 million anonymous mobile phone devices analyzed **Intervention:**	**Exposure** **Source:** US state governments **Method of dissemination:** Informational mode of delivery **Comparator**	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator**	**Primary outcome results summary:** People's daily mobility decreased significantly but with different temporal lags following the implementation of statewide stay-at-home orders across these states. With the social distancing guidelines and shelter-at-	Critical

at-Home Mandates With COVID-19 Infection Rates in the US. JAMA Network Open. 2020;3(9):e2020485. doi:10.1001/jamanetworkopen.2020.20485			Stay-at-home orders **Comparator:** baseline period before stay-at-home orders **Target Behavior:** physical distancing and reducing contacts **Key outcomes:** The change rates of median travel distance and median home dwell time **COM-B outcomes measured:** None.	N/A	N/A	home orders in place, the median home dwell time increased significantly in most states since March 23, 2020. The median travel distance decreased and the median home dwell time increased across the US during this period (before and after stay-at-home-orders: March 11 and April 10, 2020). **COM-B outcomes results summary:** None ***Differences by demographics:*** None reported	
(24) Sun, S., Folarin, A. A., Ranjan, Y., Rashid, Z., Conde, P., Stewart, C., Cummins, N., Matcham, F., Dalla Costa, G., Simblett, S., Leocani, L., Lamers, F., Sørensen, P. S., Buron, M.,	February 1, 2019 – July 5, 2020	Italy, Spain, Denmark, UK, the Netherlands	**Design:** Interrupted time series **Sample:** 1062 participants, recruited from survey collecting data for monitoring major depressive disorder, and MS using wearable devices. 1062 participants from Italy, Spain, Denmark, the UK, the Netherlands. **Intervention** Lockdown period defined as the entire period of the respective national lockdown in each country,	**Exposure** **Source:** US state governments **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	**Primary outcome results summary:** As expected, following national lockdowns, participants in all countries stayed at home for longer. Post-hoc Dunn-Bonferroni tests by country: Italy Z=-9.38, p<.001 Spain Z=-8.98, p<.001 Denmark Z=-5.44 p=.02 UK Z=-9.19 p<.001 Netherlands Z=-7.33 p<.001 During national lockdowns compared to pre-lockdown, participants in all countries travelled shorter distances.	Serious

Zabalza, A., Guerrero Pérez, A. I., Penninx, B. W., Siddi, S., Haro, J. M., Myin-Germeys, I., … RADAR-CNS Consortium (2020). Using Smartphones and Wearable Devices to Monitor Behavioral Changes During COVID-19. Journal of medical Internet research, 22(9), e19992. https://doi.org/10.2196/19992			which ended when NPIs were eased for the first time. **Comparators:** Baseline period: same period in 2019 as 2020 during national lockdown for countries where data collection was earlier than 2019, which included Italy, Spain, and the UK. This was aimed at suppressing seasonal variability. For Denmark and the Netherlands where participant recruitment and data collection started much later, the period was selected that started with the earliest stable date (no considerate missing data or outliers) with the same length of the entire respective national lockdown. Pre-lockdown period: (immediately before lockdown) **Target Behaviors:** Time spent at home, maximum distance travelled from home, physical distancing **Main Outcomes:** Objective outcomes. Time spent at home: The time spent within 200m radius of			Post-hoc Dunn-Bonferroni tests by country: Italy Z=9.0, p<.001 Spain Z=8.91, p<.001 Denmark Z=5.48 p=.02 UK Z=8.40 p<.001 Netherlands Z=-7.58 p<.001 During national lockdowns compared to pre-lockdown, participants in all countries had fewer Bluetooth-enabled devices in the vicinity. Post-hoc Dunn-Bonferroni tests by country: Italy Z=9.68, p<.001 Spain Z=8.16, p<.001 Denmark Z=5.06 p=.02 UK Z=10.2 p<.001 Netherlands Z=-7.73 p<.001 ***COM-B outcomes results summary:*** None ***Differences by demographics:*** Compared to older people, younger people spent more time at home in Italy, Spain, and the UK. Degree holders spent more time at home in in Italy and Denmark, compared to those who didn't hold a degree.	

			home location (determined using DBSCAN). Maximum distance travelled from home: The maximum distance travelled from home location Physical distancing: The maximum number of Bluetooth-enabled nearby devices **COM-B outcomes measured:** None				
Community level interventions							
(6) Davies R, Weinman J, Rubin GJ. (2023) Observed and self-reported COVID-19 health protection behaviours on a university campus and the impact of a single simple intervention. J Public Health. doi: 10.1093/p	January 23 2023	London /England 1 December 2020 and 22 March 2021.	**Design**: Single-arm pre- and post-intervention **Sample**: 311 people were observed on day one and 375 people were observed on day two.; All students and staff of the University. **Intervention**: Installation of clear signage to university building entrance stating the mandatory policy for mask wearing, hand-hygiene and social distancing within the building. **Comparator:**	***Exposure*** **Source:** Researchers; university **Method of dissemination:** 1) Informational mode of delivery 2) Visual information mode of delivery 2)Public notice mode of delivery ***Comparator*** N/A	***Exposure*** Increase knowledge and salience of appropriate behaviours **Behaviour change wheel intervention type:** Persuasion; environmental restructuring ***Comparator*** N/A	Observed physical distancing was significantly better on day two of the experiment, after the signage was in place (54.8% vs. 7%; $\chi 2 = 65.5$, $p<0.00001$) ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	Serious

ubmed/fdac147. Epub ahead of print. PMID: 36694345.			No signage was erected at the entrance. **Target Behaviour:** Physical distancing **Key outcome**: Objective outcome Physical distancing directly observation by the researchers. **COM-B outcomes measured:** None				
(25) Shiraly, R., Khoshdel, N., Jeihooni, A.K. et al. Nudging physical distancing behaviors during the pandemic: a field experiment on passengers in the subway stations of shiraz, Iran. BMC Public Health 22, 702 (2022).	07 April 2022	Crowded subway stations of Shiraz, southern Iran, Jan 5-13, 2021	Natural experimental study, participants assigned to one of three conditions. **Sample:** Individuals travelling on ascending or descending escalators, having someone in front when stepping up or down the escalator and judged to be able to keep their distance; n = 1900 observations in final sample **Intervention:** Environmental nudges as threat appeal (3 staff at site with protective clothing, face mask, overtly cleaning surfaces, offering alcohol sanitizers to passengers, no verbal education) (n = 675) Verbal advice as coping message (requesting passengers to keep physical distance to protect against	***Exposure*** **Source:** Researchers **Method of dissemination:** Human interactional mode of delivery; Face to face mode of delivery ***Comparator*** Not applicable	***Exposure*** Increase salience of threat, modelling of preventive behaviours, prompt behaviour, increase behavioural control. **Behaviour change wheel intervention type**: Persuasion; environmental restructuring ***Comparator*** Not applicable	People were two times more likely (OR 2.0, 95% CI 1.5–2.7, P < 0.001) to keep a safe distance of 1.2 m or more from the traveller in front under intervention conditions compared with those who received no intervention. When verbal advice was used, passengers were 2.6 times more likely (OR 2.6, 95% CI 1.8–3.7, P < 0.001) to keep a safe distance of 1.2 m or more from other passengers compared received no intervention. The verbal advice condition intervention was more influential compared with threat-appeal intervention (OR 1.5, 95% CI 1.1–2.1, = 0.022).	Moderate

https://doi.org/10.1186/s12889-022-13184-y			COVID-19, staff only wore masks) (n = 370) **Comparator:** No intervention (n = 855) **Target behavior:** Physical distancing **Key Outcomes:** Objective outcome. Physical distancing as the sum of number of steps between observed passenger and person in front on escalator while in stable position ("safe" is distance is >=3 steps) **COM-B outcomes measured:** None			***COM-B outcomes results summary:*** None. ***Differences by demographics:*** None reported	
(26) de Ridder, D., Aarts, H., Benjamins, J., Glebbeek, M. L., Leplaa, H., Leseman, P., ... & Zondervan-Zwijnenburg, M. (2022). "Keep your distance	07 December 2021	Utrecht University, Utrecht, The Netherlands; 6-week period in fall 2020	**Design**: sequential case-control cohort design with three sequences of control (A) and experimental (B) weeks **Sample**: All people visiting a university campus during the study were eligible but mostly university staff and students. **Intervention**: During intervention weeks, people who were in the	**Exposure** **Source:** Researchers, university **Method of dissemination:** (a) Electronic environmental object mode of delivery; (b) Public notice mode of delivery; (c) Visual informational mode of delivery **Comparator**	**Exposure** Prompt appropriate behaviour; aim to induce empathy with an empathy prompt. **Intervention type**: Persuasion; environmental restructuring **Comparator**	**Primary outcome results summary:** Distances between people (as measured by average safety in a frame) were significantly higher in the first experimental week compared to control weeks (coefficient = 0.6, SE=0.2, p=.002). Distances between people were lower in the second experimental week compared to control (coefficient =-.08, SE=.02, p<.001). There was no difference in distances between people in the third	Moderate

for me": A field experiment on empathy prompts to promote distancing during the COVID-19 pandemic. *Journal of community & applied social psychology*, *32*(4), 755-766. https://doi.org/10.1002/casp.2593			passing by or going into the lecture hall were exposed to: (a) a social robot encouraging people to keep distance in response to facial recognition of people entering the main entrance of the lecture hall (note that halfway through the experiment, existing university regulations about wearing face masks at campus became stricter with more frequent wearing of face masks as a result; this made face recognition impossible and at that point the robot was reprogrammed to express text at regular intervals); (b) pictures of student and staff models with a text expressing a prompt for empathy-based distancing (e.g., "I have asthma. Keep your distance for me") printed on life-size (85 _ 200 cm) banners and placed near the main entrance of the lecture hall; and (c) a reel of movie clips of the same models with the same texts shown on screens (_100 _ 200 cm) placed close to the entrance of the main rooms in the lecture hall and on a large led screen (_200 _ 300 cm) at the square outside the lecture hall. **Comparator:**	N/A	N/A	experimental week compared to control. ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	

			During control weeks, the robot and banners were removed and movie screens were black. **Target Behaviour:** Physical distancing **Key outcome**: Inter-person physical distancing from camera recordings at designated areas (square outside college hall, main entrance lecture hall, and entrance lecture rooms) which were taken between 8:00 a.m. and 6:00 p.m. on weekdays. Objective measurement. The average of all distances <2.5 m within a frame (cluster mean distance) the average safety within a frame calculated by the weighted distances have a 0–1 scale (with averages closer to 1 representing safer distances) according to the exponential function 1–1/(1 + exp(4*[distance – 1])) **COM-B outcomes measured:** None				
(27) Bahety, G., Bauhoff, S., Patel, D., &	November 2021	Bihar, India; between August 17 and	**Design**: Randomized controlled trial. There were 10 treatment arms: 5 message types x 2 timing variations.	***Exposure*** **Source:** Researchers	***Exposure*** Appeal to different emotions, such as fear (by making the threat of pandemic salient) or	Pooling the results of all treatment arms compared to control, there was no evidence that sending SMS messages increased uptake	Moderate

Potter, J. (2021). Texts don't nudge: An adaptive trial to prevent the spread of COVID-19 in India. Journal of development economics, 153, 102747. https://doi.org/10.1016/j.jdeveco.2021.102747		October 20, 2020.	Participants were randomly assigned to 10 rounds of treatment for each behaviour or control. **Sample**: Eligible participants were the users of phone numbers that were entered into birth registries at health centers in 15 out of 20 blocks in Saran between August 2019 and February 2020. About 75% of respondents were male with an average age of 31 years. Less than 1/3 unemployed, and most of those who worked did so in a manual job. Eighty-six percent of respondents can read SMS in Hindi, but 36% do not ever read text messages. Less than a third read SMS daily in the week prior to the interview. **Intervention**: There were 10 treatment arms: 5 SMS message types x 2 timing variations (2 morning texts at 7-8am and 10-11am OR morning and evening texts at 7-8am and 6-7pm). SMS messages were framed as neutral (simple, directed advice e.g. "Coronavirus is here. Outside the house, keep a distance of at least two arms from others"), framed as negative consequences for the community of not	**Method of dissemination:** Messaging mode of delivery ***Comparator*** Not applicable	prosocial motivation (by highlighting externalities of the preventive actions). **Behaviour change wheel intervention type**: Persuasion ***Comparator*** Not applicable	of handwashing. Compared to control where uptake of reported physical distancing was 36%, uptake of physical distancing across treatment arms decreased by 0.3% (p>.05). The lack of effect of SMS messages was demonstrated whether using administrative delivery reports on text message receipt as the endogenous variable in a treatment-on-the-treated specification or self-reported receipt of any COVID-related message. There was also no consistent evidence of differences between the control condition or treatment arms targeting physical distancing when the different treatment arms were compared to control in separate analyses. There was no difference in physical distancing uptake when two messages were received in the morning compared to one message in the morning and one in the evening. ***COM-B outcomes results summary:*** There was no difference in knowledge of social distancing between control group (49%) and treatment	

			adhering (public loss frame), framed as positive consequences for the community of adhering (public gain frame), framed as negative consequences for the individual's family of not adhering (private loss frame), framed as positive consequences for the individual's family of adhering (public gain frame). They received four text messages over the course of two days between August and October 2020. **Comparator:** No messages. **Target Behaviour:** Physical distancing **Key outcome**: Subjective outcome. Open-ended question, "What are you doing to protect against the virus?" Responses were coded as compliant with physical distancing (keeping two arms distance) and handwashing (washing hands with soap regularly) based on whether the respondent mentions each practice. **COM-B outcomes measured**: Knowledge - open ended question asking about what			group (49%) (pooled across all treatments). When examining individual treatment arms, there were also no differences between control group and any individual treatment group. ***Differences by demographics:*** None reported	

			respondents know about preventive measures. Exact item not provided.				
(28) Blanken, T.F., Tanis, C.C., Nauta, F.H. *et al.* Promoting physical distancing during COVID-19: a systematic approach to compare behavioral interventions. *Sci Rep* 11, 19463 (2021). https://doi.org/10.1038/s41598-021-98964-z	August 29-31, 2021	An art fair in De Kromhouthal, Amsterdam, the Netherlands	**Design:** Naturalistic experiment **Sample:** 787 individuals visited the art fair, of whom 639 participated in study and wore a Physical distancing Sensor **Interventions:** The art fair had three different walking directions conditions (bidirectional, unidirectional, no walking directions). In addition, within the walking direction conditions, some supplementary interventions were applied such that in the walking bidirectional condition, participants could also be assigned to receive a face mask, be subject to a buzzer if visitor within 1.5 m of another, or no supplementary intervention. Within the unidirectional walking direction condition, participants could also be assigned to be subject the buzzer if visitor within 1.5 m of another, or no supplementary intervention. In the no walking direction condition, participants were subject to the buzzer if visitor within 1.5 m of another.	***Exposure*** **Source:** Researchers **Mode of delivery**: Environmental change mode of delivery; Wearable stimulus mode of delivery ***Comparator*** Not applicable	***Exposure*** Prompt the precautionary behaviour, negative reinforcement of violating precautionary behaviours, direct feedback on violations of the precautionary behaviour, restructuring of the environment **Behaviour change wheel intervention type**: Environmental restructuring; Enablement ***Comparator*** Not applicable	People in the no walking directions condition were more likely to form a higher number of contacts than those in the condition with unidirectional walking directions (*OR* = 1.66, 95% CI [1.25, 2.17]). People in the unidirectional walking condition were no more likely to form contacts than those in the bidirectional walking condition (*OR* = 0.99, 95% CI [0.75, 1.26]). People in the buzzer condition were more likely to form a higher number of contacts than in the no supplementary intervention condition (*OR* = 1.24, 95% CI [0.95, 1.55]). However, once participants were given a demonstration of the buzzer and the buzzers were programmed to give immediate feedback, people in the buzzer condition were less likely to form a higher number of contacts than in the no supplementary intervention condition (*OR* = 1.43, 95% CI [1.06, 1.91]). This suggests that immediate feedback of being less than	Serious

			Comparator: No walking directions and no supplementary intervention **Target behavior:** Physical distancing **Key outcomes:** Number of unique contacts, defined as two visitors coming within 1.5 m from each other **COM-B outcomes measured:** None			1.5 metres distance from someone can promote physical distancing. There was no difference in the number of contacts formed between people who received a mask to wear and those who did not receive a mask to wear (*OR* = 1.05, 95% Credible Interval [0.81, 1.33]). ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	
(29) Chutiphimon H, Thipsunate A, Cherdchim A, Boonyaphak B, Vithayasirikul P, Choothong P, Vichathai S, Ngamchaliew P, Vichitkunakorn P	17 November 2020	Prince of Songkla University, Thailand. Between 6–9 August 2020	**Design:** A quasi-experiment with a comparative behavioral observation study. **Sample**: The first 100 participants per condition in a university canteen, starting at 11.00 a.m. and ending at 1.00 p.m. in order to minimize over- and underpopulation, which could have potentially confounded the results. The most frequent age range was 19–64 years, 80.0% were not wearing university uniforms, 58.5% were female.	***Exposure*** **Source:** Researchers **Mode of delivery**: Environmental change mode of delivery; Textual mode of delivery; visual mode of delivery ***Comparator*** **Source:** Researchers **Mode of delivery**: Environmental	***Exposure*** Prompt the precautionary behaviour, restructuring of the environment, increase threat appeal of virus, provide performance standards. **Behaviour change wheel intervention type**: Environmental restructuring ***Comparator*** Prompt the precautionary behaviour, provide performance standards	The proportion of people failing to physically distance significantly decreased between the first marker and the 5th marker in all conditions (34.2-38.8% at 4th and 5th markers vs 85.2-55.2% at 1st-3rd markers, p<.001). There was no difference in the interventions (i.e., fearful picture, red one-way arrow sign, and norm-speech sticker) in promoting physical distancing compliance compared with the control intervention in the university canteen.	Serious

(2020). Effectiveness of Innovation Media for Improving Physical Distancing Compliance during the COVID-19 Pandemic: A Quasi-Experiment in Thailand. *Int J Environ Res Public Health, 17(22):8535*. https://doi.org/10.3390/ijerph17228535.			**Intervention**: One of three interventions where the conventional standing point sticker (a footprint) was replaced with: 1) A fearful picture of the COVID-19 virus was the standing point 2) A red one-way arrow sign was placed between conventional interventions to instruct on direction 3) A norm-speech sticker was used to show phrases that could encourage physical distancing compliance e.g. "Please maintain a distance from other customers" **Comparator**: A conventional sign was a footprint standing sign to demonstrate appropriate distance from others in the canteen. **Target Behaviour:** Physical distancing **Key outcome**: Objective outcome. Proportion of people who failed to meet physical distancing criteria at five different marking points. Physical distancing was defined as at least a 1.0-m distance among people. People were defined as maintaining positive physical distancing followed these criteria: 1. Standing within the marking position during the process of queueing; 2.	change mode of delivery	**Behaviour change wheel intervention type**: Environmental restructuring	***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	

			Moving out of the marking position for 3 s or less each time was acceptable. **COM-B outcomes measured:** none				
Individual level interventions							
(11) Blackman A, Hoffmann B (2022) Diminishing returns: Nudging Covid-19 prevention among Colombian young adults. PLOS ONE 17(12): e0279179. https://doi.org/10.1371/journal.pone.0279179	22 December 2022	Bogota, Colombia, May to June, 2020	**Design**: 2x2 factorial randomized controlled trial **Sample**: 1349 students aged 18+ studying at more than 40 universities in Bogota. 318 in private arm, 327 in public arm, 346 in combined arm, 230 in pure control arm **Intervention** All participants attended an information session in a zoom meeting where they watched a pre-recorded slide deck presentation with information about health risks of COVID-19 and appropriate non-pharmacological interventions to reduce transmission. Then, participants were sent 3 email messages over the course of 7 days with either a control or treatment intervention. All three interventions had common contextual information and	***Exposure*** **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery ***Comparator*** **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	***Exposure*** Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	**Primary outcome results summary:** There was no significant change in staying home from the control in compliance between the personal benefits (b=.01, SE=.13, p>.05), public benefits (b=.06, SE=.13, p>.05), or combined private and public benefits (b=-.10, SE=.14,p>.05) conditions. There was no significant change in physical distancing from the control in compliance between the personal benefits (b=.51, SE=1.68, p>.05), public benefits (b=.1.57, SE=2.05, p>.05), or combined private and public benefits (b=2.19, SE=1.52, p>.05) conditions. **COM-B results summary:** The personal benefits treatment increased perceived likelihood of infection (b=.20, SE=.05,	Critical

			recommended five non-pharmacological interventions (NPI), only differed in motivation for complying: - Personal benefits - Public benefits - Combined personal and public benefits - Neither (pure control) **Comparator:** Information on irrelevant subject **Target Behavior:** Physical distancing and staying home **Key outcome:** Self-reported rates of compliance in the past 7 days of physical distancing (% of times over past 7 days maintained 2 meters' distance) and staying home (days over past 7 that stayed home except for critical trips). Subjective outcome. **COM-B outcomes measured:** Using a four-point Likert scale (from 1 to 4), with one being the lowest level and four the highest, respondents indicated the following: likelihood of			p<.01), concern for self (b=.13, SE=.07, p<.05), concern for friends (b=.17, SE=.07, p<.05), and concern for community (b=.17, SE=.07, p<.05). The public benefits treatment and combined benefits treatment both only had a significant effect on perceived likelihood of infection: public benefits (b=.17, SE=.05, p<.01); combined benefits (b=.17, SE=.04, p<.01). There was no difference in intended compliance across conditions. ***Differences by demographics:*** Not reported	

			infection, their self-assessed likelihood of contracting Covid-19; concern self, their level of concern about getting seriously ill from Covid-19; concern friends, their level of concern about infecting friends who then become seriously ill; concern household, their level of concern about infecting members of their household who then become seriously ill; and finally, concern community, their level of concern about infecting members of their community other than family and friends who then become seriously ill. Intended compliance: Intentions to physically distance (% of times over next 7 days intend to maintain 2 meters' distance) and stay home (days over past 7 that intend to stay home except for critical trips)				
(12) Ludema C, Rosenberg MS, Macy JT, Kianersi S, Luetke M, et al. (2022)	20 December 2022	Indiana University's Bloomington campus, Fall 2020	**Design**: Randomized controlled trial **Sample**: 1397 undergraduate students (>18 years, current IU students, and residents of Monroe County, Indiana) →	**Exposure** **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of	**Exposure** Increase awareness of COVID-19 immunity, make risk salient **Behaviour change wheel intervention type:**	**Primary outcome results summary:** Two weeks after antibody test results were reported to participants in the immediate results condition, chi-square tests	Serious

Does receiving a SARS-CoV-2 antibody test result change COVID-19 protective behaviors? Testing risk compensation in undergraduate students with a randomized controlled trial. PLOS ONE 17(12): e0279347. https://doi.org/10.1371/journal.pone.0279347			results reported from 1076 (77%) who completed baseline and baseline antibody test. The median age of participants was 20 years (IQR 19–21) and the ages of study participants largely aligned with traditional undergraduate student ages of 18–21 (90.6%). The majority of study participants identified as women (64%). 79% white (8% Asian, 1% Black)), 64% women, 32% lived on-campus, 24% affiliated with Greek student organizations. **Intervention**: Receive baseline Sars-Cov-2 antibody test results immediately **Comparator:** Receive results after 4 weeks **Target Behaviour:** Avoiding social events, staying home, physical distancing in public **Key outcome**: Engagement in 1) avoiding social events, 2) staying at home from work/school, and 3) ensuring physical distancing in public in the past 7 days on a scale of 1-5:	delivery **Comparator** **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery (delayed)	Persuasion **Comparator** Increase awareness of COVID-19 immunity, make risk salient **Behaviour change wheel intervention type:** Persuasion	indicated that participants in this condition did not report significantly higher or lower engagement in staying home from work and school, avoiding social events, or ensuring physical distancing in public. ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** None reported	

			Never =1 to Always=5. Subjective outcomes. **COM-B outcomes measured:** None				
(30) Buller D, Walkosz B, Henry K, Woodall WG, Pagoto S, Berteletti J, Kinsey A, Divito J, Baker K, Hillhouse J (2022). Promoting Physical distancing and COVID-19 Vaccine Intentions to Mothers: Randomized Comparison of Information Sources in Social Media Messages. *JMIR Infodemiology*,	23 August 2022	United States. Mothers were recruited to the study from a sample who had previously participated in a trial evaluating a social media campaign. January 25 to March 26, 2021	**Design:** Randomized pretest–posttest single-factor-design study with 4 assessments. **Sample**: Overall, 303 mothers were enrolled. Mothers were middle aged (range 28-64 years); well educated, with 160 (55.7%) completing college; and moderately affluent, with 150 (56.4%) having incomes over US $80,000 (see Tables 1-3). Nearly all were non-Hispanic White. **Intervention**: Mothers were randomly assigned to 1 of 3 experimental conditions that varied in the type of sources in the posts (government health agencies, near-peer parents, or news media). Mothers received a series of Facebook posts for 9 weeks starting after randomization. Each post from 1 of the 3 sources contained text with a link to related information on 4 topics: the 2 primary outcomes (NPIs and COVID-19 vaccination), digital and media literacy, and mother–daughter	**Exposure** **Source:** Government health agencies, near-peer parents, or news media **Method of dissemination:** Electronic mode of delivery; Textual informational mode of delivery. **Comparator** **Source:** Government health agencies, near-peer parents, or news media **Method of dissemination:** Electronic mode of delivery; Textual informational mode of delivery.	**Exposure** Provide credibility for message; increase knowledge of PHSMs; increase knowledge to combat misinformation; improve skills such as active listening, self-disclosure, empathy, and conflict management. **Behaviour change wheel intervention:** Persuasion **Comparator** Provide credibility for message; increase knowledge of PHSMs; increase knowledge to combat misinformation; improve skills such as active listening, self-disclosure, empathy, and conflict management. **Behaviour change wheel intervention:** Persuasion	Reports of physical distancing for both mothers (b= –0.10, 95% CIs [–0.12, –0.08], p<.001) and daughters (b= –0.10, 95% CIs [–0.12, –0.03], p<.001) decreased over the 9 weeks of the study. The decline in physical distancing by daughters over time was greater when mothers were in the near-peer parents group (b=–0.04, 95% CI –0.07 to 0.00, p=.03) but decline less when mothers were in the government agency group (b=0.05, 95% CI 0.02-0.09, p=.003). There was no difference in rate of decline in physical distancing in mothers between treatment groups. Mothers who rated the assigned information source as credible reported greater physical distancing for self (b=0.29, 95% CI 0.09-0.49, P<.01) and daughters (b=0.31, 95% CI 0.11-0.51, P<.01). The higher perceived credibility of the individual posts rated	Moderate

2(2):e36210. https://doi.org/10.2196/36210.			communication. Mothers stayed in the groups for 9 weeks. **Comparator:** The 3 interventions were compared to each other. **Target Behaviour:** Physical distancing **Key outcome**: Subjective outcome. Assessment of frequency in the past 3 weeks of physical distancing behaviors by self and daughters on a scale from 1 (never) to 5 (always). Physical distancing behaviours included: studied or worked remotely from home; deliberately canceled or postponed a social event; avoided places where people gather; kept at least 6 feet away from other people; ate indoors at a restaurant; attended a social event indoors with 10 or more people who do not live in my house. **COM-B outcomes measured:** The following COM-B variables were measured on a scale from 1 (strongly disagree) to 5 (strongly agree): Risk perceptions severity, risk perception susceptibility, self-efficacy for performing PHM behaviours, response			during the intervention also predicted increased physical distancing by daughters (b=0.23, 95% CI 0.04-0.42, P=.02) but not mothers (b=0.07, 95% CI –0.09 to 0.23, P=.37). **COM-B results** Self-efficacy for vaccination of self and daughters increased, and response costs for NPIs, decreased. There was also some evidence that perceived risk increased over time, particularly with the severity of COVID-19 increasing over time; however, perceived susceptibility declined over time. By contrast, self-efficacy and response efficacy for NPIs did not change. Note: no inferential statistics were provided on COM-B outcomes, nor did the authors examine whether changes in COM-B factors contributed to changes in social distancing. ***Differences by demographics:*** Mothers reported increased social distancing (self: b=0.40, 95% CI 0.28-0.52, P<.001; daughters: b=0.31, 95% CI 0.19-0.42, P<.001) over baseline at the 9-week	

			efficacy and response cost for PHM behaviours. Source credibility of COVID-19 information from government, near-peer parents, and news media was assessed. Exposure to media.			posttest when they were more liberal than conservative. Political leaning moderated differences by information source for reports of social distancing by daughters. Mothers who were more liberal and assigned to the near-peer parents group, reported greater social distancing by daughters at the final posttest (b=0.19, 95% CI 0.01-0.37, P=.04), while more liberal mothers in the government agency group reported reduced social distancing at the final posttest (b=–0.25, 95% CI –0.43 to –0.07, P<.01).	
(31) van Empelen P, Preuhs K, Bakker LA,Buursma P, Andree R, Anraad C, et al. (2022) Improving behavioural compliance with the COVID-19 precautionary measures by means of innovative	July 28, 2022	Netherlands May 10th and May 23rd 2020.	**Design:** Randomized controlled trial **Sample**: N=424 participants consented to participate, who were allocated to the intervention (n = 181) or control (n = 243) group. Data of 339 participants were analysed (n = 149 intervention, n = 190 control). Most participants were female, were born in the Netherlands, did not work in healthcare and had someone in their environment with an increased risk of becoming ill from COVID-19. **Intervention:** Participants made volitional	***Exposure*** **Source:** Researchers **Method of dissemination:** Website mode of delivery; Pull mode of delivery ***Comparator*** Not applicable	***Exposure*** Situational cueing of behaviour; increase behaviour regulation by reducing obstacles **Behaviour change wheel intervention**: Enablement ***Comparator*** Not applicable	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=4.03, SD=0.80) than the control condition (M=3.93, SD=0.91, p=.366). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.23, SD=1.09) than the control condition (M=4.12, SD=1.11, p=.309). At follow-up, behaviour compliance for staying home as much as possible	Serious

communication strategies: Social experimental studies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 1**			implementation plans using "if-then" statements by choosing up to three situations that may be difficult to comply with the COVID-19 precautionary measures and one solution per situation (from 2-5 possible presented solutions). **Comparator**: No experimental manipulation. **Target Behaviour**: Keep 1.5 meters away from other people; Avoid people who are vulnerable; Stay at home as much as possible; Receive as little visitors as possible; Avoid crowds **Key outcome**: Subjective outcome. Self-reported frequency of behavioural compliance in the past 7 days with the precautionary measures was assessed at 1-week follow-up with one item per precautionary measure (e.g., "Keep 1.5 meters away from other people"). **COM-B outcomes measured:** Self-efficacy for each precautionary measure, intention to comply with the COVID-19, perceived			was not significantly different in the intervention condition (M=3.79, SD=1.11) than the control condition (M=3.49, SD=1.22, p=.014) after Holm-Bonferroni correction for multiple testing. At follow-up, behaviour compliance for receiving as little visitors as possible was significantly higher in the intervention condition (M=4.06, SD=1.79) than the control condition (M=3.42, SD=1.70, p=.212). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the intervention condition (M=3.16, SD=1.72) than the control condition (M=3.46, SD=1.70, p=.239). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=4.34, SD=0.98) than the control condition (M=3.98, SD=1.20, p=.003). ***COM-B outcomes results summary:*** When adjusting for multiple testing by means of the	

			susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19 infection, response efficacy.			Holm-Bonferroni correction, at post-test, participants in the intervention group had a higher perceived vulnerability of others to become infected with COVID-19 (b=-.19, SE=.07, t=-2.78, p=.006). Participants in the intervention group reported a higher perceived severity of becoming infected with COVID-19 (b=-.39, SE=.11, t=-3.65, p<.001). No other COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** Not reported	
(32) van Empelen P, Preuhs K, Bakker LA,Buurs ma P, Andree R, Anraad C, et al. (2022) Improving behavioural compliance with the COVID-19 precaution	July 28, 2022	Netherl ands 15th of May and 7th of June 2020	**Design:** Randomized controlled trial **Sample:** Participants were randomly allocated to the behavioural journalism condition (n = 290) or control (n = 303) group. In total, data of 449 participants were analysed (n = 212 intervention, n = 235 control). Most participants were female, were born in the Netherlands, did not work in healthcare and had someone in their	***Exposure*** **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery. ***Comparator***	***Exposure*** Provide behavioural norms; provide positive role models of precautionary behaviours; increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people. **Behaviour change wheel intervention:** Modelling; Persuasion ***Comparator***	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=4.01, SD=0.85) than the control condition (M=4.02, SD=0.75, p=.801). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.19, SD=1.02) than the control	Serious

ary measures by means of innovative communication strategies: Social experimental studies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 2**			environment with an increased risk of becoming ill from COVID-19 **Intervention:** Offered four short films (ranging from 1:22 minutes to 1:40 minutes) comprising: a male student, a young working couple, a pregnant woman and a healthcare worker. In each scenarios the depicted individuals shared the impact that COVID-19 has on their lives, including taking precautionary measures and why they believed it to be important to comply with the precautionary measures. Participants were instructed to watch at least one of the films while being allowed to watch as many of the role model stories as they felt seemed relevant or interesting to them. **Comparator:** No experimental manipulation. **Target Behaviour**: Keep 1.5 meters away from other people; Avoid people who are vulnerable; Stay at home as much as possible; Receive as little visitors as possible; Avoid crowds **Key outcome**: Subjective outcome. Behavioural compliance with the precautionary measures was assessed at 1-	Not applicable	Not applicable	condition (M=4.12, SD=1.02, p=.352). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the intervention condition (M=3.59, SD=1.72) than the control condition (M=3.46, SD=1.70, p=.239). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=4.24, SD=0.92) than the control condition (M=4.24, SD=0.91, p=.974). ***COM-B outcomes results summary:*** No COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** Not reported	

			week follow-up with one item per precautionary measure (e.g., "Keep 1.5 meters away from other people"). **COM-B outcomes measured:** Self-efficacy for each precautionary measure, intention to comply with the COVID-19, perceived susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19 infection, response efficacy.				
(33) van Empelen P, Preuhs K, Bakker LA,Buurs ma P, Andree R, Anraad C, et al. (2022) Improving behavioural compliance with the COVID-19 precaution ary measures by means of innovative communic ation	July 28, 2022	Netherl ands 16th of May and 7th of June 2020	**Design:** Randomized controlled trial **Sample:** 578 of 623 participants consented to participate, which were then allocated to the intervention (n = 261) or control (n = 317) group. In total, data of 428 participants were analysed (n = 196 intervention, n = 232 control). Participants were eligible if they were from 18 to 40 years old. Most participants were Dutch females who finished higher education. **Intervention:** Watching a short film (1:42 min.) depicting a 70-year old woman who explains why she belongs to the at-risk population (due to her age	***Exposure*** **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery. ***Comparator*** Not applicable	***Exposure*** Elicit empathy for vulnerable people; provide positive reinforcement for behavior (incentives); provide prompt for behaviour performance. **Behaviour change wheel intervention:** Persuasion; Incentivisation ***Comparator*** Not applicable	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=3.65, SD=1.07) than the control condition (M=3.72, SD=1.03, p=.801). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.08, SD=1.00) than the control condition (M=4.04, SD=1.09, p=.918). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the	Serious

strategies: Social experimentalstudies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 3**			and having asthma) and that she still depends on others to follow precautionary measures to be protected. Participants who indicated their readiness to protect others were offered a gift as credit for wanting to do so. The gift also served as a reminder for taking precautionary measures and comprised a blue silicone band stating "Door mij coronavrij!" [Corona-free through me!"]. **Comparator:** No experimental manipulation. **Target Behaviour**: Keep 1.5 meters away from other people; Avoid people who are vulnerable; Stay at home as much as possible; Receive as little visitors as possible; Avoid crowds **Key outcome**: Subjective outcome. Behavioural compliance with the precautionary measures was assessed at 1-week follow-up with one item per precautionary measure (e.g., "Keep 1.5 meters away from other people"). **COM-B outcomes measured:** Self-efficacy for each precautionary measure,			intervention condition (M=3.59, SD=1.62) than the control condition (M=3.48, SD=1.63, p=.511). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=3.88, SD=1.33) than the control condition (M=3.76, SD=1.30, p=.193). ***COM-B outcomes results summary:*** After adjusting for multiple comparison by means of the Holm-Bonferroni correction, participants in the empathy induction group perceived others to be more vulnerable to COVID-19 infection compared to participants in the control group (b=-.17, SE=.06, t=-2.85, p=.005). No other COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** None reported	

			intention to comply with the COVID-19, perceived susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19 infection, response efficacy.				
(34) Kitamura, Shuhei and Yamada, Katsunori, Social Comparisons and Cooperation during COVID-19. Available at SSRN: https://ssrn.com/abstract=3978998 or http://dx.doi.org/10.2139/ssrn.3978998	April 17 – May 5, 2020	Residents aged 20-59 living 1 of 7 prefectures in Japan (Chiba, Fukuoka, Hyogo, Kanagawa, Osaka, Saitama, Tokyo)	**Design:** Crossover randomized controlled trial **Sample:** 2868 participants (included in final analysis after those who did not receive assigned intervention, did not provide post-treatment outcome information) Final sample of 2868 participants, balanced on age, education, marital status, per capita household income, negative income shock, residential location between treatment arms (apparently presented in Supplementary material, but not accessible at this time) **Intervention:** Randomized to one of four treatment arms (basic information only, basic information + tailored information about each individual's relative outing time). Two conditions were based on social comparisons	**Exposure** **Source:** Either Prime Minister Shinzo Abe or Emperor Naruhito **Method of dissemination:** Textual mode of delivery; At-a-distance mode of delivery; Visual informational mode of delivery **Comparator** **Source:** Either Prime Minister Shinzo Abe or Emperor Naruhito **Method of dissemination:** Textual mode of	**Exposure** Increase knowledge and salience of physical distancing guidelines, increase outcome expectancies, induce salience of compliance or noncompliance compared with others by social comparison, increase credibility and authority of the message. **Behaviour change wheel intervention type**: Persuasion **Comparator** Increase knowledge and salience of physical distancing guidelines, increase outcome expectancies, induce salience of compliance or noncompliance compared with others by social comparison, increase credibility and authority of the message.	**Primary outcome results summary:** There were no significant effects between Prime minister with feedback and the Prime minister without feedback conditions. For participants whose outing time during the first week was above the median value, receiving a message from the Emperor with feedback reduced their unnecessary outing time by 26 percent from the 159 minutes of unnecessary outing time in those who received a message from the Emperor without feedback. However, for participants whose total outing time was below the median value, receiving a message from the Emperor with feedback increased their total outing time by 39% percent from the 129 minutes of total outing time in those who received a message from	Serious

			where participant's own weekend outing time was either compared to the median outing time for the prefecture, or no social comparison). Two conditions were based on sender of information (either Prime Minister or Emperor). For all four conditions, participants received the same message on the ongoing problems of the pandemic and were told that their behaviours would affect the pandemic trajectory. The messages included actual statements made by the Prime minister and Emperor Naruhito. Findings were stratified by whether the median outing time measured at baseline was above median (AB) or below/equal to median (BE). **Comparator:** All intervention conditions were compared to each other, there was no pure control **Target intervention:** Social distancing **Key outcome:**	delivery; At-a-distance mode of delivery; Visual informational mode of delivery	**Behaviour change wheel intervention type**: Persuasion	the Emperor without feedback. Meanwhile, unnecessary outing time was unaffected. Although the back-firing effect of information feedback was expected, the fact that we only found it in the Emperor condition was unexpected. Contrary to our expectations about the power of the messenger, we found no significant effects of changing outing behaviors between Prime minister feedback condition vs Emperor feedback conditions. There were also no differences found between Prime minister without feedback vs Emperor message without feedback. **COM-B outcomes results summary:** None ***Differences by demographics:*** None reported	

			Self-report outing time or time spent outside the home (total and unnecessary, both in minutes), used as a proxy for cooperation with social distancing measures "Necessary" tasks = going to work, shopping for groceries, visiting hospital, attending school. Subjective measure. **COM-B outcomes measured:** None				
(35) Falco P, Zaccagni S (2021). Promoting physical distancing in a pandemic: Beyond good intentions. *PLoS One*, *6(12). D*oi: 10.1371/journal.pone.0260457	02 December, 2021	March 25 and April 7, 2020	**Design:** Randomized controlled trial **Sample:** A representative sample of 29,756 Danish residents between the age of 18 and 69, who represent close to 1% of the population. **Intervention:** Four alternative ways of framing the recommendation to "stay home as much as possible" were tested. The first frame ("you") focuses on the potential consequences of the individual. The second frame ("family") focuses on the consequences for his/her family. The third frame ("others") focuses on the consequences for other people in general. The fourth frame ("country")	***Exposure*** **Source:** Danish public authorities **Method of dissemination:** Electronic mode of delivery; Textual informational mode of delivery. ***Comparator*** Not applicable	***Exposure*** Increase motivation for physical distancing by making positive consequences of the behavior salient; making negative consequences of not performing the behaviour salient; prompting the behaviour. **Behaviour change wheel intervention type**: Persuasion ***Comparator*** Not applicable	The "you" and "family" conditions result into a 19.7% and a 14.9% increase in the percentage of participants who reported staying home compared to the control group, but these were not significant differences (p = .127 and p = .251 respectively). Overall, there was no effect of the interventions (either framing messages by "you", "family", "others", and "country", or by framing messages as gains or losses) compared to the control group. **COM-B secondary outcome results** The reminder increases respondents' intentions to stay home by 46% when it	Moderate

			focuses on the broader consequences for the country as a whole. For each of the four treatments, two variations were tested. The first was framed as a loss (emphasises the negative consequences of not complying with the recommendation). The second, was framed as a gain **(**emphasises the positive consequences of complying with the recommendation). In addition, a generic reminder to stay home as much as possible was sent without any framing. **Comparator:** A control group receives no reminder. **Target Behaviour:** Physical distancing **Key outcome:** Subjective outcome. Self-reported time spent out of the home the previous day measured in hours in minutes; self-reported maximum distance from home measured in kilometers and meters. **COM-B outcomes measured:** Subjective outcome. Self-reported intended time spent out of the home the previous day measured in hours in minutes; self-reported intended maximum			is framed with respect to personal consequences ($p = 0.007$) and consequences for one's family ($p = 0.008$). It has a lower insignificant effect on intentions when it refers to consequences for other people in general ($p = 0.459$), for the country as a whole ($p = 0.110$), and when it has no specific framing ($p = 0.190$). Changes in intentions do not translate into sizeable changes in actions. As for intentions, the reminders have no significant impact on actions when they focus on "others" ($p = 0.467$), "country" ($p = 0.113$), or have no framing ($p = 0.15$). ***Differences by demographics:*** Participants who self-reported they were in bad health were more than twice as likely to report they will stay home more after receiving a reminder that emphasises risks for family ($p = 0.036$), and the share of those who actually stay home increased by 80% ($p = 0.034$).	

			distance from home measured in kilometers and meters.				
(36) Krpan, D., Makki, F., Saleh, N., Brink, S., & Klauznicer, H. (2021). When behavioural science can make a difference in times of COVID-19. Behavioural Public Policy, 5(2), 153-179. doi.org/10.1017/bpp.2020.48	26 August 2020	United Kingdom and United States April 8, 2020 to April 17, 2020	**Design**: Randomized trial. Participants were randomly allocated to one of five conditions (control and 4 interventions conditions). **Sample**: N=2863 included (males=1401, females=1456, others=6, mean age=45.744) from general population. **Intervention**: Participants were allocated to participate in one of the following interventions: 1) Write a letter to a vulnerable person they knew stating that they would do whatever necessary to reduce COVID transmission and ensure their survival. 2) Write a clear plan to implement a meaningful activity from tomorrow, including necessary steps to ensure they are ready to start and how to overcome obstacles. 3) Read a text article with an economic argument for adhering to strict physical distancing measures for the economy in the long run. 4) Presented with six hypothetical scenarios in which people may violate	***Exposure*** **Source:** Researcher **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery ***Comparator*** No intervention.	***Exposure*** Increasing motivation and intentions for compliance, evoke feelings of collaboration, dispel misconceptions about virus, induce empathy, make risk to others salient). **Behaviour change wheel intervention type**: Persuasion ***Comparator*** No intervention.	General distancing was not significantly different in the Letter condition vs the control (b=-.02, SE=.04, p=.562, 95% CIs [-.10, .05]), in the meaningful activity plan condition vs control (b=-.01, SE=.04, p=.858, 95% CIs [-.08, .07]), in the economy argument condition vs control (b=-.01, SE=.04, p=.789, 95% CIs [-.08, .06]), or in the hypothetical scenario condition (b=.02, SE=.04, p=.563, 95% CIs [-.05, .09]). Number of times leaving the house was not significantly different in the Letter condition vs the control (b=-.07, SE=.05, p=.154, 95% CIs [-.17, .03]), in the meaningful activity plan condition vs control (b=-.04, SE=.05, p=.363, 95% CIs [-.14, .05]), in the economy argument condition vs control (b=-.06, SE=.05, p=.203, 95% CIs [-.16, .03]), or in the hypothetical scenario condition (b=-.04, SE=.05, p=.385, 95% CIs [-.14, .05]). Number of hours spent outside the house was not	Moderate

			behavioural recommendations to reduce COVID transmission (e.g., socializing with neighbours who live in the same building and have been compliant with staying at home). Rate the appropriateness of the actions in the scenario. **Comparator:** Participants in the control condition did not receive any experimental manipulation. **Target behaviour**: Physical distancing; leaving the house; social gathering **Key outcome**: Subjective outcome. General distancing (i.e., the extent to which participants practised physical distancing) was measured on a scale from 1 (Not at all) to 5 (Extremely). Going out times (i.e., how many times people left their house for non-essential reasons) and physical fitness times (i.e., how many times people left their house to exercise) were measured on a scale from 0 (Staying at home all the time) to 11 (More than 10 times) in increments of 1 time.			significantly different in the Letter condition vs the control (b=-.13, SE=.06, p=.041, 95% CIs [-.25, -.01]) after a correction was applied for multiple testing, in the meaningful activity plan condition vs control (b=-.06, SE=.06, p=.333, 95% CIs [-.18, .06]), in the economy argument condition vs control (b=-.07, SE=.06, p=.270, 95% CIs [-.18, .05]), or in the hypothetical scenario condition (b=-.10, SE=.06, p=.106, 95% CIs [-.21, .02]). Number of times leaving the house for exercise was not significantly different in the Letter condition vs the control (b=-.04, SE=.05, p=.372, 95% CIs [-.13, .05]), in the meaningful activity plan condition vs control (b=-.05, SE=.05, p=.313, 95% CIs [-.13, .04]), in the economy argument condition vs control (b=-.08, SE=.04, p=.068, 95% CIs [-.17, .01]), or in the hypothetical scenario condition (b=-.02, SE=.04, p=.662, 95% CIs [-.11, .07]). Number of hours spent outside the house for exercise was not significantly different in the Letter condition vs the	

			Going out hours and physical fitness hours were measured on a scale from 0 (Staying at home all the time) to 11 (More than 10 hours) in increments of 1 hour. Keeping distance (i.e., whether people kept the recommended distance of at least 1.5–2.0 metres or 5–7 feet between themselves and other people if they left the house) measured on a scale from 1 (Strongly disagree) to 7 (Strongly agree). Meeting family and friends (i.e., whether people left their house to meet their family members or friends) and social gatherings (i.e., whether people allowed their family members, friends or other people who do not live with them to visit them) were measured on a dichotomous response scale 0 (No) and 1 (Yes). **COM-B outcomes measured:** Perceived seriousness of disease, health concern if affected by COVID-19, concern for close others, concern for vulnerable others, economic concern,			control (b=-.05, SE=.04, p=.282, 95% CIs [-.13, .04]), in the meaningful activity plan condition vs control (b=-.04, SE=.04, p=.416, 95% CIs [-.12, .05]), in the economy argument condition vs control (b=-.06, SE=.04, p=.160, 95% CIs [-.14, .02]), or in the hypothetical scenario condition (b=-.07, SE=.04, p=.128, 95% CIs [-.15, .02]). Keeping distant was not significantly different in the Letter condition vs the control (b=-.01, SE=.08, p=.941, 95% CIs [-.16, .15]), in the meaningful activity plan condition vs control (b=-.07, SE=.08, p=.368, 95% CIs [-.22, .09]), in the economy argument condition vs control (b=-.06, SE=.08, p=.490, 95% CIs [-.21, .09]), or in the hypothetical scenario condition (b=.08, SE=.08, p=.332, 95% CIs [-.07, .22]). Meeting family and friends was not significantly different in the Letter condition vs the control (b=-.19, SE=.34, p=.581, OR=0.83, 95% CIs [.43, 1.60]), in the meaningful activity plan condition vs control (b=-.16, SE=.33, p=.621, OR=0.85, 95% CIs	

			knowledge about COVID-19, and future intentions to undertake protective behaviours going forward.			[.45, 1.61]), in the economy argument condition vs control (b=-.07, SE=.31, p=.825, OR= 1.07, 95% CIs [.59, 1.94]), or in the hypothetical scenario condition (b=-.32, SE=.33, p=.338, OR=0.73, 95% CIs [.38, 1.40]). Social gathering was not significantly different in the Letter condition vs the control (b=-.27, SE=.35, p=.434, OR=0.76, 95% CIs [.38, 1.51]), in the meaningful activity plan condition vs control (b=-.71, SE=.39, p=.067, OR=0.49, 95% CIs [.23, 1.05]), in the economy argument condition vs control (b=.32, SE=.30, p=.275, OR= 1.38, 95% CIs [.77, 2.46]), or in the hypothetical scenario condition (b=-.86, SE=.33, p=.033, OR=0.42, 95% CIs [.19, .93]) once the correction was applied for multiple testing. **COM-B secondary outcome results:** No mediation effects were identified. ***Differences by demographics:*** Not reported.	

Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.

Table 5a. Summary of studies reporting on effectiveness of interventions in promoting adherence to hand hygiene and respiratory etiquette for COVID-19

Reference	Date released	Setting and time covered	Study characteristics	*Intervention mode of delivery*	*Behaviour change strategy*	Summary of key findings in relation to the outcome	Risk of bias
Population level interventions							
(3) Tan, A. L., Ng, S. H. X., & Pereira, M. J. (2021). Singapore's COVID-19 "circuit breaker" interventions: A description of individual-level adoptions of precautionary behaviours. *Annals of the Academy of Medicine, Singapore*, *50* (8), 613–618. https://doi.org/10.4710	8 August 2021	Singapore February 21, 2020 to May 1, 2020	**Design**: Interrupted time-series **Sample**: General population in Singapore residing in the community, not including foreign workers or imported cases. **Intervention**: Circuit breaker (CB) measures in Singapore that included various forms of mandatory behavioural modifications (e.g. all non-essential workplaces and organisations were mandated to close or implement work-from-home arrangements, required behaviour	**Exposure** **Source:** Singapore government **Method of dissemination:** Informational mode of delivery **Comparator** N/A	**Exposure** Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Behaviour change wheel intervention type:** Coercion; Restriction **Comparator** N/A	Before CB, the proportion of individuals washing hands and using hand sanitizer was on average 83% (standard deviation [SD] 3.2%). During the CB, it increased to 84% (SD 0.8%, P=0.48). This behaviour remained high with no significant difference after CB ***COM-B outcomes results summary:*** None ***Differences by demographics:*** None reported	Critical

2/annals-acadmedsg.2020597			modifications such as face mask-wearing in public areas, personal hygiene via handwashing or hand sanitizer use, and avoidance of crowded areas) with legal penalties such as fines. **Comparator:** Outcomes were compared between the periods before, during and after CB. **Target Behaviour:** Handwashing or hand sanitizer use **Key outcome**: Proportion of participants washing hands or using hand sanitizer **COM-B outcomes measured:** None.				
Community level interventions							
(6) Davies R, Weinman J, Rubin GJ. (2023) Observed and self-reported	January 23 2023	London /England 1 December 2020	**Design**: Single-arm pre- and post-intervention **Sample**:	**Exposure** **Source:** Researchers; university	**Exposure** Increase knowledge and salience of appropriate behaviours **Behaviour change wheel intervention**	**Primary outcome results summary:** Observed adherence to hand hygiene behaviours when entering the building was significantly better on day two	Serious

COVID-19 health protection behaviours on a university campus and the impact of a single simple intervention. J Public Health. doi: 10.1093/pubmed/fdac147. Epub ahead of print. PMID: 36694345.		and 22 March 2021.	311 people were observed on day one and 375 people were observed on day two.; All students and staff of the University. **Intervention**: Installation of clear signage to university building entrance stating the mandatory policy for mask wearing, hand-hygiene and social distancing within the building. **Comparator:** No signage was erected at the entrance. **Target Behaviour:** Hand hygiene was defined as use of hand sanitizer or gel or use of a hand washing station. **Key outcome**: Objective outcome Handwashing and hand sanitizer use directly observation by the researchers. The observer was able to see if the person used their own supply, or if they used a hand	**Method of dissemination:** 1) Informational mode of delivery 2) Visual information mode of delivery 2)Public notice mode of delivery **Comparator** N/A	**type:** Persuasion; environmental restructuring **Comparator** N/A	of the experiment, after our sign was in place (28% vs. 16%; $\chi 2=13.3$, $p=0.0003$). ***COM-B outcomes results summary:*** None ***Differences by demographics:*** Not reported	

			sanitizer dispenser or a recently installed sink that were available immediately inside the entrance. **COM-B outcomes measured:** None				
(37) Capps, K. P., Updegraff, J. A., Foust, J. L., O'Brien, A. G., & Taber, J. M. (2022). Field experiment of signs promoting hand hygiene during the COVID-19 pandemic. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*, *41*(11), 826–832. https://doi.org/10.1037/hea0001211	11 August 2022	Midwestern United States Late February 2021 to April 9, 2021	**Design**: Single-arm pre- and post-intervention **Sample**: 832 students living in six residence halls of a large Midwestern university. **Intervention**: Gain-framed, static social norms, and dynamic social norm messages were placed on signs next to hand sanitizer dispensers in the residence halls. 36 hand sanitizer dispensers received each of the three signs in a randomized, counterbalanced order, where each sign was hung next to the dispenser for two weeks. **Comparator:**	**Exposure** **Source:** Researchers; university **Method of dissemination:** Textual information mode of delivery; public notice mode of delivery **Comparator** N/A	**Exposure** Prompt/cue action in the environment. Make social comparison salient; increase motivation by making behaviour benefits salient **Behaviour change wheel intervention type**: Persuasion; Environmental restructuring **Comparator** N/A	Dispensers with signs had higher use than those without signs. The signed dispensers had greater baseline usage (M = 1.66, 95% CI [1.10, 2.40]) than the no-sign dispensers (M = .71, 95% CI [.11, 1.88]), this difference was not significant, Mann–Whitney exact p = .20. Dispensers with signs (M 1.87, 95% CI [1.62, 2.16]) had 35% greater use than dispensers with no signs (M = 1.39, 95% CI [.90, 2.06]), but this difference was not statistically significant, z=1.37, p=.172. The gain-framed sign (M = 1.76, 95% CI [1.48, 2.08]) was associated with 8% less usage than the static and dynamic norms signs combined (M = 1.94, 95% CI [1.66 to 2.24]), although this difference was not significant, z = 1.35, p = .176. The dynamic norms sign (M = 1.84, 95% CI [1.55, 2.18]) was associated with 7% less usage than static norms	Low

			A baseline period of five days where no signs were hung was used to estimate and control for pre-existing levels of usage. Six dispensers on second floors of the residences were no-sign controls as it was expected to have comparable traffic to most other locations. **Target Behaviour:** Hand sanitizer use **Key outcome**: The primary outcome was grams of sanitizer usage per day, calculated as the difference between one day's measurement and the last prior valid measurement, divided by days since the prior measurement. **COM-B outcomes measured:** None.			(M = 2.04, 95% CI [1.72, 2.40]), but this difference was also not significant, z = 1.23, p = .218. The difference between static norms and no sign (M = 1.39, 95% CI [.90, 2.06]) approached significance, z = 1.72, p = .085, with static norms associated with 46% greater usage. The only difference between the three signs that approached significance was not hypothesized and was between the static norms and gain-framed sign, z = 1.79, p = .073, with the static norms sign associated with 16% greater usage than the gain-framed sign (M = 1.76, 95% CI [1.47, 2.08]). ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** Not reported	
(38) Bai, X., Li, X., Yan, D., Yang, H., & Tu, K. (2022). Effects of	19 June 2022	Shaanxi Province, Northwest China	**Design**: Cluster-randomized trial **Sample**:	***Exposure*** **Source:** Researchers **Method of dissemination:** Environmental	***Exposure*** Aim to affect personal motivation towards handwashing compliance by affecting the active environment.	There were significant differences between groups during the single intervention phase, χ^2=57.92, df=4, p<.001, where the local lighting had the highest rates	Moderate

Micro Architectural Environmental Interventions on Handwashing Compliance of Adolescents: A School-Based Intervention Trial. HERD, 15(4), 81–95. https://doi.org/10.1177/19375867221104412		2020	Male high school students between 15-19 years old (*N*=834) **Intervention**: Handwashing stations within 5 bathrooms were treated to different environmental designs. First, there was a 2-week period with four single intervention designs (nature background wall, wooden-background wall, spotlights to improve local illumination, manual faucet replaced with automatic faucet) and a control handwashing station. Then, over a period of 27 weeks, four combination intervention designs were implemented (added spotlight to natural background wall; replace manual faucet with auto faucet, keeping wooden background; add both auto-faucet and spotlight to previous background arrangements; add spotlight to auto-faucet group) compared to control.	change mode of delivery ***Comparator[a]*** Not applicable	**Intervention Type:** Environmental restructuring ***Comparator*** Not applicable	of handwashing. Among all groups, the lighting intervention group developed the most effective and stable positive effect while the wood-background intervention group showed the worst effect, with similar rates of handwashing to the control group. In the combined intervention phase, combining greening, lighting, and auto-faucet achieved the rates of handwashing (group 4). Followed by auto-faucet plus lighting (group 5), then nature-based background plus lighting (group 2). The results strongly indicate that combined-design interventions showed better effects on handwashing than the single interventions. ***COM-B outcomes results summary:*** None ***Differences by demographics:*** Not reported	

			Comparator: No environmental design change. **Target Behaviour**: Hand washing **Key outcome**: Objective outcome. Sensors operated between 6:30am and 11pm measured number of visits at the entrance and number of visits at the hand washing station. Handwashing rate was defined as the number of people who washed their hands divided by the number of total restroom visits. **COM-B outcomes measured:** None				
(39) Booker LA, Cordon EL, Pedersen HS, Fosgerau CF, Egerton S, Chan CKY and Skinner TC (2022) Different Behavior-Change	09 June 2022	Bendigo, Victoria, Australia, 14-week period between 12 August 2020 and 16 Novem	**Design**: Randomized cross-over study. There were two baseline periods and two intervention periods (ABAB design) **Sample**: Customers of a regional hardware store	***Exposure*** **Source:** Unclear **Method of dissemination:** Electronic environmental object mode of delivery	***Exposure*** Prompt appropriate behaviour, increase motivation to perform behaviour by invoking social norms, action planning, or information about health consequences. **Behaviour change wheel intervention type**:	There was no significant change in baseline usage during timepoints reflecting changes to COVID-19-restrictions, however there was a significant difference in the rate of use for hour of the day $F(10,361)$, 13.04, $p < 0.001$, and day of the week $F(6,365)$, 4.30, $p < 0.001$, with the morning and weekends seeing the highest usage ratios.	Moderate

Messaging Techniques Do Not Increase Customers' Hand Sanitization Adherence During the COVID-19 Pandemic: A Natural Behavioral Study. Front. Psychol. 13:876131. https://doi: 10.3389/fpsyg.2022.876131		ber 2020	**Intervention**: Occurred during a period where the Victorian State Government mandated that every business make soap and hand sanitizer available for all workers and customers. Two intervention periods that lasted around 4.5 weeks each. A 12-inch digital display monitor was erected above the dispenser. A series of 14 persuasive messages were randomly presented (changing every hour) on the digital display to target: action planning (e.g. "Be safe. Sanitize your hands."), social comparison (e.g. "Our shoppers sanitize their hands."), and information about health consequences (e.g., "Clean hands prevent the spread of COVID-19."). **Comparator:** Occurred during a period where the		Persuasion; Environmental restructuring ***Comparator*** Prompt appropriate behaviour **Behaviour change wheel intervention type**: Environmental restructuring	Weekday and hour of the day were entered as covariates due to their significance. Results showed that the usage ratio did not significantly change between individual messages and baseline [F(16,904) = 1.19, p = 0.279]. Messages were then grouped into their BCT. There was no significant difference in mean usage ratio either between BCT groups [F(3,906) = 1.33, p = 0.263]. Post hoc tests showed there was also no significant difference between messages (social comparison, p = 0.395; information, p = 1.000; action planning, p = 1.000). ***COM-B outcomes results summary:*** None. **Differences by demographics:** None reported.	
				Comparator **Source:** Unclear **Method of dissemination**: Electronic environmental object mode of delivery			

			Victorian State Government mandated that every business make soap and hand sanitizer available for all workers and customers. Two baseline periods lasting around 4 weeks (before first intervention period) and then 1 week (before second intervention period). A 12-inch digital display monitor was erected above the dispenser displaying the message, "Hand sanitizer" . **Target Behaviour:** Hand sanitizer usage **Key outcome**: Usage ratio, which was calculated by computing the total dispenser usage per hour divided by the total number of customers entering the store per hour, multiplied by 100. Objective outcome.				

			COM-B outcomes measured: None.				
(40) Van Dessel, P., Boddez, Y., & Hughes, S. (2022). Nudging societally relevant behavior by promoting cognitive inferences. *Scientific reports*, *12*(1), 9201. https://doi.org/10.1038/s41598-022-12964-1 Study #3	2 June 2022	Belgium Three weekdays in February 2021	**Design**: Field experiment with random assignment. Observation occurred in three two-hour timeslots (9 am–11 am; 12 am–2 pm; 3 pm–5 pm) with each condition assigned to each timeslot once on a randomly determined weekday. **Sample**: All customers of a Belgian grocery store (total N = 2198). **Intervention**: Goal inference nudging and action inference nudging signs were placed at the store entrance. The goal inference nudging sign said "Disinfecting hands saves lives. Will you disinfect your hands?" along with two posters of elderly and vulnerable people next to the dispenser repeating this message. The action inference nudging sign said, "please disinfect hands". **Comparator:** All nudges were	***Exposure*** **Source:** Researcher **Method of dissemination:** Printed material mode of delivery ***Comparator*** N/A	***Exposure*** Prompting a reminder to perform the behavior, increase motivation for hand sanitizer use by inducing empathy for vulnerable people, evoking moral reasoning to perform the behavior. **Behaviour change wheel intervention type**: Persuasion; environmental restructuring ***Comparator*** N/A	Inference nudging increased hand disinfection in customers of the grocery store. The proportion of participants using hand disinfection at the store entrance was higher for the goal inference (68.1%) and action inference nudging (66.1%) than the control group (44.0%), p<.001. These effects generalized to the fresh foods area, where sanitization was higher following goal (40.1%) than action inference nudging (33.7%) or controls (32.1%), p<.013. The average amount of used alcohol per customer entering the fresh foods area was higher in the goal inference nudging condition (0.48 g) compared to the other conditions (0.30–0.34 g), p<.016. ***COM-B outcomes results summary:*** none ***Differences by demographics:*** Not reported	Moderate

			absent for the control group. **Target Behaviour:** Use of hand sanitizer **Key outcome**: Objective outcome. The proportion of customers disinfecting their hands and the amount of disinfecting alcohol used. One observer registered whether each participant entered the shop with or without disinfecting their hands. A second observer observed hand sanitization inside the shop at the entrance of the fresh foods area where a second dispenser was placed. At the latter place, the amount of used disinfecting alcohol was also weighed by a third observer. None of the observers were informed about the study hypotheses or conditions. **COM-B outcomes measured:** none				
(27) Bahety, G., Bauhoff, S., Patel, D., & Potter, J.	November 2021	Bihar, India; between	**Design**: Randomized controlled trial. There were 10 treatment	***Exposure*** **Source:** Researchers	***Exposure*** Appeal to different emotions, such as fear (by making the threat of	Pooling the results of all treatment arms compared to control, there was no evidence that sending SMS	Moderate

(2021). Texts don't nudge: An adaptive trial to prevent the spread of COVID-19 in India. Journal of development economics, 153, 102747. https://doi.org/10.1016/j.jdeveco.2021.102747		August 17 and October 20, 2020.	arms: 5 message types x 2 timing variations. Participants were randomly assigned to 10 rounds of treatment for each behaviour or control. **Sample**: Eligible participants were the users of phone numbers that were entered into birth registries at health centers in 15 out of 20 blocks in Saran between August 2019 and February 2020. About 75% of respondents were male with an average age of 31 years. Less than 1/3 unemployed, and most of those who worked did so in a manual job. Eighty-six percent of respondents can read SMS in Hindi, but 36% do not ever read text messages. Less than a third read SMS daily in the week prior to the interview. **Intervention**: There were 10 treatment arms: 5 SMS message types x 2 timing variations (2 morning texts at 7-8am and 10-11am OR	**Method of dissemination:** Messaging mode of delivery ***Comparator*** Not applicable	pandemic salient) or prosocial motivation (by highlighting externalities of the preventive actions). **Behaviour change wheel intervention type**: Persuasion ***Comparator*** Not applicable	messages increased uptake of handwashing. Compared to control where uptake of reported handwashing was 35%, uptake of handwashing across treatment arms increased by 0.2% (p>.05). The lack of effect of SMS messages was demonstrated whether using administrative delivery reports on text message receipt as the endogenous variable in a treatment-on-the-treated specification or self-reported receipt of any COVID-related message. There was also no consistent evidence of differences between the control condition or treatment arms targeting handwashing when the different treatment arms were compared to control in separate analyses. There was no difference in handwashing uptake when two messages were received in the morning compared to one message in the morning and one in the evening. ***COM-B outcomes results summary:*** There was no difference in knowledge of handwashing between control group (32%) and treatment group (32.3%) (pooled across all treatments). When examining individual treatment arms, there were	

			morning and evening texts at 7-8am and 6-7pm). SMS messages were framed as neutral (simple, directed advice e.g. "Coronavirus is here. Outside the house, keep a distance of at least two arms from others"), framed as negative consequences for the community of not adhering (public loss frame), framed as positive consequences for the community of adhering (public gain frame), framed as negative consequences for the individual's family of not adhering (private loss frame), framed as positive consequences for the individual's family of adhering (public gain frame). They received four text messages over the course of two days between August and October 2020. **Comparator:** No messages. **Target Behaviour:** Handwashing **Key outcome**: Subjective outcome. Open-ended question, "What are you doing to protect against the			also no differences between control group and any individual treatment group. ***Differences by demographics:*** Not reported	

			virus?" Responses were coded as compliant with physical distancing (keeping two arms distance) and handwashing (washing hands with soap regularly) based on whether the respondent mentions each practice. **COM-B outcomes measured**: Knowledge - open ended question asking about what respondents know about preventive measures. Exact item not provided.				
(41) Younie S, Mitchell C, Bisson M-J, Crosby S, Kukona A, Laird K (2020) Improving young children's handwashing behaviour and understanding of germs: The impact of A Germ's Journey educational	November 23rd 2020	England, within primary schools, dates of study not reported	**Design**: Cluster-randomized controlled trial. At each school, one class was randomly assigned to the intervention group and one class was randomly assigned to the control group (i.e., between participants). One school included three rather than two classes; children from one of these classes were randomly split between the two groups. Follow-up was 1 week later.	***Exposure*** **Source:** Researchers **Method of dissemination:** Human interactional mode of delivery; Face to face mode of delivery; Printed material mode of delivery; website mode of delivery; gamification mode of delivery.	***Exposure*** Provide means to remember to perform the behaviour; Increase knowledge of handwashing techniques; increase confidence in handwashing techniques; improve handwashing skills; provide access to handwashing facilities; provide social roles models for the behaviours; increase motivation by eliciting perceived benefits of handwashing and perceived costs of not handwashing; increase	Between baseline and post-intervention in the intervention group, the percentage of participants performing handwashing behaviours increased for soap (55% vs 71% p<.001), wrists (4% vs 29% p<.001), fingers (11% vs 34% p<.001) and nails (1% vs 19% p<.001). There was no difference in rubbing (70% vs 76% p=.26) or drying (78% vs 84% p=.21). Overall, the number of handwashing behaviours being performed post-intervention compared to baseline was significantly	Moderate

resources in schools and public spaces. PLoS ONE 15(11): e0242134. https://doi.org/10.1371/journal.pone.0242134 **Study 1**			**Sample**: 225 children ages 4-5 years old from four primary schools in Leicestershire, England were recruited to participate. The schools were located in Leicester city centre (2; n = 117) and rural Leicestershire (2; n = 108). **Intervention**: Two sessions were scheduled at each school, spaced approximately one month apart. A multicomponent intervention delivered as a workshop lasted approximately 40 minutes in total. Included Germ's Journey educational resources comprising of a book, song, web-based games, and glo-gel (Glo-gel rubbing and washing off) activities. The children moved among the activities in small groups for experiential learning. **Comparator:** Activities unrelated to hand hygiene.		perceived susceptibility and severity of adverse outcomes; elicit fear and disgusts of germs; facilitate descriptive and injunctive norms toward the behaviour. **Behaviour change wheel intervention type**: Education; Persuasion; Training; Modelling; Enablement	higher (*Est* = 0.93, *SE* = 0.14, *t* = 6.57, *p* < 0.001). Between baseline and follow-up in the intervention group, the percentage of participants performing handwashing behaviours remained significantly higher for wrists (4% vs 16% p<.001), fingers (11% vs 29% p<.001) and nails (1% vs 10% p<.001). Overall, significant improvements between baseline vs. follow-up were observed in the intervention group in the number of handwashing behaviours, *Est* = 0.48, *SE* = 0.14, *t* = 3.30, *p* = 0.001. There was no significant difference between baseline and follow-up for any of the handwashing behaviours in the control group. ***COM-B outcomes results summary:*** Significant improvements between baseline vs. follow up were observed for knowledge scores in the intervention group, Est = 2.14, SE = 0.52, z = 4.11, p < 0.001. Participants that had knowledge that "germs" are why we wash our hands were observed to engage in a higher number of handwashing behaviours at	
				Comparator	***Comparator***		
				Not applicable	Not applicable		

			Target Behaviour: Handwashing **Key outcome**: Objective outcome. Observed handwashing behaviours: use of soap, rubbing with soap, cleaning wrists, cleaning fingers, cleaning nails, dry hands. Scored from 0-6 where 0 represents performing 0 of the handwashing behaviours and 6 represents performing all of the handwashing behaviours. **COM-B outcomes measured:** Why do we wash our hands?" (i.e., knowledge).			post-intervention (M= 3.30, SD = 1.64) vs those who didn't answer "germs" post-intervention (M = 2.60, SD = 1.35) t(49.13) = 2.13, p = 0.04 (CI: 0.04, 1.37). A higher number of handwashing behaviours continued to be observed at follow-up for those who knew "germs" are why we wash our hands (M= 2.89, SD = 1.47) compared to those who did not know the answer of "germs" (M= 2.00, SD = 1.29), t(46.30) = 2.90, p = 0.006 (CI: 0.27, 1.52). ***Differences by demographics:*** Not reported	
(42) Younie S, Mitchell C, Bisson M-J, Crosby S, Kukona A, Laird K (2020) Improving young children's handwashing behaviour and understandi	November 23rd 2020	England, within Birmingham Science Museum, dates of study not reported	**Design**: Randomized controlled trial. Participants were randomly assigned to the intervention or control group (i.e., between participants). **Sample**: 104 children (age *M*= 6.54 years, SD = 2.27; Range = 3 to 12 years).	***Exposure*** **Source:** Researchers **Method of dissemination:** Audio informational mode of delivery before observing handwashing.	***Exposure*** Increase knowledge of handwashing techniques; increase confidence in handwashing techniques; provide social roles models for the behaviours **Behaviour change wheel intervention type**: Education; Environmental	The number of handwashing behaviours performed by the intervention group was significantly higher than the control group (*Est.* =-0.71, *SE* = 0.34, *t* = -2.07, *p* = 0.04). The number of behaviours of handwashing performed also increased with age (*Est.* = 0.87, *SE* = 0.23, *t* = 3.71, *p* < 0.001).	Moderate

ng of germs: The impact of A Germ's Journey educational resources in schools and public spaces. PLoS ONE 15(11): e0242134. https://doi.org/10.1371/journal.pone.0242134 **Study 2**			Intervention: n = 54 and control: n = 50. **Intervention**: Germ's Journey song. A video monitor in the exhibit's toilets, which is integrated into the mirror in front of the sinks, plays the song and its associated video. Observed during one-week period. Took part in the song activity and were then observed once. The sessions lasted approximately 5 minutes in total. **Comparator**: Provided a pre intervention baseline. Then took part in the song activity. The sessions lasted approximately 5 minutes in total. **Target behaviour**: Handwashing **Key outcome**: Objective outcome. A single observation was made of children in both groups of performance of the 6 handwashing behaviours. Scored from 0-6 where 0 represents performing 0 of the handwashing behaviours and 6		restructuring; Enablement; Modelling ***Comparator*** Provide means to remember to perform the behaviour; increase knowledge of handwashing techniques; increase confidence in handwashing techniques; provide social roles models for the behaviours **Behaviour change wheel intervention type**: Enablement; Education; Environmental restructuring; Modelling.	***COM-B outcomes results summary/ Differences by demographics:*** For the knowledge scores, group (Est. = -2.56, SE = 1.18, z = -2.18, p = 0.03), age (Est. = 1.99, SE = 0.65, z = 3.04, p = 0.002) and their interaction (Est. = -2.57, SE = 1.31, z = -1.97, p = 0.05) were significant, such that particularly among older participants, knowledge scores were higher in the intervention than control group.	
				Comparator **Source:** Researchers **Method of dissemination:** Audio informational mode of delivery. Delivered after observing handwashing.			

			represents performing all of the handwashing behaviours. **COM-B outcomes measured:** Why do we wash our hands?" (i.e., knowledge).				
Individual level interventions							
(11) Blackman A, Hoffmann B (2022) Diminishing returns: Nudging Covid-19 prevention among Colombian young adults. PLOS ONE 17(12): e0279179. https://doi.org/10.1371/journal.pone.0279179	22 December 2022	Bogota, Colombia, May to June, 2020	**Design**: 2x2 factorial randomized controlled trial **Sample**: 1349 students aged 18+ studying at more than 40 universities in Bogota. 318 in private arm, 327 in public arm, 346 in combined arm, 230 in pure control arm **Intervention** All participants attended an information session in a zoom meeting where they watched a pre-recorded slide deck presentation with information about health risks of COVID-19 and appropriate non-	**Exposure** **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery **Comparator** **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual	**Exposure** Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Behaviour change wheel intervention type**: Persuasion **Comparator** N/A	**Primary outcome results summary:** Compared to control, there was a small increase in handwashing compliance in the public benefits treatment (b=1.66, SE=.98, p<.10), an increase of 2%. However, this effect did not reach significance. No other treatments had an effect on handwashing compliance. **COM-B secondary outcome results:** The personal benefits treatment increased perceived likelihood of infection (b=.20, SE=.05, p<.01), concern for self (b=.13, SE=.07, p<.05), concern for friends (b=.17, SE=.07, p<.05), and concern for community (b=.17, SE=.07, p<.05).	Critical

			pharmacological interventions to reduce transmission. Then, participants were sent 3 email messages over the course of 7 days with either a control or treatment intervention. All three interventions had common contextual information and recommended five non-pharmacological interventions (NPI), only differed in motivation for complying: - Personal benefits - Public benefits - Combined personal and public benefits - Neither (pure control) **Comparator:** Information on irrelevant subject **Target Behavior:** Handwashing **Key outcome:** Self-reported rates of compliance with handwashing as measured by % of	informational mode of delivery		Perceived likelihood of infection significantly increased in the public benefits condition (b=.17, SE=.05, p<.01) and combined benefits condition (b=.17, SE=.04, p<.01). There was no difference in intended compliance across conditions. ***Differences by demographics:*** Not reported	

			times over past 7 days washed hands when should have. **COM-B outcomes measured:** Using a four-point Likert scale (from 1 to 4), with one being the lowest level and four the highest, respondents indicated the following: likelihood of infection, their self-assessed likelihood of contracting Covid-19; concern self, their level of concern about getting seriously ill from Covid-19; concern friends, their level of concern about infecting friends who then become seriously ill; concern household, their level of concern about infecting members of their household who then become seriously ill; and finally, concern community, their level of concern about infecting members of their community other than family and friends who then become seriously ill.				

			Intended compliance: % of times over next 7 days intend to wear a mask while outside				
(43) Baretta, D., Amrein, M. A., Baeder, C., Ruschetti, G. G., Ruettimann, C., Del Rio Carral, M., Fabian, C., & Inauen, J. (2022). Promoting hand hygiene during the COVID-19 pandemic: A parallel randomized trial for the optimization of the Soapp app. JMIR mHealth and uHealth, 10.2196/43241. Advance online publication. https://doi.org/10.2196	6 October 2022	German-speaking adult Swiss general population Study took 34 days, from 26 March 2021	**Design:** Double-blind parallel randomized trial **Sample:** German-speaking adult Swiss general population. Eligibility criteria were being at least 18 years old, ii) owning a smartphone with mobile access to the internet, iii) being proficient in the German language, and iv) having signed an electronically informed consent form to participate in the study. 232 participants recruited. Participants' mean age was 39.9 years, 73% were women, 66% had high-school qualifications, 54% were employed and 23% were living alone. **Intervention:** 9 intervention groups, characterized by unique combination and sequence of two out of three	**Exposure** **Source:** Federal Office of Public Health, researchers **Method of dissemination:** Informational mode of delivery; Mobile digital device mode of delivery; Pull mode of delivery	**Exposure** BCTs provided by author: Basic module: Goal setting, instruction to perform behaviour, information about consequences, action planning Motivation: goal setting, information about consequences, salience of consequences, pros and cons, problem solving, verbal persuasion about capabilities, focus on past success, self-reward. Habit: information about antecedents, self-monitoring, action planning, prompts/cues, behaviour practice/rehearsal, habit formation. Social norms: Monitoring of behaviour by others without feedback, feedback on behaviour, social comparison, social reward, social incentive, information about health consequences, information about others' approval, credible source, social incentive,	**Primary outcome results summary:** In all intervention conditions, hand hygiene significantly increased over time ($F = 10.95$, $P < .01$). There was no effect of exposure to a specific module during the course of the intervention. **COM-B outcomes summary:** None **Differences by demographics:** Not reported	Serious

/43241			intervention modules (motivation, habit, social norms) - delivered via personal smartphone through Soapp app. Duration was 34 days. A basic module will provide information on hand hygiene to all participants. Motivation module includes information about bacteria, germs and contamination processes, listing pros and cons for performing correct hand hygiene, behaviour monitoring, action and coping planning, remembering previous successes in performing hand hygiene, push notifications reminders, and persuasive messages to increase capability to perform the behaviour. The habit module includes information about habit formation, identification of suitable cues, diary of daily routines requiring hand hygiene, develop an		restructuring the physical environment. **Behaviour change wheel intervention type:** Enablement; Education; Persuasion; Incentivisation; Training; Environmental restructuring; Modelling		
				Comparator	**Comparator**		
				No control	No control		

			implementation intention and receive push notifications reminders to follow it. Social norm includes participants monitoring their performance, a community environment in the app where performance scores are posted and shared in a daily newsfeed, interaction and encouragement between users and healthcare professionals. Encouragement to evoke social norms in the home. Push notifications to support the perception of norms and to emphasise social comparison. **Comparator:** No control group, intervention arms were compared to each other. **Target Behavior:** Handwashing **Key Outcomes:**				

			Frequency of correct hand hygiene at key times at follow-up, via Ecological Momentary Assessment (electronic diary inside Soapp app). The 5-point response scale ranged from never (1) to always (5). The main outcome was operationalized as the mean reported frequency of correct hand hygiene across all the indicated key times and ranged from 1 to 5. **COM-B outcomes measured:** None				
(44) Smith, S.R., Hagger, M.S., Keech, J.J., Moyers, S.A., Hamilton, K. (2022) Improving Hand Hygiene Behavior Using a Novel Theory-Based	13 September 2022	Australian citizens. Data were collected between April 16 and 28, 2020. At the time of the study, were	**Design**: Randomized controlled trial **Sample**: Participants were eligible for recruitment if they lived in Australia, were aged 18 years or older, and were not currently in formal quarantine for COVID-19. Participants were adult Australian residents (52% men, 47.6% women, 0.04% other)	***Exposure*** **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery	***Exposure*** Increase knowledge of WHO guidelines; increase positive attitudes toward the behavior; encourage the formation of a goal intention to avoid touching face with unwashed hands; increase perceived risk toward touching face with unwashed hands; increase perceived behavioural control to perform the behaviour; increase intentions to perform the behaviour; develop plan	Participants reported greater rates of avoiding touching the face with unwashed hands at follow-up (1 week later) compared to baseline ($F(1,252) = 8.52$, $p = .004$, $\eta p\ 2 = .033$), regardless of condition. There was no statistically significant time × condition interaction effect, $F(1,252) = 0.911$, $p = .341$, $\eta p\ 2 = 0.004$, meaning that the rate of change in avoidance of touching the face did not	Serious

Intervention During the COVID-19 Pandemic, *Annals of Behavioral Medicine*, Volume 56, Issue 11, November 2022, Pages 1157–1173, https://doi.org/10.1093/abm/kaac041 **Study 1**		subject to nationwide "stay at home" orders to prevent the spread of the virus.	ranging in age from 18 to 82 years (M = 48.37, SD = 17.06). Participants were mostly Caucasian (79.1%), as well as Asian (14.2%), and Middle Eastern (0.8%). The majority of participants had completed tertiary-level education (i.e., Diploma or higher, 73.6%). **Intervention**: Participants were presented with a slideshow containing publicly available educational information on the performance of personal hand hygiene behaviors for preventing the spread of COVID-19 from the WHO website. The intervention adopted persuasive communication and mental imagery techniques which targeted behavior change. It was a slideshow containing information and instructions for self-enacted hand hygiene exercises. A timer was used on all slides containing		to implement behaviour with situational cuing. **Behaviour change wheel intervention type:** Education, Persuasion ***Comparator*** Increase knowledge of WHO guidelines **Behaviour change wheel intervention type** – Education	differ between intervention and control conditions. ***COM-B outcomes results summary:*** Participants assigned to the intervention condition reported higher levels of action planning at T2 (M = 5.32, SD = 1.61) compared to T1 (M = 4.94, SD = 1.91), F (1,252) = 10.61, p = .001, $\eta p 2 = 0.040$. A change in action planning from T1 to T2 was not observed for participants assigned to the education-only condition. Participants in the education only condition reported lower perceived behavioral control at T2 (M = 5.35, SD = 1.29) compared to T1 (M = 5.52, SD = 1.20). There was no effect of time on perceived behavioral control for the theory-based intervention condition. We found no effects of time and condition on intention, attitude, subjective norm, perceived risk, action control, habit, or anticipated regret. ***Differences by demographics:*** Not reported	
				Comparator **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery			

			intervention stimuli to prevent participants advancing through the information and activities too quickly without fully engaging in the content. **Comparator:** Participants in the education-only condition (i.e., active control condition) were presented only with the educational component of the intervention (i.e. slideshow containing publicly available educational information on the performance of personal hand hygiene behaviors for preventing the spread of COVID-19 from the WHO website). **Target Behaviour:** Avoid touching their face with unwashed hands. **Key outcome**: Subjective outcome used. Self-reported frequency of touching face with unwashed hands measured on a 7-point Likert scale (1 = never to 7 = always). Self-reported incidence of avoiding touching face with				

			unwashed hands measured on a 7-point Likert scale (1 = false to 7 = true). **COM-B outcomes measured:** Intention to avoid touching face with unwashed hands, Attitude toward engaging in the target behavior, subjective norm, perceived behavioral control, perceived risk, action planning, action control, habit, anticipated regret.				
(45) Smith, S.R., Hagger, M.S., Keech, J.J., Moyers, S.A., Hamilton, K. (2022) Improving Hand Hygiene Behavior Using a Novel Theory-Based Intervention During the	13 September 2022	US citizens Data were collected between n May 19 and June 2, 2020.	**Design**: Randomized controlled trial **Sample**: Participants were eligible if they lived in the United States, were aged 18 years or older, and were not currently in formal quarantine for COVID-19. Participants were adult US residents (N = 245, 56.7% men) ranging in age from 18 to 84 years (M = 49.51, SD = 16.41). Participants were	**Exposure** **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery	**Exposure** Increase knowledge of WHO guidelines; increase positive attitudes toward the behavior; encourage the formation of a goal intention to avoid touching face with unwashed hands; increase perceived risk toward touching face with unwashed hands; increase perceived behavioural control to perform the behaviour; increase intentions to perform the behaviour; develop plan to implement behaviour with situational cuing.	Participants reported greater rates of avoiding touching the face with unwashed hands at follow-up (1 week later) compared to baseline, $F(1,242) = 23.67$, $p < .001$, $\eta p 2 = 0.089$, such that uniform increases in avoiding touching the face with unwashed hands were observed from baseline to follow-up 1 week later. There was no statistically significant difference between intervention and control conditions, $F(2,242) = 2.58$, $p = .078$, $\eta p 2 = 0.021$. There was also no statistically significant time × condition	Serious

COVID-19 Pandemic, *Annals of Behavioral Medicine*, Volume 56, Issue 11, November 2022, Pages 1157–1173, https://doi.org/10.1093/abm/kaac041 **Study 2**			mostly Caucasian (84.5%), as well as Asian (6.5%), Black (6.1%) and Middle Eastern (.4%). The majority of participants had completed tertiary-level education (i.e., Diploma or higher, 71.5%). **Intervention**: Participants were presented with a slideshow containing publicly available educational information on the performance of personal hand hygiene behaviors for preventing the spread of COVID-19 from the WHO website. The intervention adopted persuasive communication and mental imagery techniques which targeted behavior change. It was a slideshow containing information and instructions for self-enacted hand hygiene exercises. A timer was used on all slides containing intervention stimuli to prevent participants advancing through the		**Behaviour change wheel intervention type:** Education, Persuasion ***Comparator*** Control 1: Increase knowledge of WHO guidelines Control 1: **Behaviour change wheel intervention type**: Education Control 2: not applicable	interaction effect, F (2,242) = 1.12, p = .328, ηp 2 = 0.009, meaning that the rate of change in avoidance of touching the face did not differ between intervention and control conditions. ***COM-B outcomes results summary:*** Action planning increased form T1 to T2 for the theory-based intervention condition, F (1,242) = 5.42, p = .021, ηp 2 = 0.022, and the education-only condition, F (1,242) = 4.88, p = .028, ηp 2 = 0.020, but not for the control condition. All three conditions showed uniform increases in action control from T1 to T2. Habit increased from T1 to T2 for participants allocated to the theory-based intervention condition, F (1,242) = 4.14, p = .043, ηp 2 = 0.017, but not for the education only or control conditions. Habit was significantly higher for the theory-based intervention group (M = 4.62, SD = 1.28) at T2 compared to the education-only group at T2 (M =3.87, SD = 1.28; p = .001, d = .59).	
				Comparator **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery			

			information and activities too quickly without fully engaging in the content. **Comparator:** Control 1: Participants in the education-only condition (i.e., active control condition) were presented only with the educational component of the intervention (i.e. slideshow containing publicly available educational information on the performance of personal hand hygiene behaviors for preventing the spread of COVID-19 from the WHO website). Control group 2: no-education control condition **Target Behaviour:** Avoid touching their face with unwashed hands **Key outcome**: Subjective outcome used. Self-reported frequency of touching face with unwashed hands measured on a 7-point Likert scale (1 = never to 7 = always). Self-reported incidence of avoiding touching face with			Being assigned to the theory-based intervention group significantly increased behaviour from T1 (M = 4.37, SD = 1.43) to T2 (M = 5.28, SD = 1.11; d = 0.71) for participants who had low perceived risk at T1. Education-only and control conditions did not increase behaviour in those with low perceived risk. For participants who had high perceived risk, there were increases in behaviour from T1 to T2 across all three conditions. ***Differences by demographics:*** Not reported	

			unwashed hands measured on a 7-point Likert scale (1 = false to 7 = true). **COM-B outcomes measured:** Intention to avoid touching face with unwashed hands, Attitude toward engaging in the target behavior, subjective norm, perceived behavioral control, perceived risk, action planning, action control, habit, anticipated regret.				
(31) van Empelen P, Preuhs K, Bakker LA,Buursma P, Andree R, Anraad C, et al. (2022) Improving behavioural compliance with the COVID-19 precautionary measures by means of innovative communication strategies: Social	July 28, 2022	Netherlands May 10th and May 23rd 2020.	**Design:** Randomized controlled trial **Sample:** N=424 participants consented to participate, who were allocated to the intervention (n = 181) or control (n = 243) group. Data of 339 participants were analysed (n = 149 intervention, n = 190 control). Most participants were female, were born in the Netherlands, did not work in healthcare and had someone in their environment with an increased risk	***Exposure*** **Source:** Researchers **Method of dissemination:** Website mode of delivery; Pull mode of delivery ***Comparator*** Not applicable	***Exposure*** Situational cueing of behaviour; increase behaviour regulation by reducing obstacles **Behaviour change wheel intervention**: Enablement ***Comparator*** Not applicable	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=4.11, SD=0.79) than the control condition (M=3.78, SD=1.00, p=.056). At follow-up, behaviour compliance for sneezing or coughing into elbow was not significantly different in the intervention condition (M=4.37, SD=1.01) than the control condition (M=4.25, SD=0.91, p=.032) after Holm-Bonferroni correction for multiple testing. At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition	Serious

experimental studies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 1**			of becoming ill from COVID-19. **Intervention**: Participants made volitional implementation plans using "if-then" statements by choosing up to three situations that may be difficult to comply with the COVID-19 precautionary measures and one solution per situation (from 2-5 possible presented solutions). **Comparator:** No experimental manipulation. **Target Behaviour:** 1) Washing one's hands regularly (20 sec.) with water and soap; 2) sneezing in one's elbow; 3) Use paper tissues. **Key outcome**: Subjective outcome. Behavioural compliance with the precautionary measures was assessed at 1-week follow-up with one item per precautionary measure (e.g., "In the last week I have sneezed or coughed in my elbow") on scale from 1 = never, to 5 =			(M=4.34, SD=0.98) than the control condition (M=3.98, SD=1.20, p=.478). ***COM-B outcomes results summary:*** When adjusting for multiple testing by means of the Holm-Bonferroni correction, at post-test, participants in the intervention group had a higher perceived vulnerability of others to become infected with COVID-19 (b=-.19, SE=.07, t=-2.78, p=.006). Participants in the intervention group reported a higher perceived severity of becoming infected with COVID-19 (b=-.39, SE=.11, t=-3.65, p<.001). No other COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** Not reported	

			always. **COM-B outcomes measured:** Self-efficacy for each precautionary measure, intention to comply with the COVID-19, perceived susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19 infection, response efficacy.				
(32) van Empelen P, Preuhs K, Bakker LA,Buursma P, Andree R, Anraad C, et al. (2022) Improving behavioural compliance with the COVID-19 precautionary measures by means of innovative communication strategies: Social experimenta	July 28, 2022	Netherlands 15th of May and 7th of June 2020	**Design:** Randomized controlled trial **Sample:** Participants were randomly allocated to the behavioural journalism condition (n = 290) or control (n = 303) group. In total, data of 449 participants were analysed (n = 212 intervention, n = 235 control). Most participants were female, were born in the Netherlands, did not work in healthcare and had someone in their environment with an increased risk of becoming ill from	***Exposure*** **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery. ***Comparator*** Not applicable	***Exposure*** Provide behavioural norms; provide positive role models of precautionary behaviours; increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people. **Behaviour change wheel intervention:** Modelling; Persuasion ***Comparator*** Not applicable	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=4.09, SD=0.93) than the control condition (M=4.11, SD=0.91, p=.898). At follow-up, behaviour compliance for sneezing or coughing into elbow was not significantly different in the intervention condition (M=4.41, SD=0.91) than the control condition (M=4.36, SD=0.94, p=.584). At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition (M=4.03, SD=1.41) than the control condition (M=4.17, SD=1.30, p=.394).	Serious

l studies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 2**			COVID-19 **Intervention:** Offered four short films (ranging from 1:22 minutes to 1:40 minutes) comprising: a male student, a young working couple, a pregnant woman and a healthcare worker. In each scenarios the depicted individuals shared the impact that COVID-19 has on their lives, including taking precautionary measures and why they believed it to be important to comply with the precautionary measures. Participants were instructed to watch at least one of the films while being allowed to watch as many of the role model stories as they felt seemed relevant or interesting to them. **Comparator:** No experimental manipulation. **Target Behaviour:** 1) Washing one's hands regularly (20 sec.) with water and soap; 2) sneezing in one's elbow; 3) Use paper tissues. **Key outcome**: Subjective outcome.			***COM-B outcomes results summary:*** No COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** Not reported	

			Behavioural compliance with the precautionary measures was assessed at 1-week follow-up with one item per precautionary measure (e.g., "In the last week I have sneezed or coughed in my elbow") on scale from 1 = never, to 5 = always. **COM-B outcomes measured:** Self-efficacy for each precautionary measure, intention to comply with the COVID-19, perceived susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19 infection, response efficacy.				
(33) van Empelen P, Preuhs K, Bakker LA,Buursma P, Andree R, Anraad C, et al. (2022) Improving	July 28, 2022	Netherlands 16th of May and 7th of June 2020	**Design:** Randomized controlled trial **Sample:** 578 of 623 participants consented to participate, which were then allocated to the intervention (n =	***Exposure*** **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery.	***Exposure*** Elicit empathy for vulnerable people; provide positive reinforcement for behavior (incentives); provide prompt for behaviour performance. **Behaviour change wheel intervention:**	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=3.69, SD=1.07) than the control condition (M=3.72, SD=1.03, p=.821). At follow-up, behaviour compliance for sneezing or	Serious

behavioural compliance with the COVID-19 precautionary measures by means of innovative communication strategies: Social experimentalstudies. PLoS ONE 17(7): e0272001. https://doi.org/10.1371/journal.pone.0272001 **Study 3**			261) or control (n = 317) group. In total, data of 428 participants were analysed (n = 196 intervention, n = 232 control). Recruitment of participants and were eligible if they were from 18 to 40 years old. Most participants were Dutch females who finished higher education. **Intervention:** Watching a short film (1:42 min.) depicting a 70-year old woman who explains why she belongs to the at-risk population (due to her age and having asthma) and that she still depends on others to follow precautionary measures to be protected. Participants who indicated their readiness to protect others were offered a gift as credit for wanting to do so. The gift also served as a reminder for taking precautionary measures and comprised a blue silicone band stating "Door mij	***Comparator*** Not applicable	Persuasion; Incentivisation ***Comparator*** Not applicable	coughing into elbow was not significantly different in the intervention condition (M=4.10, SD=1.07) than the control condition (M=4.07, SD=1.16, p=.877). At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition (M=3.97, SD=1.36) than the control condition (M=3.86, SD=1.44, p=.658). ***COM-B outcomes results summary:*** After adjusting for multiple comparison by means of the Holm-Bonferroni correction, participants in the empathy induction group perceived others to be more vulnerable to COVID-19 infection compared to participants in the control group (b=-.17, SE=.06, t=-2.85, p=.005). No other COM-B variables were significantly different between control and intervention groups after correction. ***Differences by demographics:*** Not reported	

			coronavrij!" [Corona-free through me!"]. **Comparator:** No experimental manipulation. **Target Behaviour:** 1) Washing one's hands regularly (20 sec.) with water and soap; 2) sneezing in one's elbow; 3) Use paper tissues. **Key outcome**: Subjective outcome. Behavioural compliance with the precautionary measures was assessed at 1-week follow-up with one item per precautionary measure (e.g., "In the last week I have sneezed or coughed in my elbow") on scale from 1 = never, to 5 = always. **COM-B outcomes measured:** Self-efficacy for each precautionary measure, intention to comply with the COVID-19, perceived susceptibility to COVID-19 infection, perceived severity, perceived susceptibility of others towards to COVID-19				

			infection, response efficacy.				
(46) Keller, J., Kwasnicka, D., Wilhelm, L. O., Lorbeer, N., Pauly, T., Domke, A., Knoll, N., & Fleig, L. (2022). Hand Washing and Related Cognitions Following a Brief Behavior Change Intervention During the COVID-19 Pandemic: a Pre-Post Analysis. *International journal of behavioral medicine*, *29*(5), 575–586. https://doi.org/10.1007/s12529-021-10042-w	29 November 2021	University students and staff of the Freie Universität Berlin and Medical school Berlin, July 2020 to November 2020	**Design**: Sequential pre-/post-analysis **Sample**: 123 participants in a convenience sample, eligible (>18 years, had sufficient comprehension of German language, ability to understand and complete study materials) (age: *M* = 23.96 years; *SD* = 5.82; 80% women). 34 participants who only provided baseline data, 89 retained for follow-up analyses. **Intervention**: Intervention based on various behavioral change techniques applied to handwashing. Using educational material in the first part of the intervention, participants received general information about effective hand washing (for at least 20 s, with water and soap), its pros and cons (BCT 9.2), and	**Exposure** **Source:** Researchers **Method of dissemination:** Textual mode of delivery; Visual informational mode of delivery; Pull mode of delivery **Comparator** N/A	**Exposure** Increase knowledge and skills for the behaviours, increase knowledge and salience risks of non-compliance, increase self-efficacy by modelling the behaviour, increase self-incentive, self-monitoring of behaviour, form implementation intentions. **Intervention Type:** Persuasion; Enablement; Education; Incentivisation; Environmental restructuring; Training **Comparator** N/A	**Primary outcome results summary:** Hand washing significantly increased throughout the study period ($b = 0.02$, $SE = 0.01$, 95% CI [0.01; 0.03], $p < 0.001$). Specifically, participants on average washed their hands about 1.9 times more per day on day 86 (6.9 times), as compared with baseline (5.0 times), which represents a large effect size ($\lambda = 0.84$, F (1,63) = 11.85, $p = 0.001$; $\eta^2 = 0.16$). **COM-B secondary outcome results:** On days when participants reported higher-than-usual intentions to wash hands, they were more likely to report higher-than-usual self-efficacy ($r = 0.21$, $p = 0.001$). On days when participants reported higher-than-usual self-monitoring, they were more likely to report more-than-usual next-week hand washing ($r = 0.17$, $p = 0.013$). Generally, next-week hand washing was higher when participants reported higher intentions to wash hands ($r = 0.21$, $p = 0.045$) and	Serious

			information about health consequences of hand washing (BCT 5.1), which was linked with the COVID-19 pandemic. They also received instructions on how to perform the behavior (BCT 4.1), illustrated by photographs of effective hand washing. Participants were asked to write down what can make hand washing feel good or pleasant (e.g., using soap which smells nicely; BCT 10.7: self-incentive). The second part of the intervention involved creating a personalized hand washing plan by writing down up to two situations of their daily life (i.e., prompts/cues) in which they would like to form a new hand washing habit. The cues could refer to anything that can be experienced in daily life but occurs (a) several times a week and (b) with a certain degree of regularity. **Comparator:**			greater self-monitoring ($r = 0.38$, $p < 0.001$). ***Differences by demographics:*** Not reported	

			Baseline measurement, pre-intervention **Target Behaviour:** Handwashing **Key outcome**: Daily handwashing over 86 days, reported in daily end-of-day reports, using the item "How often did you wash your hands for 20 s with water and soap today?" Next-week handwashing was computed reflecting daily mean levels across 7-day increments following questionnaire assessments. **COM-B outcomes measured:** Intention, self-efficacy, and self-monitoring				
(36) Krpan, D., Makki, F., Saleh, N., Brink, S., & Klauznicer, H. (2021). When behavioural science can	26 August 2020	United Kingdom and United States April 8, 2020 to April 17, 2020	**Design**: Randomized trial. Participants were randomly allocated to one of five conditions (control and 4 interventions conditions). **Sample**: N=2863 included	***Exposure*** **Source:** Researcher **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery	***Exposure*** Increasing motivation and intentions for compliance, evoke feelings of collaboration, dispel misconceptions about virus, induce empathy, make risk to others salient).	Handwashing times was not significantly different in the Letter condition vs the control (b=-.23, SE=.29, p=.426, 95% CIs [-.81, .34]), in the meaningful activity plan condition vs control (b=-.22, SE=.29, p=.442, 95% CIs [-.78, .34]), in the economy argument condition	Moderate

make a difference in times of COVID-19. Behavioural Public Policy, 5(2), 153-179. doi.org/10.1017/bpp.2020.48			(males=1401, females=1456, others=6, mean age=45.744) from general population. **Intervention**: Participants were allocated to participate in one of the following interventions: 1) Write a letter to a vulnerable person they knew stating that they would do whatever necessary to reduce COVID transmission and ensure their survival. 2) Write a clear plan to implement a meaningful activity from tomorrow, including necessary steps to ensure they are ready to start and how to overcome obstacles. 3) Read a text article with an economic argument for adhering to strict physical distancing measures for the economy in the long run. 4) Presented with six hypothetical scenarios in which people may violate behavioural recommendations to		**Behaviour change wheel intervention type**: Persuasion ***Comparator*** No intervention.	vs control (b=.05, SE=.29, p=.873, 95% CIs [-.51, .61]), or in the hypothetical scenario condition (b=.24, SE=.28, p=.392, 95% CIs [-.31, .80]). Relative handwashing was not significantly different in the Letter condition vs the control (b=-.05, SE=.09, p=.573, 95% CIs [-.23, .13]), in the meaningful activity plan condition vs control (b=-.09, SE=.09, p=.304, 95% CIs [-.26, .08]), in the economy argument condition vs control (b=-.11, SE=.09, p=.191, 95% CIs [-.28, .06]), or in the hypothetical scenario condition (b=.03, SE=.09, p=.720, 95% CIs [-.14, .20]). **COM-B secondary outcome results:** None of the COM-B variable mediated the effect of intervention on handwashing. ***Differences by demographics:*** Not reported	

			reduce COVID transmission (e.g., socializing with neighbours who live in the same building and have been compliant with staying at home). Rate the appropriateness of the actions in the scenario. **Comparator:** Participants in the control condition did not receive any experimental manipulation. **Target behaviour**: Handwashing **Key outcome**: Subjective outcome. Relative hand washing (i.e., whether people washed their hands more than they would usually wash them before the COVID-19 crisis) was rated on a scale from 1 (Strongly disagree) to 7 (Strongly agree). Hand washing times (i.e., how many times approximately they washed their hands) was measured on a scale from 0 (Never) to 21 (More than 20 times) in increments of 1 time. **COM-B outcomes**				

			measured: Perceived seriousness of disease, health concern if affected by COVID-19, concern for close others, concern for vulnerable others, economic concern, knowledge about COVID-19, and future intentions to undertake protective behaviours going forward.				
Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.							

Table 5b. Summary of studies reporting on effectiveness of interventions in promoting adherence to hand hygiene and respiratory etiquette for H1N1

Reference	Date released	Setting and time covered	Study characteristics	Intervention mode of delivery	Behaviour change strategy	Summary of key findings in relation to the outcome	Risk of bias
Individual level interventions							
(47) Yardley L, Miller S, Schlotz W, Little P. Evaluation of a Web-based intervention to promote hand hygiene: exploratory randomized controlled trial. J Med Internet Res. 2011 Dec 9;13(4):e107. https://doi.org/	9th December 2011	Southern England from August to October 2010 (4 months after the	**Design**: Randomized controlled trial. Parallel-group design, where two-thirds of participants were randomly assigned to the intervention once initially logging on to the website, while the remaining third of participants were assigned to the control condition.	***Exposure*** **Source:** Health professionals; researchers **Method of dissemination:** Textual mode of delivery; website mode of delivery	***Exposure*** Enhance credibility with medical expertise; implementation plan formation with situational cueing; reinforce positive attitudes and norms towards handwashing; address common negative beliefs, e.g. perceived vulnerability to infection. **Behaviour change wheel intervention**	Handwashing rates were higher postintervention in the intervention condition (M=4.40; SD=0.86) than in the control group (M=4.04; SD=0.86) at 4 weeks follow-up ($p<.001$; Cohen's d=0.42). Handwashing rates remained higher in the intervention group (M=4.45; SD=0.82) than the control group (M=4.12; SD=1.10) at 12 week follow-up ($p<.001$; Cohen's d=0.34).	Serious

10.2196/jmir.1963.		onset of the H1N1 pandemic)	**Sample**: Total N=517; N=336 intervention; N=181 control. Nearly two-thirds of the sample were women, and the age range was 22 to 82 years. The sample was predominantly high socioeconomic status. 46.4% of participants at baseline reported already meeting target of handwashing at least 10 times a day. **Intervention**: 4 weekly web sessions. Session 1 (10 core pages) had information about: the medical team giving the advice; the need to prevent seasonal and pandemic flu; the link between hand-washing and virus transmission; expert recommendations for hand-washing frequency and technique; and instructions for picking up a free supply of hand gel from their local practice. Participants completed a hand-washing plan and tailored feedback was provided to help users		**type**: Enablement; education; Persuasion; Training	***COM-B outcomes results summary:*** Intentions improved significantly more extent in the intervention than in the control group (time × group interaction $F1,375.4 = 11.71$, $P = .001$). Attitudes towards the behaviour improved significantly more in the intervention group (F1,382.2 = 14.91, P < .001). There was no effect of the intervention on subjective norm (F1,357.9 = 2.23, P = .14) or perceived behavioral control were negligible (F1,360.8 = 0.99, P= .32). The effect of the intervention on increased handwashing was explained indirectly by increases in positive attitude toward handwashing (coefficient = .16, 95% CI, .09–.26) and greater intentions for handwashing (coefficient = .15, 95% CI, .08–.26). ***Differences by demographics:*** Women had greater handwashing intentions and behaviour throughout the study but the frequency of handwashing did not change depending on the intervention. There was no effect of age or socioeconomic status on hand-	
				Comparator[a]	***Comparator***		
				N/A	N/A		

			improve their plan where necessary. Users were encouraged to print, sign, and post up the plan and involve other household members. The three remaining sessions reinforced positive attitudes and norms and addressed common negative beliefs identified during piloting. Tailored feedback was given about current hand-washing frequency, agreement that hand-washing would prevent virus transmission, and perceived difficulty of carrying out the behavior. Half of the participants were randomly assigned to also receive advice (1 page per session) on how to reduce infection risk by boosting the immune system (e.g., through a healthy lifestyle or taking echinacea) during session 2. **Comparator:** Usual care. No access to website during the study period. **Target Behaviour:** Hand washing			washing frequency or intentions.	

			Key outcome: Subjective outcome. Hand-washing frequency (explicitly defined as using soap and water or antibacterial gel) was assessed by a single item ranging from 1 (0–2 times a day) to 5 (10 or more times a day). **COM-B outcomes measured:** Instrumental and affective attitudes toward the behaviour. Subjective norms of the behaviour. Perceived behavioral control was a composite of self-efficacy ("I am confident that I could") and perceived control ("it will be possible for me") items. Intention to perform the behaviour. Perceived likelihood of catching pandemic flu if no preventive action was taken.				
Community level interventions							
(48) Updegraff, J. A., Emanuel, A. S., Gallagher, K. M., & Steinman, C. T. (2011). Framing	2011	Kent State University, Kent,	**Design:** Cluster randomized trial **Sample:** People who had access to high	***Exposure*** **Source:** Researchers **Method of dissemination:** Informational mode of	***Exposure*** Add hand sanitizer to the environment; provide visual prompt to perform the behaviour; increase	Compared to the control condition, hand sanitizer usage was significantly greater in the gain-framed signs condition (66.4% increase from control, $p<.001$), loss-framed signs	Moderate

flu prevention--an experimental field test of signs promoting hand hygiene during the 2009-2010 H1N1 pandemic. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*, *30*(3), 295–299. https://doi.org/10.1037/a0023125		OH, USA September 2009 to mid-March 2010. During H1N1 pandemic.	traffic public areas (i.e., lecture buildings, the library, cafeterias) where the hand sanitizers were placed. **Intervention:** 58 dispensers randomized to one of four signs, and changed every 3 weeks such that by end of study, each dispenser had been assigned to all four sign conditions: (a) Perceived susceptibility "Germs are out to get you. Get them first!" (b) social norms headline read "Everybody is doing it. Are you?" (c) the gain-framed headline read "Stay healthy this season. Sanitize your hands" (d) loss-framed headline read "H1N1. Getting it is as easy as passing me by." **Comparator:** 7 dispensers remained as a no-sign control over the course of the study **Target Behavior:** Hand sanitizer use **Key Outcome:** Objective outcome. Sanitizer usage –	delivery; Printed material mode of delivery; Public notice mode of delivery ***Comparator*** Not applicable	motivation for hand hygiene by increasing perceived susceptibility to H1N1; providing social norms for the behaviour; making positive consequences of the behavior salient; making negative consequences of not performing the behaviour salient. **Behaviour change wheel intervention type:** Persuasion; environmental restructuring ***Comparator*** Not applicable	condition (58.4% increase from control, p<.001), the social norms condition (44.3% increase compared to control, p<.001), and perceived susceptibility condition (40.6% increase, p<.001). Hand sanitizer use was significantly greater in the gain-framed condition when compared to all the other signs combined (12.5% more usage, p=.029). However, pairwise comparisons demonstrated that there was no difference between the gain-frame and loss-framed messages (p = .40). ***COM-B outcomes results summary:*** None. ***Differences by demographics:*** Note reported	

			grams of sanitizer used per day **COM-B outcomes measured:** None.				
Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.							

Table 6. Summary of studies reporting on effectiveness of interventions in promoting adherence to cleaning and disinfecting

Reference	Date released	Setting and time covered	Study characteristics	Intervention mode of delivery	Behaviour change strategy	Summary of key findings in relation to the outcome	Risk of bias
Individual level interventions							
(11) Blackman A, Hoffmann B (2022) Diminishing returns: Nudging Covid-19 prevention among Colombian young adults. PLOS ONE 17(12): e0279179. https://doi.org/10.1371/journal.pone.0279179]	22 December 2022	Bogota, Colombia, May to June, 2020	2x2 factorial randomized controlled trial **Sample**: 1349 students aged 18+ studying at more than 40 universities in Bogota. 318 in private arm, 327 in public arm, 346 in combined arm, 230 in pure control arm **Intervention** All participants attended an information session in a zoom meeting where they watched a pre-recorded slide deck presentation with information about health risks of COVID-19 and appropriate non-pharmacological interventions to reduce transmission. Then, participants were sent 3 email messages over the	***Exposure*** **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery ***Comparator*** **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	***Exposure*** Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	**Primary outcome results summary:** Compared to the control, there was a significant decrease in cleaning compliance in the personal benefits condition (b=-.27, SE=.13, p<.05), a 7 percent decrease. The public benefits and combined benefits conditions were not significantly different from the control condition. **COM-B results summary:** The personal benefits treatment increased perceived likelihood of infection (b=.20, SE=.05, p<.01), concern for self (b=.13, SE=.07, p<.05), concern for friends (b=.17, SE=.07, p<.05), and concern for community (b=.17, SE=.07, p<.05). Perceived likelihood of infection significantly increased in the public benefits condition (b=.17,	Critical

			course of 7 days with either a control or treatment intervention. All three interventions had common contextual information and recommended five non-pharmacological interventions (NPI), only differed in motivation for complying: - Personal benefits - Public benefits - Combined personal and public benefits - Neither (pure control) **Comparator:** Information on irrelevant subject **Target Behavior:** Cleaning **Key outcome:** Self-reported rates of compliance with cleaning as measured by % of days over the past 7 days where frequently touched surfaces were cleaned. Subjective outcome. **COM-B outcomes**			SE=.05, p<.01) and combined benefits condition (b=.17, SE=.04, p<.01). There was no difference in intended compliance across conditions. ***Differences by demographics:*** None reported	

			measured: Using a four-point Likert scale (from 1 to 4), with one being the lowest level and four the highest, respondents indicated the following: likelihood of infection, their self-assessed likelihood of contracting Covid-19; concern self, their level of concern about getting seriously ill from Covid-19; concern friends, their level of concern about infecting friends who then become seriously ill; concern household, their level of concern about infecting members of their household who then become seriously ill; and finally, concern community, their level of concern about infecting members of their community other than family and friends who then become seriously ill. Intended compliance: % of times over next 7 days intend to wear a mask while outside				
				Exposure	***Exposure***		Moderate

(36) Krpan, D., Makki, F., Saleh, N., Brink, S., & Klauznicer, H. (2021). When behavioural science can make a difference in times of COVID-19. Behavioural Public Policy, 5(2), 153-179. doi.org/10.1017/bpp.2020.48	26 August 2020	United Kingdom and United States. April 8, 2020 to April 17, 2020	**Design**: Randomized trial. Participants were randomly allocated to one of five conditions (control and 4 interventions conditions). **Sample**: N=2863 included (males=1401, females=1456, others=6, mean age=45.744) from general population. **Intervention**: Participants were allocated to participate in one of the following interventions: 1) Write a letter to a vulnerable person they knew stating that they would do whatever necessary to reduce COVID transmission and ensure their survival. 2) Write a clear plan to implement a meaningful activity from tomorrow, including necessary steps to ensure they are ready to start and how to overcome obstacles. 3) Read a text article with an economic argument for adhering	**Source:** Researcher **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery ***Comparator[a]*** N/A	Increasing motivation and intentions for compliance, situational cueing, evoke feelings of collaboration, dispel misconceptions about virus, induce empathy. **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	Disinfecting behaviour was not significantly different in the Letter condition vs the control (b=.08, SE=.16, p=.626, 95% CIs [-.24, .39]), in the meaningful activity plan condition vs control (b=.24, SE=.16, p=.134, 95% CIs [-.07, .55]), in the economy argument condition vs control (b=.19, SE=.16, p=.228, 95% CIs [-.12, .50]), or in the hypothetical scenario condition (b=.18, SE=.16, p=.258, 95% CIs [-.13, .49]). **COM-B secondary outcome results:** No significant relationships between the COM-B variables and disinfecting. ***Differences by demographics:*** None reported	

			to strict physical distancing measures for the economy in the long run. 4) Presented with six hypothetical scenarios in which people may violate behavioural recommendations to reduce COVID transmission (e.g., socializing with neighbours who live in the same building and have been compliant with staying at home). Rate the appropriateness of the actions in the scenario. **Comparator:** Participants in the control condition did not receive any experimental manipulation. **Target Behaviour:** Disinfecting **Key outcome**: Subjective outcomes. Disinfecting behaviour (whether people were disinfecting any packages or foods they brought into the house) was measured on a scale from 1 (strongly disagree) to 7				

			(strongly agree). Compliance was measured by the percentage of participants who selected a particular response option for the variable. **COM-B outcomes measured:** Perceived seriousness of disease, health concern if affected y COVID-19, concern for close others, concern for vulnerable others, economic concern, knowledge about COVID-19, and future intentions to undertake protective behaviours going forward.				
Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.							

Table 7. Summary of studies reporting on effectiveness of interventions in promoting adherence to multiple behaviours

Reference	Date released	Setting and time covered	Study characteristics	Intervention mode of delivery	Behaviour change strategy	Summary of key findings in relation to the outcome	Risk of bias
Individual level interventions							
(49) Pearce, L. & Cooper, J. (2021) Fostering	September 20th 2021	Online, time covered not	**Design**: Randomized trial with random assignment to one of 4 conditions (Advocacy,	***Exposure*** **Source:** WHO, researchers **Method of**	***Exposure*** Increase knowledge of COVID precautionary behaviour guidelines; evoke positive attitudes	Frequency of performing COVID precautionary behaviours was higher in the dissonance condition (*M*=51.58, SD=44.89) than	Serious

COVID-19 Safe Behaviors Using Cognitive Dissonance, Basic and Applied Social Psychology, 43:5, 267-282, DOI: 10.1080/01973533.2021.1953497		reported	Mindfulness, Dissonance, Control). **Sample**: 101 participants recruited from Prolific (online crowdsourcing platform). **Intervention**: All participants watched a video produced by the World Health Organization, one group of participants (Advocacy) was asked to advocate for taking action to conform to the WHO recommendations. Another group watched the video and then was asked to remember times that they had violated WHO recommendations (Mindfulness). The dissonance group watched the video, advocated for taking action, and then wrote about occasions in which they had violated WHO recommendations. **Comparator:** Watched the video	**dissemination:** Visual informational mode of delivery; Pull mode of delivery ***Comparator*** **Source:** WHO, researchers **Method of dissemination:** Visual informational mode of delivery	toward guideline behaviours; behaviour monitoring; elicit cognitive dissonance. **Behaviour change wheel intervention type**: Education, Persuasion ***Comparator*** Increase knowledge of COVID precautionary behaviour guidelines **Behaviour change wheel intervention type**: Education	the advocacy condition (*M*=21.63, SD=15.73), mindfulness condition (*M*=21.571 SD=24.10) and control condition (*M*=27.64, SD=33.06). Inferential statistics not reported. ***COM-B outcomes results summary:*** In all conditions, the participants' appeared to favour COVID-19 safety precautions (Control M=5.36; Advocacy M=5.29; Mindfulness M=5.05; Dissonance M=5.11). The data show that intentions to behave in accordance with safety measures was high across conditions (Control M=6.15, Advocacy M=6.0, Dissonance M=6.07), except Mindfulness, where it was noticeably lower (M= 5.6). No inferential statistics reported. ***Differences by demographics:*** None reported	

			about WHO recommendations before proceeding directly to the dependent measures. **Target Behaviour:** Several target behaviours: indoor contact with people of different household; mask-wearing and/social distance when having indoor contact with people of different household; outdoor contact with people of different household; mask-wearing and/social distance when having outdoor contact with people of different household; wearing face-mask; use of hand sanitizer; wearing a fabric face-mask; washing fabric face-mask; store fabric face-mask in sanitary way; go out to store; wear face-mask in store; sanitize door surfaces; get curbside delivery; attend social gathering with >3 people from different household. **Key outcome**: Subjective outcome. Self-report frequency				

			of performing behaviours related to Covid-19 safety measures during the past seven days. The frequency of performing the various behaviours was summed, with a range of 0-100. **COM-B outcomes measured:** Attitude Questionnaire, evaluating participants' agreement with safety precautions such as those mentioned in the WHO video. Intention Questionnaire evaluating participants' intention to follow safety measures during the next seven days.				
(50) Torres C, Ogbu-Nwobodo L, Alsan M, et al. Effect of Physician-Delivered COVID-19 Public Health	July 14th 2021	United states, August 7 to September 6, 2020	**Design**: Randomized controlled trial **Sample**: Participants aged 18 years or older, self-identifying as White or Black, and without a college degree were	***Exposure*** **Source**: American Medical Association; medical doctor; Centers for Disease Control and Prevention. **Method of dissemination:**	***Exposure*** Increase knowledge about COVID symptoms and transmission, increase credibility of information, make case counts salient, increase knowledge of guidelines, make increased risk to Black individuals salient,	At follow-up 1 week later, there was no difference in the safety gap index incidence rate between the control group (0.47 (95%CI, 0.45-0.48) and the intervention group (0.45 (95%CI, 0.44-0.46) in the treatment group (IRR, 0.96 [95%CI 0.92-1.01];	Moderate

Messages and Messages Acknowledging Racial Inequity on Black and White Adults' Knowledge, Beliefs, and Practices Related to COVID-19: A Randomized Clinical Trial. *JAMA Network Open*. 2021;4(7):e2117115. https://doi.org/10.1001/jamanetworkopen.2021.17115			eligible. The intervention was tailored for the Black community. N=20,460 took part with N=16,366 assigned to intervention group and N=4094 assigned to control group. Our sample included 9880 (55.9%) women. The mean (SD) age was 40.2 (17.8) years, 4206 (23.8%) reported household incomes greater than $60 000, 4228 Black participants (53.7%) and 2749 White participants (28.0%) identified as members of the Democratic party. **Intervention**: All participants saw 3 videos on COVID-19, recorded by several physicians of varied age, gender, and race. Video 1 defined COVID-19 and discussed common symptoms associated with COVID-19 as well as asymptomatic transmission. Video 2 reminded the viewer that COVID-19 was actively circulating in the United States.	Visual informational mode of delivery ***Comparator[a]*** **Source:** American Medical Association; medical doctor. **Method of dissemination:** Visual informational mode of delivery	acknowledge harms of systemic racism. **Behaviour change wheel intervention type**: Education ***Comparator*** **Comparator** Acknowledge harms of systemic racism; increase knowledge about health behaviours. **Behaviour change wheel intervention type**: Education	*P* = .08, q = .08). Overall, 244 participants (20.1%) and 218 participants (18.0%) in the control group and 1040 participants (21.6%) and 837 participants (17.4%) in the intervention group reported respecting all and none, respectively, of 4 safety practices. ***Differences by demographics:*** The effect of intervention relative to control on knowledge gaps was more pronounced for participants with a high school education or more.	

			Video 3 described the Centers for Disease Control and Prevention physical distancing guidelines. Participants in each group (placebo and intervention) saw video messages delivered either by a Black or a White study physician. In the intervention condition, video 2 had a script that emphasized increased mortality for Black individuals (3 times as likely to become infected as White individuals and 4 times as likely to die), controlling for age. In addition, those randomized to the intervention condition were randomized within that condition to receive one of two statements from the American Medical Association: either about the role of systemic racism as a threat to public health, health equity, and excellence of medical care OR a placebo message about drug pricing.				

			Comparator: In the control groups, participants saw 3 placebo videos with generic health topics, including fitness guidelines, recommended sugar intake, and the importance of adequate sleep, delivered by either Black or White physicians. In addition, those randomized to the control condition were randomized within that condition to receive one of two statements from the American Medical Association: either about the role of systemic racism as a threat to public health, health equity, and excellence of medical care OR a placebo message about drug pricing. **Target Behaviour:** Several behaviours: wearing mask indoors, wearing mask outdoor, handwashing, physical distancing. **Key outcome**: Subjective outcome. Self-reported safety				

			behavior was measured a few days after the initial intervention among a subsample that was eligible for follow-up and could be tracked. Participants were asked about how often they engaged in 4 behaviors of interest: (1) whether they wore a mask indoors; (2) whether they wore a mask outdoors; (3) whether they washed their hands; and (4) whether they followed physical distancing guidelines. The safety gap index had values of 0 (if a participant reported that they always practiced the 4 behaviors of interest) to 4 (participant reported that they practiced none of the behaviors).				
Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.							

Table 8. Summary of behaviour change strategies across PHSMs by intervention type

Behaviour change strategy description	Comparator description	Supplemental Intervention types	Findings	PHSM	Risk of bias	Reference

Restriction						
Intervention description: Mask mandate **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** Texas Governor Greg Abbott **Method of dissemination:** Informational mode of delivery	**Comparator description**: Removal of mask mandate **Source**: N/A **Mode of delivery**: N/A	Coercion	The likelihood of physical distancing was higher when the mask mandate was in effect (OR = 1.21, 95% CI 1.09–1.34). Individuals had higher likelihood of physical distancing at the urban park with a trail compared to the farmer's market (OR = 4.61, 95% CI 4.10–5.17).	Masking	Critical	(2)
Intervention description: Lockdown **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** German government **Method of dissemination:** Informational mode of delivery	**Comparator description**: No lockdown **Source**: N/A **Mode of delivery**: N/A	N/A	At the beginning of the investigation period (13 January−8 March), we observed an overall median of traveled distances measured through mobile tracking of 15.33 km. The individual distances show large variation with quartiles 3.75 km (25% quantile) and 41.25 km (75% quantile). Those values decreased considerably after mobility restrictions were implemented. Comparing the beginning of the investigation period to the period 23 March to 17 May, the median decreased 46% to 8.22 km. The quartiles decreased to 1.28 km (25% quantile) and 26.6 km (75% quantile). Week of May 4th, national social distancing significantly declined further, with 10.0% ($p>0.01$) less social distancing on weekdays and 20.9% ($p>0.01$) less on weekends, compared with the week prior to relaxed	Physical distancing and reduction in contacts	Moderate	(22)

			social distancing mandates. This trend was observed regardless of reopening date. In the week of March 2nd, prior to the March 11th WHO pandemic announcement, there was a significant small-magnitude difference between weekday and weekend social distancing: national social distancing was 0.9% ($p<0.05$) greater on weekdays than on weekends. By the week of March 16th, following the pandemic announcement, 21.8% ($p<0.05$) more social distancing occurred on weekends compared with weekdays. Throughout April, social distancing remained higher on weekends than weekdays, although the magnitude of the disparity declined from early to late April, being 11.7% and 7.5% for the weeks of April 6th and 20th, respectively. However, by the week of May 4th, the first week following state reopening, the trend reversed: national social distancing was now 3.4% ($p<0.05$) greater on weekdays than weekends.			
Intervention description: Stay at home order **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** US government **Method of dissemination:** Informationalmode of delivery	**Comparator description**: No stay-at-home order **Source**: N/A **Mode of delivery**: N/A	N/A	Counties in states that enacted a stay-at-home order had significantly fewer people remaining within 1 mile of home (26.3% compared to 27.9%, $t = 6.13$, $p < .001$) and significantly more vehicle miles being traveled at baseline (5.5 million compared to 2.4 million, $t = 4.63$, $p < .001$) during the first week of March. Similarly, counties in states that enacted a stay-at-home order were more populated ($t = 4.66$, $p < .001$) and less rural ($t = 4.28$, $p < .001$). From the first week of March to the first week of April, counties in states that enacted a stay-at-home order had 3.1% more people remain within 1 mile of home (95% CI [2.6%, 3.6%], $p < .001$) and 1.6% fewer vehicle miles traveled (95% CI [0.6%, 2.6%],	Physical distancing and reduction in contacts	Low	(18)

			p = .002) compared to counties in states that did not enact a stay-at-home order. From the first week of April to the first week of May, counties in states that ended their stay-at-home orders by May 7 saw 1.2% fewer people remain within 1 mile of home (95% CI [1.0%, 1.4%], p < .001) and 6.2% more vehicle miles traveled (95% CI [4.6%, 7.9%], p < .001) compared to counties in states that maintained their stay-at-home orders.			
Intervention description: Stay at home order **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** US government **Method of dissemination:** Informationalmode of delivery	**Comparator description**: No stay-at-home order **Source**: N/A **Method of dissemination:** N/A	N/A	People's daily mobility decreased significantly but with different temporal lags following the implementation of statewide stay-at-home orders across these states. With the social distancing guidelines and shelter-at-home orders in place, the median home dwell time increased significantly in most states since March 23, 2020. The median travel distance decreased and the median home dwell time increased across the US during this period (before and after stay-at-home-orders: March 11 and April 10, 2020).	Physical distancing and reduction in contacts	Critical	(23)
Intervention description: Stay at home order and physical distancing directive **Behaviour change strategy**:	**Comparator description**: No stay-at-home order or physical distancing directive **Source:** N/A	N/A	Mobility decreased by 19% (P<0.001) in the ten days following the introduction of a social distancing order. Mobility was significantly reduced two to five days after shelter-in-place orders were passed. However, a sustained marginal effect of shelter-in-place orders on mobility was not detected after accounting for the effects of social distancing orders already in place	Physical distancing and reduction in contacts	Moderate	(17)

Enforcing required behaviour with changes to law. **Source:** Georgia government **Method of dissemination:** Informationalmode of delivery	**Method of dissemination:** N/A		(all counties had physical distancing orders prior to shelter-in-place orders). Therefore, the event study involving shelter-in-place orders indicates the marginal effect of shelter-in-place orders after accounting for social distancing orders.			
Intervention description: Release of national guidelines, stay at home orders, physical distancing directive **Behaviour change strategy**: Enforcing required behaviour with changes to law, providing guidelines for recommended behaviours. **Source:** US government, WHO **Method of dissemination:** Informationalmode of delivery	**Comparator description**: Absence of national guidelines, stay at home orders, and physical distancing directive **Source:** N/A **Method of dissemination:** N/A	Coercion	Throughout March, mobility declined, indicating that social distancing was increasing with the number of confirmed cases. However, the magnitude of the decline in mobility peaked nationally on April 12th, with 56.1% less mobility recorded than prior to the pandemic. Following this peak, social distancing decreased, despite a continued increase in new cases. During the week of March 16th, following the WHO declaration of a COVID-19 pandemic on March 11th and President Trump's declaration of a national emergency on March 13th, national social distancing significantly increased both on weekdays – with a 18.6% decline in mobility ($p<0.05$) compared with the week of March 2nd – and weekends – with a 41.3% decline ($p<.05$) This increase in social distancing occurred before the CDC announced specific social distancing guidelines on March 16th. In the week beginning April 20th, after the White House had released the OUAA guidelines, individuals socially distanced significantly less on weekdays (1.1%, $p<0.05$ less social distancing) and on the weekends (5.3%, $p<0.05$) than during the week prior to the week of the guideline release.	Physical distancing and reduction in contacts	Critical	(21)

			This decline (i.e., increase in mobility) occurred before any states officially relaxed social distancing policies, which were not implemented until the week of April 27th.			
Intervention description: Stay at home orders **Behaviour change strategy**: Enforcing required behaviour with changes to law **Source:** US government **Method of dissemination:** Informationalmode of delivery	**Comparator description**: Prior to stay-at-home order **Source:** N/A **Method of dissemination:** N/A	N/A	There was an approximately 25% increase in grocery/pharmacy mobility prior to implementation of stay-at-home orders, potentially reflecting anticipatory shopping prior to sheltering in place. This was preceded by a 15% increase and subsequent decline in retail/recreation mobility. The increase in grocery/pharmacy mobility coincided with a 25% decrease in workplace mobility and a 10% increase in residential mobility, consistent with transition to working from home. After implementation of stay-at-home orders, mobility in grocery/pharmacy, retail/recreation and workplace decreased 10%–40%, while residential mobility increased 10%–20%. These reductions in mobility were significantly more pronounced in urban compared with rural counties, After stay-at-home orders elapsed, all mobility began to increase toward baseline levels, more rapidly in urban than rural areas. Grocery/pharmacy mobility ultimately exceeded baseline mobility in rural areas	Physical distancing and reduction in contacts	Moderate	(16)
Intervention description: Lockdown **Behaviour change strategy**: Enforcing required behaviour with changes to law **Source:**	**Comparator description**: Prior to lockdown **Source:** N/A **Method of dissemination:** N/A	N/A	The incident number of social contacts significantly reduced from 90% during 1st week of lockdown to 40% during the 4th week, and returned to pre lockdown levels in the immediate post lockdown weeks (91%), a significant increase from during lockdown. Similar trends were observed in duration of social contacts. The level of compliance to lockdown in terms of relative reduction in social contact rate during and post lockdown periods in	Physical distancing and reduction in contacts	Serious	(14)

Puducherry government **Method of dissemination:** Informational mode of delivery			comparison to the pre-lockdown phase is given in. Over four out of five people (82.4%) in the district of Puducherry were adherent to a high level of compliance to lockdown during the first week of lockdown. However, by the fourth week of nationwide lockdown, high levels of compliance declined to less than half (45.2%). Then, again the level of compliance has increased to more than 80% even after the withdrawal of nationwide lockdown (1st week post-lockdown). However, seven months post-lockdown, the compliance to the high level of reduction in social contact rate declined to about 11.9%.			
Intervention description: Lockdown and stay at home order **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** Ontario government **Method of dissemination:** Informational mode of delivery	**Comparator description**: Prior to lockdown or stay at home order **Source:** N/A **Method of dissemination:** N/A	N/A	Mobility data indicated that time spent in residence increased slightly over the course of one month after the stay-at-home order announcement in April. Then, time spent in residence decreased in May. People were more likely to adhere to time spent in residence on weekdays than on weekends. There was a decrease in mobility outside of residence for at least 3 weeks after the stay-at-home order announcement. Although people seemed to adhere to the second stay-at-home order in April, mobility outside of residence significantly increased in May compared to April. The increase in mobility outside of the residence is related to the mobility increase in public parks due to good weather.	Physical distancing and reduction in contacts	Moderate	(15)
Intervention description: Declaration of national emergency, stay at home order and physical distancing directive	**Comparator description**: Prior to national emergency declaration	N/A	The states are sorted in descending order by their SDI scores on the last weekday (May 29). The top five regions that are performing more social distancing are the District of Columbia, Hawaii, New York, New Jersey, and Maryland, all of which issued stay-at-home	Physical distancing and reduction in contacts	Moderate	(20)

Behaviour change strategy: Enforcing required behaviour with changes to law. **Source:** US government **Method of dissemination:** Informational mode of delivery	**Source:** N/A **Method of dissemination:** N/A		orders. Meanwhile, the states practicing less social distancing are Wyoming, North Dakota, South Dakota, Arkansas, and Montana, most of which did not issue stay-at-home mandates. On the East and West Coasts, it is possible that people practiced more social distancing because they were exposed to the infection risk for a longer period and are aware of the higher infection risk with higher population density.			
Intervention description: Stay at home order **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** Government of New York **Method of dissemination:** Informational mode of delivery	**Comparator description**: Prior to stay-at-home order **Source:** N/A **Method of dissemination:** N/A	N/A	Percent area with red traffic congestion was highest during the pre-COVID time period, and then decreased abruptly during COVID Period 1 (from a mean of 0.99% to 0.41%) before steadily increasing for COVID Periods 2 and 3. By COVID Period 3, the mean percent area with red traffic congestion had rebounded to about 75% of the pre-pandemic average. During the Pre-COVID period rush hour peaks were highest, with weekdays demonstrating a clear bimodal distribution with peaks around 9 am and 5 pm, and weekends a clear unimodal peak around 5 pm. However, during COVID Period 1, both weekday and weekend traffic peaks were greatly dampened, and the bimodal weekday distribution shifted to nearly unimodal, becoming very similar to the weekend distribution. During COVID Period 2 and 3 the daily traffic peaks were greater than for Period 1, but still lower than pre-pandemic levels. Even as overall traffic increased during these periods, the weekday distribution remained altered, such that the morning peak was much smaller than the evening peak.	Physical distancing and reduction in contacts	Serious	(19)

Intervention description: Lockdown **Behaviour change strategy**: Enforcing required behaviour with changes to law. **Source:** US state governments **Method of dissemination:** Informational mode of delivery	**Comparator description**: Same period from previous year with no lockdown **Source:** N/A **Method of dissemination:** N/A	N/A	Following national lockdowns, participants in all countries stayed at home for longer. Post-hoc Dunn-Bonferroni tests by country: Italy Z=-9.38, p<.001 Spain Z=-8.98, p<.001 Denmark Z=-5.44 p=.02 UK Z=-9.19 p<.001 Netherlands Z=-7.33 p<.001 During national lockdowns compared to pre-lockdown, participants in all countries travelled shorter distances. Post-hoc Dunn-Bonferroni tests by country: Italy Z=9.0, p<.001 Spain Z=8.91, p<.001 Denmark Z=5.48 p=.02 UK Z=8.40 p<.001 Netherlands Z=-7.58 p<.001 During national lockdowns compared to pre-lockdown, participants in all countries had fewer Bluetooth-enabled devices in the vicinity. Post-hoc Dunn-Bonferroni tests by country: Italy Z=9.68, p<.001 Spain Z=8.16, p<.001 Denmark Z=5.06 p=.02 UK Z=10.2 p<.001 Netherlands Z=-7.73 p<.001	Physical distancing and reduction in contacts	Serious	(24)
Intervention description: Stay at home orders, closures, mandatory NPI implementation **Behaviour change strategy**: Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate	**Comparator description**: Periods before and after intervention was lifted **Source:** N/A **Method of dissemination:** N/A	N/A	Individuals reported a high tendency to avoid crowded public areas even prior to the measures (69%, SD 12%, P=0.80), and so there was no significant difference between before and during CB (85%, SD 1.1%, P=0.80). Before CB, the proportion of individuals reporting work-from-home arrangements was 17% (11–31%). During CB, it significantly increased (20.4%, 95% confidence interval [CI] 11.7–29.2, *P*<0.01). There was no statistically significant difference between periods during and after CB.	Physical distancing and reduction in contacts	Critical	(3)

behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Source:** Singapore government **Method of dissemination:** Informational mode of delivery						
Intervention description: Stay at home orders, closures, mandatory NPI implementation **Behaviour change strategy**: Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Source:** Singapore government **Method of dissemination:** Informational mode of delivery	**Comparator description**: Period before and after intervention was lifted **Source:** N/A **Method of dissemination:** N/A	N/A	Before CB, the proportion of individuals washing hands and using hand sanitizer was on average 83% (standard deviation [SD] 3.2%). During the CB, it increased to 84% (SD 0.8%, P=0.48). This behaviour remained high with no significant difference after CB.	Hand hygiene and respiratory etiquette for COVID-19	Critical	(3)

Intervention description: Stay at home orders, closures, mandatory NPI implementation **Behaviour change strategy**: Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase knowledge of appropriate behaviours. Reinforcement of behaviors with financial penalty for non-compliance. **Source:** Singapore government **Method of dissemination:** Informational mode of delivery	**Comparator description**: Period before and after intervention was lifted **Source:** N/A **Method of dissemination:** N/A	N/A	Before CB, the proportion of individuals wearing face masks in public was on average 25% (standard deviation [SD] 5.4%). During the CB, it increased to 86% (SD 7.7%). The difference in average proportion before and during CB was statistically significant (46.9%, 95% CI 34.9–58.8, P<0.01).	Masking	Critical	(3)
Intervention description: Mask mandate **Behaviour change strategy**: Enforcing required behaviour with mandate; prompt mask-wearing with signage; negative reinforcement with fines for non-compliance.	**Comparator description**: Areas with no mask mandate. **Source:** N/A **Method of dissemination:** N/A	Coercion	In areas with the mask mandate, proportion of mask-wearing increased by more than 30 percentage points (second difference = 0.32, $p < 0.001$). The predicted probability of mask-wearers in the pre-intervention treatment condition was 3% and 39% in the post-intervention condition.	Masking	Moderate	(9)

Source: Amsterdam and Rotterdam municipal governments. **Method of dissemination:** Informational mode of delivery; public notice mode of delivery.						
Environmental restructuring						
Intervention description: Environmental redesign **Behaviour change strategy**: Aim to affect personal motivation towards handwashing compliance by affecting the active environment. **Source:** Researchers **Method of dissemination:** Environmental change mode of delivery	**Comparator description**: No environmental design change. **Source:** N/A **Method of dissemination:** N/A	N/A	There were significant differences between groups during the single intervention phase, χ^2=57.92, df=4, p<.001, where the local lighting had the highest rates of handwashing. Among all groups, the lighting intervention group developed the most effective and stable positive effect while the wood-background intervention group showed the worst effect, with similar rates of handwashing to the control group. In the combined intervention phase, combining greening, lighting, and auto-faucet achieved the rates of handwashing (group 4). Followed by auto-faucet plus lighting (group 5), then nature-based background plus lighting (group 2). The results strongly indicate that combined-design interventions showed better effects on handwashing than the single interventions.	Hand hygiene and respiratory etiquette	Moderate	(38)
Intervention description: Add walking directions, free masks, and buzzer to indicate violations of physical distancing, to the environment.	**Comparator description**: No walking directions and no supplementary intervention **Source:**	Enablement	People in the no walking directions condition were more likely to form a higher number of contacts than those in the condition with unidirectional walking directions (OR = 1.66, 95% CI [1.25, 2.17]). People in the unidirectional walking condition were no more likely to form contacts than those in the bidirectional	Physical distancing and reduction in contacts	Serious	(28)

Behaviour change strategy: Prompt the precautionary behaviour, negative reinforcement of violating precautionary behaviours, direct feedback on violations of the precautionary behaviour, restructuring of the environment **Source:** Researchers **Method of dissemination:** Environmental change mode of delivery; Wearable stimulus mode of delivery	N/A **Method of dissemination:** N/A		walking condition (OR = 0.99, 95% CI [0.75, 1.26]). People in the buzzer condition were more likely to form a higher number of contacts than in the no supplementary intervention condition (OR = 1.24, 95% CI [0.95, 1.55]). However, once participants were given a demonstration of the buzzer and the buzzers were programmed to give immediate feedback, people in the buzzer condition were less likely to form a higher number of contacts than in the no supplementary intervention condition (OR = 1.43, 95% CI [1.06, 1.91]). This suggests that immediate feedback of being less than 1.5 metres distance from someone can promote physical distancing. There was no difference in the number of contacts formed between people who received a mask to wear and those who did not receive a mask to wear (OR = 1.05, 95% Credible Interval [0.81, 1.33]).			
Intervention description: Add persuasive standing point stickers (i.e. indicating correct distance) to the environment **Behaviour change strategy**: Prompt the precautionary behaviour, restructuring of the environment, increase threat appeal of virus, provide performance standards.	**Comparator description**: A conventional standing point sticker with a footprint demonstrate appropriate distance. **Source:** Researchers **Mode of delivery:** Environmental change mode of delivery	N/A	The proportion of people failing to physically distance significantly decreased between the first marker and the 5th marker in all conditions (34.2-38.8% at 4th and 5th markers vs 85.2-55.2% at 1st-3rd markers, $p<.001$). There was no difference in the interventions (i.e., fearful picture, red one-way arrow sign, and norm-speech sticker) in promoting physical distancing compliance compared with the control intervention.	Physical distancing and reduction in contacts	Serious	(29)

Source: Researchers **Method of dissemination:** Environmental change mode of delivery; Textual mode of delivery; visual mode of delivery						
Intervention description: Mobile app to notify of exposure to COVID-19 case/confirmation of positive COVID-19 test result **Behaviour change strategy**: Prompt protective action by providing knowledge of exposure to COVID. **Source:** Cantonal Health Directorate **Method of dissemination:** Mobile digital device mode of delivery	**Comparator description**: Notification of exposure to COVID positive case by manual contact tracing. **Source:** Cantonal Health Directorate **Method of dissemination:** Call mode of delivery	N/A	There was no evidence for a difference in the time from exposure to quarantine between app notified (median 0.5 days, IQR0.5–2.0) and non-app notified household contacts (median 1 day, IQR 0.5–2.0; p=0.11).	Quarantine and isolation	Moderate	(1)
Intervention description: Provision of free masks, education on mask use, role models for mask usage	**Comparator description**: No mask, education, or role models. **Source:** N/A	Education, Training, Modelling,	The free mask and education arm increased mask usage by 3.1 percentage points (p = 0.037; 95% CIs [1.9, 6.0]) from a mean correct mask usage rate in control villages of 6.8%. Mask usage in the education only (M=1.5% increase; 95% CIs [1.2, 4.4]) and role model (2.3% increase; 95% CIs [0.5, 5.2])	Masking	Moderate	(7)

Behaviour change strategy: Masks were handed to educate villagers on both the proper use of the mask to prevent COVID-19 transmission, as well as enable role modelling by trusted community members. **Source:** Researchers, SafeHands Kenya **Method of dissemination:** Human interactional mode of delivery; Environmental change mode of delivery	**Method of dissemination:** N/A		interventions were not significantly greater than the control condition. The increase in mask usage in the free mask and education arm compared to control was not maintained at 5-8 week follow-up.			
Intervention description: Provision of free masks, education on mask use, role models for mask usage, prompt mask wearing with reminder texts; persuade mask wearing with messages of altruism or self-protection; increase motivation to wear mask with verbal/public commitments; increase mask-wearing social norms; incentivization. **Behaviour change strategy**: Masks were distributed to educate villagers on both	**Comparator description**: The control villages did not receive any interventions. **Source:** N/A **Method of dissemination:** N/A	Education Persuasion; Incentivization; Modelling	Mask-wearing was 13.3% in control villages and 42.3% in intervention villages. Adjusted regression estimates indicate a significant overall increase of 28.8 percentage points (95% CI [0.26, 0.31] for all intervention villages. Considering only surveillance conducted when no mask distribution was taking place, mask-wearing increased 27.9 percentage points, from 13.4% in control villages to 41.3% in intervention villages (regression adjusted estimate = 0.28 [0.26, 0.30]). We also run our analysis separately in mosques, markets, and other locations such as tea stalls, the entrance of restaurants, and the	Masking	Low	(8)

the proper use of the mask to prevent COVID-19 transmission; prompt mask-wearing at point-of-use with face-to-face interaction; enable role modelling by trusted community members; prompt mask wearing with reminder texts; persuade mask wearing with messages of altruism or self-protection; increase motivation to wear mask with verbal/public commitments; increase mask-wearing social norms; incentivization. **Source:** The Honorable Prime Minister of Bangladesh Sheikh Hasina, the head of the Imam Training Academy, and national cricket star Shakib Al Hasan. WHO from brochure materials. Local leaders, including imams. **Method of dissemination:** Face to face mode of delivery; Playable electronic storage mode of delivery; Human interactional			main road in the village. The increase in mask wearing was largest in mosques (37.0 percentage points), whereas in all other locations it was 25 to 29 percentage points. None of the additional village cross-randomizations (i.e. receive reminder text message, certificate incentive, monetary incentive, public commitment) or household cross-randomizations (i.e. 100% or 50% of household receive reminder texts, altruistic or self-protective messaging, or verbal commitment) significantly increased mask-wearing.			

mode of delivery; Printed material mode of delivery						
Enablement						
Intervention description: Mobile app with education and daily persuasive messages and exercises **Behaviour change strategy**: Goal setting, instruction to perform behaviour, information about consequences, action planning, pros and cons, problem solving, verbal persuasion about capabilities, focus on past success, self-reward, information about antecedents, self-monitoring, prompts/cues, behaviour practice/rehearsal, habit formation, monitoring of behaviour by others without feedback, feedback on behaviour, social comparison, social reward, social incentive, information about health consequences, information about others' approval, credible source, social incentive,	**Comparator description**: No control group, intervention arms were compared to each other. **Source:** N/A **Method of dissemination:** N/A	Education; Persuasion; Incentivisation; Training; Environmental restructuring; Modelling	In all intervention conditions, hand hygiene significantly increased over time ($F = 10.95$, $P < .01$). There was no effect of exposure to a specific module during the course of the intervention.	Hand hygiene and respiratory etiquette	Serious	(43)

restructuring the physical environment. **Source:** Federal Office of Public Health, researchers **Method of dissemination:** Informational mode of delivery; Mobile digital device mode of delivery; Pull mode of delivery						
Intervention description: Mobile app with education and daily persuasive messages and exercises, implementation intention plans **Behaviour change strategy**: Increase knowledge and skills for the behaviours, increase knowledge and salience risks of non-compliance, increase self-efficacy by modelling the behaviour, increase self-incentive, self-monitoring of behaviour, form implementation intentions. **Source:** Researchers	**Comparator description**: Baseline measurement without mobile app **Source:** N/A **Method of dissemination:** N/A	Persuasion; Education; Incentivisation; Environmental restructuring; Training	Hand washing significantly increased throughout the study period ($b = 0.02$, $SE = 0.01$, 95% CI [0.01; 0.03], $p < 0.001$). Specifically, participants on average washed their hands about 1.9 times more per day on day 86 (6.9 times), as compared with baseline (5.0 times), which represents a large effect size ($\lambda = 0.84$, F (1,63) = 11.85, $p = 0.001$; $\eta^2 = 0.16$).	Hand hygiene and respiratory etiquette	Serious	(46)

Method of dissemination: Textual mode of delivery; Visual informational mode of delivery; Pull mode of delivery						
Intervention description: Weekly web sessions with education and persuasive messages and exercises, implementation intention plans **Behaviour change strategy**: Enhance credibility with medical expertise; implementation plan formation with situational cueing; reinforce positive attitudes and norms towards handwashing; address common negative beliefs, e.g. perceived vulnerability to infection. **Source:** Health professionals; researchers **Method of dissemination:** Textual mode of delivery; website mode of delivery	**Comparator description**: Usual care. No access to website during the study period. **Source:** N/A **Method of dissemination:** N/A	Education; Persuasion; Training	Handwashing rates were higher postintervention in the intervention condition (M=4.40; SD=0.86) than in the control group (M=4.04; SD=0.86) at 4 weeks follow-up (p<.001; Cohen's *d*=0.42). Handwashing rates remained higher in the intervention group (M=4.45; SD=0.82) than the control group (M=4.12; SD=1.10) at 12 week follow-up (p<.001; Cohen's *d*=0.34).	Hand hygiene and respiratory etiquette	Serious	(47)
Intervention description: Educational workshop with book, song,	**Comparator description**: Unrelated activities **Source:**	Education; Persuasion; Modelling; Training	Between baseline and post-intervention in the intervention group, the percentage of participants performing handwashing behaviours increased for soap (55% vs 71% p<.001), wrists (4% vs 29% p<.001), fingers	Hand hygiene and respiratory etiquette	Moderate	(41)

activities, and online games. **Behaviour change strategy**: Increase knowledge of handwashing techniques; increase confidence in handwashing techniques; improve handwashing skills; provide access to handwashing facilities; provide social roles models for the behaviours; increase motivation by eliciting perceived benefits of handwashing and perceived costs of not handwashing; increase perceived susceptibility and severity of adverse outcomes; elicit fear and disgusts of germs; facilitate descriptive and injunctive norms toward the behaviour. **Source:** Researchers **Method of dissemination:** Human interactional mode of delivery; Face to face mode of delivery; Printed material mode of delivery; website mode of delivery; gamification mode of delivery.	N/A **Method of dissemination:** N/A		(11% vs 34% p<.001) and nails (1% vs 19% p<.001). There was no difference in rubbing (70% vs 76% p=.26) or drying (78% vs 84% p=.21). Overall, the number of handwashing behaviours being performed post-intervention compared to baseline was significantly higher (Est = 0.93, SE = 0.14, t = 6.57, p < 0.001). Between baseline and follow-up in the intervention group, the percentage of participants performing handwashing behaviours remained significantly higher for wrists (4% vs 16% p<.001), fingers (11% vs 29% p<.001) and nails (1% vs 10% p<.001). Overall, significant improvements between baseline vs. follow-up were observed in the intervention group in the number of handwashing behaviours, Est = 0.48, SE = 0.14, t = 3.30, p = 0.001. There was no significant difference between baseline and follow-up for any of the handwashing behaviours in the control group.			

Intervention description: Point-of-use educational song and video prior to handwashing **Behaviour change strategy**: Increase knowledge of handwashing techniques; increase confidence in handwashing techniques; provide social roles models for the behaviours **Source:** Researchers **Method of dissemination:** Audio informational mode of delivery before observing handwashing	**Comparator description:** Same as intervention, after measuring handwashing **Source:** Researchers **Method of dissemination:** Audio informational mode of delivery. Delivered after observing handwashing	Education; Modelling; environmental restructuring	The number of handwashing behaviours performed by the intervention group was significantly higher than the control group (*Est.* =-0.71, *SE* = 0.34, *t* = -2.07, *p* = 0.04). The number of behaviours of handwashing performed also increased with age (*Est.* = 0.87, *SE* = 0.23, *t* = 3.71, *p* < 0.001).	Hand hygiene and respiratory etiquette	Moderate	(42)
Intervention description: Action planning **Behaviour change strategy**: Situational cueing of behaviour; increase behaviour regulation by reducing obstacles **Source:** Researchers **Method of dissemination:**	**Comparator description:** No experimental manipulation **Source:** N/A **Method of dissemination:** N/A	N/A	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=4.11, SD=0.79) than the control condition (M=3.78, SD=1.00, p=.056). At follow-up, behaviour compliance for sneezing or coughing into elbow was not significantly different in the intervention condition (M=4.37, SD=1.01) than the control condition (M=4.25, SD=0.91, p=.032) after Holm-Bonferroni correction for multiple testing. At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition (M=4.34,	Hand hygiene and respiratory etiquette	Serious	(31)

Website mode of delivery; Pull mode of delivery			SD=0.98) than the control condition (M=3.98, SD=1.20, p=.478)			
Intervention description: Action planning **Behaviour change strategy**: Situational cueing of behaviour; increase behaviour regulation by reducing obstacles **Source:** Researchers **Method of dissemination:** Website mode of delivery; Pull mode of delivery	**Comparator description:** No persuasive messaging **Source:** N/A **Method of dissemination:** N/A	N/A	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=4.03, SD=0.80) than the control condition (M=3.93, SD=0.91, p=.366). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.23, SD=1.09) than the control condition (M=4.12, SD=1.11, p=.309). At follow-up, behaviour compliance for staying home as much as possible was not significantly different in the intervention condition (M=3.79, SD=1.11) than the control condition (M=3.49, SD=1.22, p=.014) after Holm-Bonferroni correction for multiple testing. At follow-up, behaviour compliance for receiving as little visitors as possible was significantly higher in the intervention condition (M=4.06, SD=1.79) than the control condition (M=3.42, SD=1.70, p=.212). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the intervention condition (M=3.16, SD=1.72) than the control condition (M=3.46, SD=1.70, p=.239). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=4.34, SD=0.98) than the control condition (M=3.98, SD=1.20, p=.003).	Physical distancing and reduction in contacts	Serious	(31)
Persuasion						

Intervention description: Receive immediate feedback on COVID-19 immunity status **Behaviour change strategy**: Increase awareness of COVID-19 immunity, make risk salient **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery	**Comparator description:** Delayed feedback **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery (delayed for 4 weeks)	N/A	Two weeks after antibody test results were reported to participants in the immediate results condition, chi-square tests indicated that participants in this condition did not report significantly higher or lower engagement in staying home from work and school, avoiding social events, or ensuring physical distancing in public.	Physical distancing and reduction in contacts	Serious	(12)
Intervention description: Receive immediate feedback on COVID-19 immunity status **Behaviour change strategy**: Increase awareness of COVID-19 immunity, make risk salient **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery	**Comparator description:** Delayed feedback **Source:** COVID-19 lab testing staff **Method of dissemination:** Email mode of delivery (delayed for 4 weeks)	N/A	Participants who received antibody test results immediately did not report significantly higher or lower engagement in wearing face masks in the following 2 weeks compared to participants who did not receive their test results for 4 weeks. Furthermore, for seronegative participants, receiving antibody test results was not associated with higher or lower face mask engagement [RR (95% CI): 1.01 (1.00, 1.03)]. Similar results were observed for our smaller sample of seropositive participants [RR (95% CI): 0.91 (0.80, 1.04)].	Masking	Serious	(12)

Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	**Comparator description:** Irrelevant information **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	N/A	Compared to the control, there was a significant decrease in cleaning compliance in the personal benefits condition (b=-.27, SE=.13, p<.05), a 7 percent decrease. The public benefits and combined benefits conditions were not significantly different from the control condition.	Cleaning and disinfecting	Critical	(11)
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increasing motivation and intentions for compliance, situational cueing, evoke feelings of collaboration,	**Comparator description:** No experimental manipulation **Source:** N/A	N/A	Disinfecting behaviour was not significantly different in the Letter condition vs the control (b=.08, SE=.16, p=.626, 95% CIs [-.24, .39]), in the meaningful activity plan condition vs control (b=.24, SE=.16, p=.134, 95% CIs [-.07, .55]), in the economy argument condition vs control (b=.19, SE=.16, p=.228, 95% CIs [-.12, .50]), or in the hypothetical scenario condition (b=.18, SE=.16, p=.258, 95% CIs [-.13, .49]).	Cleaning and disinfecting	Moderate	(36)

dispel misconceptions about virus, induce empathy. **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery	**Method of dissemination:** N/A					
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Appeal to different emotions, such as fear (by making the threat of pandemic salient) or prosocial motivation (by highlighting externalities of the preventive actions). **Source:** Researchers **Method of dissemination:** Messaging mode of delivery	**Comparator description**: No messages. **Source:** N/A **Method of dissemination:** N/A	N/A	Pooling the results of all treatment arms compared to control, there was no evidence that sending SMS messages increased uptake of handwashing. Compared to control where uptake of reported handwashing was 35%, uptake of handwashing across treatment arms increased by 0.2% ($p>.05$). The lack of effect of SMS messages was demonstrated whether using administrative delivery reports on text message receipt as the endogenous variable in a treatment-on-the-treated specification or self-reported receipt of any COVID-related message. There was also no consistent evidence of differences between the control condition or treatment arms targeting handwashing when the different treatment arms were compared to control in separate analyses. There was no difference in handwashing uptake when two messages were received in the morning compared to one message in the morning and one in the evening.	Hand hygiene and respiratory etiquette	Moderate	(27)
Intervention description:	**Comparator description:**	N/A	Compared to control, there was a small increase in handwashing compliance in the public benefits treatment (b=1.66, SE=.98,	Hand hygiene and respiratory etiquette	Critical	(11)

Persuasive messaging and exercises **Behaviour change strategy**: Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	Irrelevant information **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery		p<.10), an increase of 2%. However, this effect did not reach significance. No other treatments had an effect on handwashing compliance.			
Intervention description: Point-of-use persuasive messaging on outdoor signs **Behaviour change strategy**: Increase knowledge and salience of appropriate behaviours	**Comparator description**: No signs. **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	Observed adherence to hand hygiene behaviours when entering the building was significantly better on day two of the experiment, after our sign was in place (28% vs. 16%; $\chi 2=13.3$, p=0.0003)	Hand hygiene and respiratory etiquette	Serious	(6)

Source: Researchers **Method of dissemination:** Informational mode of delivery, visual information mode of delivery, public notice mode of delivery						
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increasing motivation and intentions for compliance, situational cueing, evoke feelings of collaboration, dispel misconceptions about virus, induce empathy. **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery	**Comparator description:** No experimental manipulation **Source:** N/A **Method of dissemination:** N/A	N/A	Handwashing times was not significantly different in the Letter condition vs the control (b=-.23, SE=.29, p=.426, 95% CIs [-.81, .34]), in the meaningful activity plan condition vs control (b=-.22, SE=.29, p=.442, 95% CIs [-.78, .34]), in the economy argument condition vs control (b=.05, SE=.29, p=.873, 95% CIs [-.51, .61]), or in the hypothetical scenario condition (b=.24, SE=.28, p=.392, 95% CIs [-.31, .80]). Relative handwashing was not significantly different in the Letter condition vs the control (b=-.05, SE=.09, p=.573, 95% CIs [-.23, .13]), in the meaningful activity plan condition vs control (b=-.09, SE=.09, p=.304, 95% CIs [-.26, .08]), in the economy argument condition vs control (b=-.11, SE=.09, p=.191, 95% CIs [-.28, .06]), or in the hypothetical scenario condition (b=.03, SE=.09, p=.720, 95% CIs [-.14, .20]).	Hand hygiene and respiratory etiquette	Moderate	(36)
Intervention description: Persuasive messaging and exercises plus education	**Comparator description:** Education-only	Education	Participants reported greater rates of avoiding touching the face with unwashed hands at follow-up (1 week later) compared	Hand hygiene and respiratory etiquette	Serious	(44)

Behaviour change strategy: Increase knowledge of WHO guidelines; increase positive attitudes toward the behavior; encourage the formation of a goal intention to avoid touching face with unwashed hands; increase perceived risk toward touching face with unwashed hands; increase perceived behavioural control to perform the behaviour; increase intentions to perform the behaviour; develop plan to implement behaviour with situational cuing. **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery	**Source:** N/A **Method of dissemination:** Computer mode of delivery; Textual mode of delivery		to baseline (F (1,252) = 8.52, p = .004, ηp 2 = .033), regardless of condition. There was no statistically significant time × condition interaction effect, F (1,252) = 0.911, p = .341, ηp 2 = 0.004, meaning that the rate of change in avoidance of touching the face did not differ between intervention and control conditions			
Intervention description: Persuasive messaging and exercises plus education **Behaviour change strategy**: Increase knowledge of WHO guidelines; increase positive attitudes toward the behavior; encourage	**Comparator description:** *Control group 1*: Education-only *Control group 2*: no-education control condition **Source:** N/A	Education	Participants reported greater rates of avoiding touching the face with unwashed hands at follow-up (1 week later) compared to baseline, F (1,242) = 23.67, p < .001, ηp 2 = 0.089, such that uniform increases in avoiding touching the face with unwashed hands were observed from baseline to follow-up 1 week later. There was no statistically significant difference between intervention and control	Hand hygiene and respiratory etiquette	Serious	(45)

the formation of a goal intention to avoid touching face with unwashed hands; increase perceived risk toward touching face with unwashed hands; increase perceived behavioural control to perform the behaviour; increase intentions to perform the behaviour; develop plan to implement behaviour with situational cuing. **Source:** Researchers **Method of dissemination:** Computer mode of delivery; Textual mode of delivery	**Method of dissemination:** Computer mode of delivery; Textual mode of delivery		conditions, F (2,242) = 2.58, p = .078, ηp 2 = 0.021. There was also no statistically significant time × condition interaction effect, F (2,242) = 1.12, p = .328, ηp 2 = 0.009, meaning that the rate of change in avoidance of touching the face did not differ between intervention and control conditions.			
Intervention description: Point-of-use persuasive messaging/ nudges **Behaviour change strategy**: Prompting a reminder to perform the behavior, increase motivation for hand sanitizer use by inducing empathy for vulnerable people, evoking moral reasoning to perform the behavior.	**Comparator description:** No persuasive messaging **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	Inference nudging increased hand disinfection in customers of the grocery store. The proportion of participants using hand disinfection at the store entrance was higher for the goal inference (68.1%) and action inference nudging (66.1%) than the control group (44.0%), p<.001. These effects generalized to the fresh foods area, where sanitization was higher following goal (40.1%) than action inference nudging (33.7%) or controls (32.1%), p<.013. The average amount of used alcohol per customer entering the fresh foods area was higher in the goal inference nudging condition (0.48 g) compared to the other conditions (0.30–0.34 g), p<.016.	Hand hygiene and respiratory etiquette	Moderate	(40)

Source: Researchers **Method of dissemination:** Printed material mode of delivery						
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Provide behavioural norms; provide positive role models of precautionary behaviours; increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery.	**Comparator description:** No persuasive messaging **Source:** N/A **Method of dissemination:** N/A	Modelling	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=4.09, SD=0.93) than the control condition (M=4.11, SD=0.91, p=.898). At follow-up, behaviour compliance for sneezing or coughing into elbow was not significantly different in the intervention condition (M=4.41, SD=0.91) than the control condition (M=4.36, SD=0.94, p=.584). At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition (M=4.03, SD=1.41) than the control condition (M=4.17, SD=1.30, p=.394).	Hand hygiene and respiratory etiquette	Serious	(32)
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**:	**Comparator description:** No persuasive messaging **Source:** N/A	Incentivisation	At follow-up, behaviour compliance for washing hands was not significantly different in the intervention condition (M=3.69, SD=1.07) than the control condition (M=3.72, SD=1.03, p=.821). At follow-up, behaviour compliance for sneezing or coughing into elbow was not	Hand hygiene and respiratory etiquette	Serious	(33)

Provide behavioural norms; provide positive role models of precautionary behaviours; increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery.	**Method of dissemination:** N/A		significantly different in the intervention condition (M=4.10, SD=1.07) than the control condition (M=4.07, SD=1.16, p=.877). At follow-up, behaviour compliance for use of tissue was not significantly different in the intervention condition (M=3.97, SD=1.36) than the control condition (M=3.86, SD=1.44, p=.658).			
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Source:** Researchers **Method of dissemination:** At-a-distance	**Comparator description:** Irrelevant information **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	N/A	Compared to the control, there was no significant change in masking compliance in the personal benefits (b=.30, SE=.89, p>.05), public benefits (b=-1.14, SE=1.10, p>.05), or combined private and public benefits (b=-1.00, SE=.96, p>.05) conditions.	Masking	Critical	(11)

mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery						
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase empathy and reciprocity towards health workers, provide social norms, evoke a sense of civic duty, increase salience to risk perception, increase self-efficacy, prompt behavior, increase motivation. **Source:** Researchers **Method of dissemination:** Mobile digital device mode of delivery	**Comparator description:** No text messages **Source:** N/A **Method of dissemination:** N/A	N/A	Receiving a text message significantly increases the probability of having reported using a mask when leaving their home in the last seven days compared to control. Yet, when the five different treatment groups are compared with the control, respondents who received the 'civic duty' frame, designed to prime a sense of duty to protect family and friends, were consistently more likely to always wear a mask, although this difference is small. Also, on average, 77% of people report that they always wore a mask in public during the previous seven days. However, respondents who received the 'civic duty' frame were 3% more likely to report always wearing a mask (an increase of 2.3 percentage points).	Masking	Serious	(4)
Intervention description: Persuasive imagery exercises **Behaviour change strategy**:	**Comparator description:** Social media image of a public health message about face masks. **Source:**	Education	Compared to the control condition, mask-wearing adherence was not statistically significantly different than the outcomes imagery condition (b = .294, Wald $\chi2(1)$ = .441, p = .507), process imagery condition (b = −.234, Wald $\chi2(1)$ = .303, p = .582) or combined imagery condition (b = −.340,	Masking	Serious	(10)

Increase knowledge of masking guidelines, increase positive attitudes toward the behavior, increase behavioural control, increase self-efficacy. **Source:** Researchers, UK government **Method of dissemination:** Informational mode of delivery; Pull mode of delivery (a mode of delivery that requires action from participants)	UK government **Method of dissemination:** Informational mode of delivery		Wald $\chi2(1) = .285$, $p = .594$) at 4 week follow-up.			
Intervention description: Point-of-use persuasive messaging on outdoor signs **Behaviour change strategy**: Increase knowledge and salience of appropriate behaviours **Source:** Researchers **Method of dissemination:** Informational mode of delivery, visual information mode of	**Comparator description**: No signs. **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	Observed adherence for adequate mask wearing when entering the building was significantly greater on day two of the experiment, after the signage was in place (99.7% vs. 82%; $\chi2=68.8$, $p=0.00001$)	Masking	Serious	(6)

delivery, public notice mode of delivery						
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase knowledge of COVID precautionary behaviour guidelines; evoke positive attitudes toward guideline behaviours; behaviour monitoring; elicit cognitive dissonance. **Source:** WHO, researchers **Method of dissemination:** Visual informational mode of delivery; Pull mode of delivery	**Comparator description:** WHO video **Source:** WHO, researchers **Method of dissemination:** Visual informational mode of delivery	Education	Frequency of performing COVID precautionary behaviours was higher in the dissonance condition (*M*=51.58, SD=44.89) than the advocacy condition (*M*=21.63, SD=15.73), mindfulness condition (*M*=21.57, SD=24.10) and control condition (*M*=27.64, SD=33.06). Inferential statistics not reported.	Multiple	Serious	(49)
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Appeal to different emotions, such as fear (by making the threat of pandemic salient) or prosocial motivation (by highlighting externalities of the preventive actions).	**Comparator description**: No messages. **Source:** N/A **Method of dissemination:** N/A	N/A	Pooling the results of all treatment arms compared to control, there was no evidence that sending SMS messages increased uptake of handwashing. Compared to control where uptake of reported physical distancing was 36%, uptake of physical distancing across treatment arms decreased by 0.3% (p>.05). The lack of effect of SMS messages was demonstrated whether using administrative delivery reports on text message receipt as the endogenous variable in a treatment-on-the-treated specification or self-reported receipt of any COVID-related message.	Physical distancing and reduction in contacts	Moderate	(27)

Source: Researchers **Method of dissemination:** Messaging mode of delivery			There was also no consistent evidence of differences between the control condition or treatment arms targeting physical distancing when the different treatment arms were compared to control in separate analyses. There was no difference in physical distancing uptake when two messages were received in the morning compared to one message in the morning and one in the evening.			
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase knowledge of risk and consequences, increase salience of risk and consequences, induce empathy, increase knowledge of benefits of protective behaviours **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Audio informational mode of delivery; Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	**Comparator description:** Irrelevant information **Source:** Researchers **Method of dissemination:** Email mode of delivery; Textual mode of delivery; Visual informational mode of delivery	N/A	There was no significant change in staying home from the control in compliance between the personal benefits (b=.01, SE=.13, p>.05), public benefits (b=.06, SE=.13, p>.05), or combined private and public benefits (b=-.10, SE=.14,p>.05) conditions. There was no significant change in physical distancing from the control in compliance between the personal benefits (b=.51, SE=1.68, p>.05), public benefits (b=.1.57, SE=2.05, p>.05), or combined private and public benefits (b=2.19, SE=1.52, p>.05) conditions.	Physical distancing and reduction in contacts	Critical	(11)

Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Increase empathy and reciprocity towards health workers, provide social norms, evoke a sense of civic duty, increase salience to risk perception, increase self-efficacy, prompt behavior, increase motivation. **Source:** Researchers **Method of dissemination:** Mobile digital device mode of delivery	**Comparator description:** No text messages **Source:** N/A **Method of dissemination:** N/A	N/A	Compared to the control group, receiving SMS messages was not associated with differences in the frequency with which individuals left their homes, or reported keeping distance.	Physical distancing and reduction in contacts	Serious	(4)
Intervention description: Persuasive messaging and exercises, credible sources **Behaviour change strategy**: Provide credibility for message; increase knowledge of PHSMs; increase knowledge to combat misinformation; improve skills such as active listening, self-disclosure, empathy, and conflict management.	**Comparator description:** Experimental conditions were compared to each other **Source:** Government health agencies, near-peer parents, or news media **Method of dissemination:**	N/A	Reports of physical distancing for both mothers (b= –0.10, 95% CIs [–0.12, –0.08], p<.001) and daughters (b= –0.10, 95% CIs [–0.12, –0.03], p<.001) decreased over the 9 weeks of the study. The decline in physical distancing by daughters over time was greater when mothers were in the near-peer parents group (b=–0.04, 95% CI –0.07 to 0.00, p=.03) but decline less when mothers were in the government agency group (b=0.05, 95% CI 0.02-0.09, p=.003). There was no difference in rate of decline in physical distancing in mothers between treatment groups. Mothers who rated the assigned information source as credible reported greater physical	Physical distancing and reduction in contacts	Moderate	(30)

Source: Government health agencies, near-peer parents, or news media **Method of dissemination:** Electronic mode of delivery; Textual informational mode of delivery.	Electronic mode of delivery; Textual informational mode of delivery.		distancing for self (b=0.29, 95% CI 0.09-0.49, P<.01) and daughters (b=0.31, 95% CI 0.11-0.51, P<.01). The higher perceived credibility of the individual posts rated during the intervention also predicted increased physical distancing by daughters (b=0.23, 95% CI 0.04-0.42, P=.02) but not mothers (b=0.07, 95% CI –0.09 to 0.23, P=.37).			
Intervention description: Point-of-use persuasive messaging on outdoor signs **Behaviour change strategy**: Increase knowledge and salience of appropriate behaviours **Source:** Researchers **Method of dissemination:** Informational mode of delivery, visual information mode of delivery, public notice mode of delivery	**Comparator description**: No signs. **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	Observed physical distancing was significantly better on day two of the experiment, after the signage was in place (54.8% vs. 7%; $\chi 2 = 65.5$, $p<0.00001$)	Physical distancing and reduction in contacts	Serious	(6)
Intervention description: Point-of-use persuasive messaging from robot	**Comparator description:** The robot and banners were	Environmental restructuring	Distances between people (as measured by average safety in a frame) were significantly higher in the first experimental week compared to control weeks (coefficient = 0.6, SE=0.2, p=.002). Distances between	Physical distancing and reduction in contacts	Moderate	(26)

Behaviour change strategy: Aim to induce empathy with an empathy prompt. **Source:** Researchers, university **Method of dissemination:** (a) Electronic environmental object mode of delivery; (b) Public notice mode of delivery; (c) Visual informational mode of delivery	removed and movie screens were black. **Source:** N/A **Method of dissemination:** N/A		people were lower in the second experimental week compared to control (coefficient =-.08, SE=.02, p<.001). There was no difference in distances between people in the third experimental week compared to control.			
Intervention description: Persuasive message reminder **Behaviour change strategy**: Increase motivation for physical distancing by making positive consequences of the behavior salient; making negative consequences of not performing the behaviour salient; prompting the behaviour. **Source:** Danish public authorities **Method of dissemination:**	**Comparator description:** No reminder message **Source:** N/A **Method of dissemination:** N/A	N/A	The "you" and "family" conditions result into a 19.7% and a 14.9% increase in the percentage of participants who reported staying home compared to the control group, but these were not significant differences (p = .127 and p = .251 respectively). Overall, there was no effect of the interventions (either framing messages by "you", "family", "others", and "country", or by framing messages as gains or losses) compared to the control group.	Physical distancing and reduction in contacts	Moderate	(35)

Electronic mode of delivery; Textual informational mode of delivery.						
Intervention description: Persuasive message reminder, credible sources **Behaviour change strategy**: Increase knowledge and salience of physical distancing guidelines, increase outcome expectancies, induce salience of compliance or noncompliance compared with others by social comparison, increase credibility and authority of the message. **Source:** Either Prime Minister Shinzo Abe or Emperor Naruhito **Method of dissemination:** Textual mode of delivery; At-a-distance mode of delivery; Visual informational mode of delivery	**Comparator description:** Intervention conditions were compared to each other. **Source:** Either Prime Minister Shinzo Abe or Emperor Naruhito **Method of dissemination:** Textual mode of delivery; At-a-distance mode of delivery; Visual informational mode of delivery	N/A	There were no significant effects between Prime minister with feedback and the Prime minister without feedback conditions. For participants whose outing time during the first week was above the median value, receiving a message from the Emperor with feedback reduced their unnecessary outing time by 26 percent from the 159 minutes of unnecessary outing time in those who received a message from the Emperor without feedback. However, for participants whose total outing time was below the median value, receiving a message from the Emperor with feedback increased their total outing time by 39% percent from the 129 minutes of total outing time in those who received a message from the Emperor without feedback. Meanwhile, unnecessary outing time was unaffected. Although the back-firing effect of information feedback was expected, the fact that we only found it in the Emperor condition was unexpected. Contrary to our expectations about the power of the messenger, we found no significant effects of changing outing behaviors between Prime minister feedback condition vs Emperor feedback conditions. There were also no differences found between Prime minister without feedback vs Emperor message without feedback.	Physical distancing and reduction in contacts	Serious	(34)
Intervention description:	**Comparator description:**	N/A	General distancing was not significantly different in the Letter condition vs the control (b=-.02, SE=.04, p=.562, 95% CIs	Physical distancing and	Moderate	(36)

Persuasive messaging and exercises **Behaviour change strategy**: Increasing motivation and intentions for compliance, situational cueing, evoke feelings of collaboration, dispel misconceptions about virus, induce empathy. **Source:** Researchers **Method of dissemination:** At-a-distance mode of delivery; Pull mode of delivery; Textual information mode of delivery	No experimental manipulation **Source:** N/A **Method of dissemination:** N/A		[-.10, .05]), in the meaningful activity plan condition vs control (b=-.01, SE=.04, p=.858, 95% CIs [-.08, .07]), in the economy argument condition vs control (b=-.01, SE=.04, p=.789, 95% CIs [-.08, .06]), or in the hypothetical scenario condition (b=.02, SE=.04, p=.563, 95% CIs [-.05, .09]). Number of times leaving the house was not significantly different in the Letter condition vs the control (b=-.07, SE=.05, p=.154, 95% CIs [-.17, .03]), in the meaningful activity plan condition vs control (b=-.04, SE=.05, p=.363, 95% CIs [-.14, .05]), in the economy argument condition vs control (b=-.06, SE=.05, p=.203, 95% CIs [-.16, .03]), or in the hypothetical scenario condition (b=-.04, SE=.05, p=.385, 95% CIs [-.14, .05]). Number of hours spent outside the house was not significantly different in the Letter condition vs the control (b=-.13, SE=.06, p=.041, 95% CIs [-.25, -.01]) after a correction was applied for multiple testing, in the meaningful activity plan condition vs control (b=-.06, SE=.06, p=.333, 95% CIs [-.18, .06]), in the economy argument condition vs control (b=-.07, SE=.06, p=.270, 95% CIs [-.18, .05]), or in the hypothetical scenario condition (b=-.10, SE=.06, p=.106, 95% CIs [-.21, .02]). Number of times leaving the house for exercise was not significantly different in the Letter condition vs the control (b=-.04, SE=.05, p=.372, 95% CIs [-.13, .05]), in the meaningful activity plan condition vs control (b=-.05, SE=.05, p=.313, 95% CIs [-.13, .04]), in the economy argument condition vs control (b=-.08, SE=.04, p=.068, 95% CIs [-.17, .01]), or in the hypothetical scenario condition (b=-.02, SE=.04, p=.662, 95% CIs [-.11, .07]).	reduction in contacts		

			Number of hours spent outside the house for exercise was not significantly different in the Letter condition vs the control (b=-.05, SE=.04, p=.282, 95% CIs [-.13, .04]), in the meaningful activity plan condition vs control (b=-.04, SE=.04, p=.416, 95% CIs [-.12, .05]), in the economy argument condition vs control (b=-.06, SE=.04, p=.160, 95% CIs [-.14, .02]), or in the hypothetical scenario condition (b=-.07, SE=.04, p=.128, 95% CIs [-.15, .02]). Keeping distant was not significantly different in the Letter condition vs the control (b=-.01, SE=.08, p=.941, 95% CIs [-.16, .15]), in the meaningful activity plan condition vs control (b=-.07, SE=.08, p=.368, 95% CIs [-.22, .09]), in the economy argument condition vs control (b=-.06, SE=.08, p=.490, 95% CIs [-.21, .09]), or in the hypothetical scenario condition (b=.08, SE=.08, p=.332, 95% CIs [-.07, .22]). Meeting family and friends was not significantly different in the Letter condition vs the control (b=-.19, SE=.34, p=.581, OR=0.83, 95% CIs [.43, 1.60]), in the meaningful activity plan condition vs control (b=-.16, SE=.33, p=.621, OR=0.85, 95% CIs [.45, 1.61]), in the economy argument condition vs control (b=-.07, SE=.31, p=.825, OR= 1.07, 95% CIs [.59, 1.94]), or in the hypothetical scenario condition (b=-.32, SE=.33, p=.338, OR=0.73, 95% CIs [.38, 1.40]). Social gathering was not significantly different in the Letter condition vs the control (b=-.27, SE=.35, p=.434, OR=0.76, 95% CIs [.38, 1.51]), in the meaningful activity plan condition vs control (b=-.71, SE=.39, p=.067, OR=0.49, 95% CIs [.23, 1.05]), in the economy argument condition vs control (b=.32, SE=.30, p=.275, OR=			

			1.38, 95% CIs [.77, 2.46]), or in the hypothetical scenario condition (b=-.86, SE=.33, p=.033, OR=0.42, 95% CIs [.19, .93]) once the correction was applied for multiple testing.			
Intervention description: Point-of-use persuasive messaging **Behaviour change strategy**: Increase salience of threat, modelling of preventive behaviours, prompt behaviour, increase behavioural control. **Source:** Researchers **Method of dissemination:** Human interactional mode of delivery; Face to face mode of delivery	**Comparator description:** No messages **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	People were two times more likely (OR 2.0, 95% CI 1.5–2.7, P < 0.001) to keep a safe distance of 1.2 m or more from the traveller in front compared under intervention conditions compared with those received no intervention. When verbal advice was used, passengers were 2.6 times more likely (OR 2.6, 95% CI 1.8–3.7, P < 0.001) to keep a safe distance of 1.2 m or more from other passengers compared received no intervention. The verbal advice condition intervention was more influential compared with threat-appeal intervention (OR 1.5, 95% CI 1.1–2.1, = 0.022).	Physical distancing and reduction in contacts	Moderate	(25)
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Provide behavioural norms; provide positive role models of precautionary behaviours;	**Comparator description:** No persuasive messaging **Source:** N/A **Method of dissemination:**	Modelling	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=4.01, SD=0.85) than the control condition (M=4.02, SD=0.75, p=.801). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.19, SD=1.02) than the	Physical distancing and reduction in contacts	Serious	(32)

increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery.	N/A		control condition (M=4.12, SD=1.02, p=.352). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the intervention condition (M=3.59, SD=1.72) than the control condition (M=3.46, SD=1.70, p=.239). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=4.24, SD=0.92) than the control condition (M=4.24, SD=0.91, p=.974).			
Intervention description: Persuasive messaging and exercises **Behaviour change strategy**: Provide behavioural norms; provide positive role models of precautionary behaviours; increase positive attitude towards precautionary behaviours; elicit empathy for vulnerable people **Source:** Researchers **Method of dissemination:** Electronic mode of delivery; Visual informational mode of delivery.	**Comparator description:** No persuasive messaging **Source:** N/A **Method of dissemination:** N/A	Incentivisation	At follow-up, behaviour compliance for keeping 1.5 meters away from other people was not significantly different in the intervention condition (M=3.65, SD=1.07) than the control condition (M=3.72, SD=1.03, p=.801). At follow-up, behaviour compliance for avoiding people who are vulnerable was not significantly different in the intervention condition (M=4.08, SD=1.00) than the control condition (M=4.04, SD=1.09, p=.918). At follow-up, behaviour compliance for working from home as much as possible was not significantly different in the intervention condition (M=3.59, SD=1.62) than the control condition (M=3.48, SD=1.63, p=.511). At follow-up, behaviour compliance for avoiding crowds was significantly higher in the intervention condition (M=3.88, SD=1.33) than the control condition (M=3.76, SD=1.30, p=.193).	Physical distancing and reduction in contacts	Serious	(33)

Intervention description: Point-of-use persuasive messaging signs **Behaviour change strategy**: Add hand sanitizer to the environment; provide visual prompt to perform the behaviour; increase motivation for hand hygiene by increasing perceived susceptibility to H1N1; providing social norms for the behaviour; making positive consequences of the behavior salient; making negative consequences of not performing the behaviour salient. **Source:** Researchers **Method of dissemination:** Informational mode of delivery; Printed material mode of delivery; Public notice mode of delivery	**Comparator description**: No signs **Source:** N/A **Method of dissemination:** N/A	Environmental restructuring	Compared to the control condition, hand sanitizer usage was significantly greater in the gain-framed signs condition (66.4% increase from control, p<.001), loss-framed signs condition (58.4% increase from control, p<.001), the social norms condition (44.3% increase compared to control, p<.001), and perceived susceptibility condition (40.6% increase, p<.001). Hand sanitizer use was significantly greater in the gain-framed condition when compared to all the other signs combined (12.5% more usage, p=.029). However, pairwise comparisons demonstrated that there was no difference between the gain-frame and loss-framed messages (p = .40).	Hand hygiene and respiratory etiquette	Moderate	(48)
Intervention description: Point-of-use persuasive messaging on signs **Behaviour change strategy**: Prompt/cue action in the environment. Make social	**Comparator description**: No signs **Source:** N/A	Environmental restructuring	Dispensers with signs had higher use than those without signs. The signed dispensers had greater baseline usage (M = 1.66, 95% CI [1.10, 2.40]) than the no-sign dispensers (M = .71, 95% CI [.11, 1.88]), this difference was not significant, Mann–Whitney exact p = .20. Dispensers with signs (M 1.87, 95% CI [1.62, 2.16]) had 35% greater use than	Hand hygiene and respiratory etiquette	Low	(37)

comparison salient; increase motivation by making behaviour benefits salient **Source:** Researchers; university **Method of dissemination:** Textual information mode of delivery; public notice mode of delivery	**Method of dissemination:** N/A		dispensers with no signs (M = 1.39, 95% CI [.90, 2.06]), but this difference was not statistically significant, z=1.37, p=.172. The gain-framed sign (M = 1.76, 95% CI [1.48, 2.08]) was associated with 8% less usage than the static and dynamic norms signs combined (M = 1.94, 95% CI [1.66 to 2.24]), although this difference was not significant, z = 1.35, p = .176. The dynamic norms sign (M = 1.84, 95% CI [1.55, 2.18]) was associated with 7% less usage than static norms (M = 2.04, 95% CI [1.72, 2.40]), but this difference was also not significant, z = 1.23, p = .218. The difference between static norms and no sign (M = 1.39, 95% CI [.90, 2.06]) approached significance, z = 1.72, p = .085, with static norms associated with 46% greater usage. The only difference between the three signs that approached significance was not hypothesized and was between the static norms and gain-framed sign, z = 1.79, p = .073, with the static norms sign associated with 16% greater usage than the gain-framed sign (M = 1.76, 95% CI [1.47, 2.08]).			
Intervention description: Point-of-use persuasive messaging on electronic signs **Behaviour change strategy**: Prompt appropriate behaviour, increase motivation to perform behaviour by invoking social norms, action planning, or information about health consequences.	**Comparator description**: Two baseline periods lasting around 4 weeks (before first intervention period) and then 1 week (before second intervention period). A 12-inch digital display monitor was erected above the dispenser displaying the message, "Hand sanitizer" .	Environmental restructuring	There was no significant change in baseline usage during timepoints reflecting changes to COVID-19-restrictions, however there was a significant difference in the rate of use for hour of the day $F(10,361)$, 13.04, $p < 0.001$, and day of the week $F(6,365)$, 4.30, $p < 0.001$, with the morning and weekends seeing the highest usage ratios. Weekday and hour of the day were entered as covariates due to their significance.	Hand hygiene and respiratory etiquette	Moderate	(39)

Source: Unclear **Method of dissemination:** Electronic environmental object mode of delivery	**Source:** Unclear **Method of dissemination:** Electronic environmental object mode of delivery		Results showed that the usage ratio did not significantly change between individual messages and baseline [F(16,904) = 1.19, p = 0.279]. Messages were then grouped into their BCT. There was no significant difference in mean usage ratio either between BCT groups [F(3,906) = 1.33, p = 0.263]. Post hoc tests showed there was also no significant difference between messages (social comparison, p = 0.395; information, p = 1.000; action planning, p = 1.000).			
Education						
Intervention description: Tailored education message **Behaviour change strategy**: Increase knowledge about COVID symptoms and transmission, increase credibility of information, make case counts salient, increase knowledge of guidelines, make increased risk to Black individuals salient, acknowledge harms of systemic racism. **Source:** American Medical Association; medical doctor; Centers for Disease Control and Prevention.	**Comparator description:** Generic educational message **Source:** American Medical Association; medical doctor; Centers for Disease Control and Prevention. **Method of dissemination:** Visual informational mode of delivery	N/A	At follow-up 1 week later, there was no difference in the safety gap index incidence rate between the control group (0.47 (95%CI, 0.45-0.48) and the intervention group (0.45 (95%CI, 0.44-0.46) in the treatment group (IRR, 0.96 [95%CI 0.92-1.01]; *P* = .08, q = .08). Overall, 244 participants (20.1%) and 218 participants (18.0%) in the control group and 1040 participants (21.6%) and 837 participants (17.4%) in the intervention group reported respecting all and none, respectively, of 4 safety practices.	Multiple behaviors	Moderate	(50)

Method of dissemination: Visual informational mode of delivery						
Intervention description: CDC guidelines **Behaviour change strategy**: Increase knowledge of required behaviours **Source:** CDC **Method of dissemination:** Informational mode of delivery	**Comparator description**: Time period preceding CDC recommendation (3-4 April) **Source:** N/A **Method of dissemination:** N/A	N/A	There was no difference in mask-wearing (+2 pts, 95% CI[−2, 5]) or mask-buying (+2 percentage points, 95% CI[−2, 5]) from April 3 to April 4 (days before CDC guidelines announcement). Once the CDC recommendation had been in place for at least one full day (i.e., comparing the April 3-4 period to the April 5-7 period), there were large increases in reported mask wearing (+21pts, 95% CI[16, 27]; 48 to 69%) and mask buying (+16 pts, 95% CI[11, 21]; 43 to 59%). The significant increase in mask-wearing (+12 pts, 95% CI[7, 18]; 49 to 61%) and mask buying (+7 pts, 95% CI[2, 13]; 44 to 51%) between April 3-4 period to the April 5-7 period remained after controlling for income, race/ethnicity, political party, and geographic region, albeit of a smaller magnitude.	Masking	Moderate	(5)
Intervention description: CDC guidelines **Behaviour change strategy**: Enforcing required behaviour with closure of business, workplaces, schools, non-essential buildings, etc.; increase	**Comparator description**: Time period preceding CDC recommendation update **Source:** N/A	N/A	By early May 2020, the United States there has been a reduction of approximately 65% of the typical daily mobility. The aggregate trend in commute volume remained relatively stable from early May, at about a 60–70% reduction, though it began to trend upwards again as of early September. At its peak, the amount of transits between metropolitan areas among participants had decreased by almost 50%, on average.	Physical distancing and reduction in contacts	Serious	(13)

knowledge of appropriate behaviours. **Source:** CDC/US guidelines **Method of dissemination:** Informational mode of delivery	**Method of dissemination:** N/A		By early May, the average daily mobility decreased by between 45–55% relative to a typical weekday. The range of distance traveled increased steadily from May to June, and by early July returns to about 95% of the typical behavior. Participants had 75% fewer distinct contacts per day by mid-April. Unique contacts increased steadily starting in May and through June, leveling off for the remainder of the summer at approximately 40–50% reduction compared to typical contacts. This increased trend in contacts coincided with loosening of restrictions. By mid-April, the duration of contacts was reduced by about 75% compared to typical behavior before physical distancing measures took effect. Then, from May to June, there was a steady increase up to about a 45% reduction from typical.			

Table 9. Summary of studies reporting on spillover effects of interventions in promoting adherence

Reference	Date released	Setting and time covered	Study characteristics	*Intervention mode of delivery*	*Behaviour change strategy*	Summary of key findings in relation to the outcome	Risk of bias
Population level interventions							
(2) Trevas, S., Manuel, K., Malkani, R., & Hoelscher, D. (2023). Mask Adherence and Social Distancing in Houston, TX from January to April 2021. International Journal of Environmental Research and Public Health, 20(3), 2723. https://doi.org/10.3390/ijerph20032723	03 February 2023	Texas, US, From 20 January to 30 April 2021.	**Design**: Prospective, serial, cross-sectional observational study **Sample**: People in public spaces that were observed for the study: (1) an urban park; (2) an urban park with a trail; and (3) a farmer's market. Sociodemographic information based on observations: Out of the 7778 observations, 62.7% of individuals were White, 11.2% were Black, 16.4% were Latino, and 9.7% were Asian. Most (53.4%) of the individuals observed were female, and the age distribution was as follows: 0.50% of individuals were toddlers (0–2 years old), 6.2% were children (3–12 years old), 1.2% were teens (13–19 years old),	**Exposure** **Source:** Texas Governor Greg Abbott **Method of dissemination:** Informational mode of delivery **Comparator[a]** N/A	**Exposure** Enforcing required behaviour with changes to law; coerce compliance with behaviour with financial penalty for non-compliance. **Behaviour change wheel intervention type**: Restriction; coercion **Comparator** N/A	The likelihood of physical distancing was higher when the mask mandate was in effect (OR = 1.21, 95% CI 1.09–1.34). Individuals had higher likelihood of physical distancing at the urban park with a trail compared to the farmer's market (OR = 4.61, 95% CI 4.10–5.17). ***COM-B outcomes results summary:*** None. **Differences by demographics:** Women had lower odds of physical distancing compared to men (OR = 0.66, 95% CI 0.59–0.73). Latino and Asian individuals had lower odds of physical distancing compared to White individuals (OR = 0.75, 95% CI 0.65–0.87) and (OR = 0.68, 95% CI 0.56–0.82),	Critical

			80.3% were adults (20–59 years old), and 11.9% were seniors (60+ years old). **Intervention**: Mask mandate (in place since July 2020) and issuance of $250USD fines to anyone not wearing a mask or face covering (in place since August 2020). **Comparator:** Removal of mask mandate **Target Behaviour:** Masking outdoors **Spillover Behaviour:** Physical distancing **Key outcome**s: Incidence of observed physical distancing (defined as being six feet away from other people) during observations conducted from 10 a.m. to 12 p.m. on Saturdays for the farmer's market, and on Wednesdays and Fridays between the			respectively, whereas Black individuals had the highest odds of physical distancing (OR = 1.19, 95% CI 1.01–1.40). Compared to adults, children and teenagers had lower odds of physical distancing, whereas seniors had the highest odds of physical distancing.	

			hours of 11 a.m. and 2:40 p.m. at the parks. **COM-B outcomes measured:** None.				
(24) Sun, S., Folarin, A. A., Ranjan, Y., Rashid, Z., Conde, P., Stewart, C., et al. (2020). Using Smartphones and Wearable Devices to Monitor Behavioral Changes During COVID-19. Journal of medical Internet research, 22(9), e19992. https://doi.org/10.2196/19992	February 1, 2019 – July 5, 2020	Italy, Spain, Denmark, UK, the Netherlands	**Design**: Interrupted time series **Sample**: 1062 participants, recruited from survey collecting data for monitoring major depressive disorder, and MS using wearable devices. 1062 participants from Italy, Spain, Denmark, the UK, the Netherlands. **Intervention**: Lockdown period defined as the entire period of the respective national lockdown in each country, which ended when NPIs were eased for the first time. **Comparator:** Baseline period: same period in 2019 as 2020 during national lockdown for countries starting to collect data earlier than 2019, which included Italy, Spain,	**Exposure** **Source:** Governments of Italy, Spain, Denmark, the UK, the Netherlands **Method of dissemination:** Pull mode of delivery **Comparator[a]** N/A	**Exposure** Enforcing required behaviour with changes to law. **Behaviour change wheel intervention type:** Restriction **Comparator** N/A	As expected, following respective national lockdowns, participants in all countries walked less. Post-hoc Dunn-Bonferroni tests by country: Italy Z=8.23, p<.001 Spain Z=7.72, p<.001 Denmark Z=5.48 p=.02 UK Z=6.82 p<.001 Netherlands Z=4.78 p<.001 Participants in Spain, Italy, and the UK went to bed later during lockdown compared with pre-lockdown. Post-hoc Dunn-Bonferroni tests by country: Italy Z=-4.31 p<.001 Spain Z=-7.54 p<.001 UK Z=-5.28 p<.001 Participants in Spain, Italy, and the UK slept more during lockdown compared with pre-lockdown. Post-hoc Dunn-Bonferroni tests by country: Italy Z=-4.65 p<.001 Spain Z=5.17 p<.001 UK Z=-4.24 p<.001	Serious

			and the UK. This was aimed at suppressing seasonal variability. For Denmark and the Netherlands where participant recruitment and data collection started much later, we chose the period that started with the earliest stable date (no considerate missing data or outliers) with the same length of the entire respective national lockdown. Pre-lockdown period: (immediately before lockdown) **Target Behaviour:** Time spent at home, maximum distance travelled from home, physical distancing **Spillover behaviours:** Physical activity, sleep **Spillover outcome:** Physical activity: total step count per day measured by Fitbit devices. Sleep: sleep duration (summation of three Fitbit-output sleep categories (light, deep, and rem) sampled				

			every 30 seconds for the time interval from 8 pm to 11 am the next day) and bedtime (Bedtime was defined as the time of the first sleep category reported by Fitbit after 8 pm). Objective outcomes. **COM-B outcomes measured:** none.				
(5) Goldberg MH, Gustafson A, Maibach EW, Ballew MT, Bergquist P, Kotcher JE, Marlon JR, Rosenthal SA and Leiserowitz A (2020) Mask-Wearing Increased After a Government Recommendation: A Natural Experiment in the U.S.	June 17th 2020	United States, April 3rd - 7th 2020	**Design**: Interrupted time-series. Comparison of before and after a CDC recommendation was announced. **Sample**: 4493 US respondents recruited by Climate Nexus Polling from April 3 to 7, 2020 → final sample of 3933 after excluding incomplete surveys/dropouts **Intervention:** CDC guidelines (classified as days after announcement from April 3-4 and 5-7)	**Exposure** **Source:** Centers for Disease Control and Prevention (CDC) **Method of dissemination:** Informational mode of delivery; Pull mode of delivery ***Comparator*** N/A	**Exposure** Compel required behaviours with guidelines; increase knowledge of required behaviours **Behaviour change wheel intervention type**: Education ***Comparator*** N/A	Between the 3-4 April and 5-7 April, there was a significant increase in: Handwashing (b=.04, 95% CI [.02, .07]) Tissue use (b=.04, 95% CI [.01, .07]) Disinfect home/workspace (b=.06, 95% CI [.02, .09]) Stopped shaking hands (b=.04, 95% CI [.01, .07]) Stopped hugging and kissing (b=.06, 95% CI [.03, .10]) Limit public transport (b=.05, 95% CI [.01, .09])	Moderate

During the COVID-19 Pandemic. Front. Commun. 5:44. https://doi.org/10.3389/fcomm.2020.00044			**Comparator:** Time period preceding CDC guidelines (day before announcement) **Target Behaviour:** Masking wearing, mask buying S**pillover behaviours:** Hand washing, tissue use for coughing/sneezing, cough/sneeze into elbow, disinfect home/workspace, stopped shaking hands, stopped hugging/kissing, limit public transportation, limit ridesharing (taxis, lyft, uber), maintain 6ft from others, stayed home school/work/other, avoid crowded places, reduced visiting place of worship, avoid personal events, avoid being with family/friends, prepare to stay at home, stopped traveling outside local area, stocked up on food/supplies/medication, worked from home, kept children home, , avoided			Limit ridesharing (b=.06, 95% CI [.01, .10]) Reducing visiting place of worship (b=.04, 95% CI [.01, .08]) Prepare to stay home (b=.05, 95% CI [.02, .09]) Keeping children home (b=.05, 95% CI [.01, .10])	

			restaurants, used hand sanitizer. **Spillover outcome:** Participants' responses to the question, "Which, if any, of the following actions have you taken because of the spread of the coronavirus?" (Yes = 1; No, I prefer not to = 0; No, I'm not able to = 0; Don't know = missing; Does not apply to me = missing)" in reference to 27 items on protective behaviors, such as (buying protective masks, wearing a mask in public to protect oneself or others				
(27)[b] Bahety, G., Bauhoff, S., Patel, D., & Potter, J. (2021). Texts don't nudge: An adaptive trial to prevent the spread of COVID-19 in India. Journal of developmen	Nove mber 2021	Bihar, India; betwee n August	**Design**: Randomized controlled trial. There were 10 treatment arms: 5 message types x 2 timing variations. Participants were randomly assigned to 10 rounds of treatment for each behaviour or control. **Sample**: Eligible participants were the users of phone numbers that	**Exposure** **Source:** Researchers **Method of dissemination**: Messaging mode of delivery ***Comparator*** N/A	**Exposure** Appeal to different emotions, such as fear (by making the threat of pandemic salient) or prosocial motivation (by highlighting externalities of the preventive actions). **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	***Spillover outcome results summary***: Pooling the results of all treatment arms for messages about physical distancing compared to control, there was no evidence that sending SMS messages changed uptake of handwashing. Compared to control where uptake of reported handwashing was 35%, uptake of 34.5% across treatment arms, a decrease of	Moderate

t economics, 153, 102747. https://doi.org/10.1016/j.jdeveco.2021.102747			were entered into birth registries at health centers in 15 out of 20 blocks in Saran between August 2019 and February 2020. About 75% of respondents were male with an average age of 31 years. Less than 1/3 unemployed, and most of those who worked did so in a manual job. Eighty-six percent of respondents can read SMS in Hindi, but 36% do not ever read text messages. Less than a third read SMS daily in the week prior to the interview. **Intervention:** A comparison of 10 message types: 2 target behaviours (handwashing & social distancing) x 5 message frames (neutral, public gain or loss, and private gain or loss). There were 10 treatment arms: 5 message types x 2 timing variations (2 morning texts at 7-8am and 10-11am OR			0.5% (p>.05) that was not significant. When examining individual treatment arms, participants who received the neutral framed message about physical distancing were less likely to report handwashing uptake (34.2%) compared to the control group (35%), which was statistically significant p<.05. ***COM-B outcomes results summary:*** There was no difference in knowledge of handwashing between control group (32%) and treatment groups who had received physical distancing messages (31.6%) (pooled across all treatments). When examining individual treatment arms, participants who received the private loss framed message about physical distancing were less likely to report handwashing knowledge (31.2%) compared to the control group (32%), which was statistically significant p<.05.	

			morning and evening texts at 7-8am and 6-7pm). Participants were randomly assigned to 10 rounds of treatment for each behaviour. They received four text messages over the course of two days between August and October 2020. **Comparator**: No messages. **Target Behaviour**: Physical distancing **Spillover behaviours**: Handwashing **Spillover outcome**: Subjective outcome. Open-ended question, "What are you doing to protect against the virus?". Handwashing (washing hands with soap regularly) based on whether the respondent mentions each practice. **COM-B outcomes measured**: Knowledge - open ended question asking about what respondents know about preventive				

			measures. Exact item not provided.				
(27)[b] Bahety, G., Bauhoff, S., Patel, D., & Potter, J. (2021). Texts don't nudge: An adaptive trial to prevent the spread of COVID-19 in India. Journal of development economics, 153, 102747. https://doi.org/10.1016/j.jdeveco.2021.102747	November 2021	Bihar, India; between August	**Design**: Randomized controlled trial. There were 10 treatment arms: 5 message types x 2 timing variations. Participants were randomly assigned to 10 rounds of treatment for each behaviour or control. **Sample**: Eligible participants were the users of phone numbers that were entered into birth registries at health centers in 15 out of 20 blocks in Saran between August 2019 and February 2020. About 75% of respondents were male with an average age of 31 years. Less than 1/3 unemployed, and most of those who worked did so in a manual job. Eighty-six percent of respondents can read SMS in Hindi, but 36% do not ever read text messages. Less than a third read SMS daily in the week prior	**Exposure** **Source:** Researchers **Method of dissemination**: Messaging mode of delivery ***Comparator*** N/A	**Exposure** Appeal to different emotions, such as fear (by making the threat of pandemic salient) or prosocial motivation (by highlighting externalities of the preventive actions). **Behaviour change wheel intervention type**: Persuasion ***Comparator*** N/A	***Spillover outcome results summary***: Pooling the results of all treatment arms for messages about handwashing compared to control, there was no evidence that sending SMS messages changed uptake of physical distancing. Compared to control where uptake of reported physical distancing was 36%, uptake of 36.2% across handwashing treatment arms, an increase of 0.2% ($p>.05$) that was not significant. When examining individual treatment arms, there were no differences in physical distancing uptake between the control group and any treatment group who received handwashing messages. ***COM-B outcomes results summary:*** There was no difference in knowledge of physical distancing between control group (49%) and treatment groups who had received handwashing messages (49%) (pooled across all treatments).	Moderate

			to the interview. **Intervention:** A comparison of 10 message types: 2 target behaviours (handwashing & social distancing) x 5 message frames (neutral, public gain or loss, and private gain or loss). There were 10 treatment arms: 5 message types x 2 timing variations (2 morning texts at 7-8am and 10-11am OR morning and evening texts at 7-8am and 6-7pm). Participants were randomly assigned to 10 rounds of treatment for each behaviour. They received four text messages over the course of two days between August and October 2020. **Comparator**: No messages. **Target Behaviour:** Handwashing **Spillover behaviours:** Physical distancing			When examining individual treatment arms, there were no differences in physical distancing knowledge between the control group and any treatment group who received handwashing messages.	

			Spillover outcome: Subjective outcome. Open-ended question, "What are you doing to protect against the virus?". Physical distancing (keeping two arms distance) based on whether the respondent mentions each practice. **COM-B outcomes measured**: Knowledge - open ended question asking about what respondents know about preventive measures. Exact item not provided.				
Community level interventions							
(8) Abaluck J, Kwong LH, Styczynski A, Haque A, Kabir MA, Bates-et al. (2022) Impact of community masking on COVID-19: A cluster-randomized trial in Bangladesh.	14 January 2022	Bangladesh, November 2020 to April 2021	**Design:** Cluster Randomized Controlled Trial. **Sample:** 572 Bangladeshi villages. No sociodemographic information given. **Intervention:** Intervention period lasted 8 weeks. The basic intervention package consists of five main elements:	***Exposure*** **Source:** The Honorable Prime Minister of Bangladesh Sheikh Hasina, the head of the Imam Training Academy, and national cricket star Shakib Al Hasan. WHO from brochure materials. Local leaders, including imams. **Method of dissemination**:	***Exposure*** Masks were distributed to educate villagers on both the proper use of the mask to prevent COVID-19 transmission; prompt mask-wearing at point-of-use with face-to-face interaction; enable role modelling by trusted community members; prompt mask wearing with reminder texts; persuade mask wearing with messages of altruism or self-protection; increase motivation to	In control villages, 24.1% of observed individuals practiced physical distancing compared with 29.2% in intervention villages, an increase of 5.1% (regression adjusted estimate = 0.05 95% CIs [0.04, 0.06]). Physical distancing increased 5.1 percentage points overall (i.e. all treatment villages vs control), but there was substantial heterogeneity across locations. In markets, individuals were 7.4% (N=570, p<.001) more likely	Serious

Science. 375(6577):eabi9069. doi: 10.1126/science.abi9069.			1) One-time mask distribution and information provision (about masks) at households in video format and WHO information brochure. 2) Mask distribution in markets for 3 to 6 days per week during all 8 weeks of the intervention. 3) Mask distribution at mosques on three Fridays during the first 4 weeks of the intervention. 4) Mask promotion in public spaces and markets where non–mask wearers were encouraged to wear masks (weekly or biweekly). 5) Role modeling and advocacy by local leaders, including imams discussing the importance of mask-wearing at Friday prayers in Mosques. There was also cross-randomization of additional intervention components within intervention arms. At the village level, villages were randomized to receive: 1) Either cloth or	Face to face mode of delivery; Playable electronic storage mode of delivery; Human interactional mode of delivery; Printed material mode of delivery. ***Comparator*** N/A	wear mask with verbal/public commitments; increase mask-wearing social norms; incentivization. **Behaviour change wheel intervention type:** Environmental restructuring; Enablement; Education Modelling ***Comparator*** N/A	to physically distance. By contrast, there was no physical distancing practiced in any mosque (N=570, p>.05). In other locations, physical distancing increased by 6.8% (N=568, p<.001). When there was no active promotion, the increase in physical distancing was 5.6% percentage points (N=572, p<.001). When villages were given surgical masks, the increase in physical distancing was 5.4% (N=380, p<.001) compared to control. For cloth masks the increase in physical distancing was 4.4% (N=192, p<.001). ***COM-B outcomes results summary:*** None	

			surgical masks; 2) public commitment (asking households to place provided signage on doors that declares they are a mask-wearing household) to encourage formation of social norms or no public signage; 3) No incentive, nonmonetary incentive, or monetary incentive of $190 given to the village leader for a project benefitting the public. Monetary or non-monetary incentives were awarded if village-level mask-wearing among adults exceeded 75% at 8 weeks after the intervention started; 4) 100% of households receiving twice-weekly text message reminders about the importance of mask-wearing or no households receiving text reminders. At the household level, further randomizations included: 1) receive messages emphasizing either altruism or self protection; 2) adults in				

			the household make a verbal commitment to be a mask-wearing household or not; 3) receive twice-weekly text reminders or not. Text message saturation was randomly varied to 0, 50, or 100% of all households receiving texts, and in the 50% villages, the specific households that received the texts was also random. **Comparator:** The control group did not receive any interventions. **Target Behaviour:** Masking **Spillover behaviour:** Physical distancing **Spillover outcome:** Prevalence of physical distancing through direct observation (objective). Surveillance was conducted using a standard protocol that instructed staff to spend 1 hour at each of the following high-traffic locations				

			in the village: market, restaurant entrances, main road, tea stalls, and mosque; the location and timing changed so that the mask wearing and physical distancing practices of as many individuals as possible could be recorded. In rural Bangladeshi villages, observations were conducted outside except at the mosque. **COM-B outcomes measured**: None.				
(9) Liebst, L.S., Ejbye-Ernst, P., de Bruin, M. et al. No evidence that mask-wearing in public places elicits risk compensation behavior during the COVID-19 pandemic. Sci Rep 12, 1511 (2022). https://doi.org/10.1038	10 January 2022	Amsterdam and Rotterdam	**Design**: Non-randomized controlled natural experiment. Three treatment areas and three comparable control areas, which had the best-quality public security cameras installed. **Sample**: Eligible participants were those who were in area of the the eight particularly crowded streets (i.e., tourist and shopping areas) where intervention was implemented.	**Exposure** **Source:** Amsterdam and Rotterdam municipal governments. **Method of dissemination:** Informational mode of delivery; Public notice mode of delivery ***Comparator*** N/A	**Exposure** **Exposure** Enforcing required behaviour with mandate; prompt mask-wearing with signage; negative reinforcement with fines for non-compliance. **Behaviour change wheel intervention type:** Coercion; Restriction ***Comparator*** N/A	**Spillover outcome results**: Mask use was not associated with social distancing (β = 0.03, CI 95% [− 0.05, 0.10], p = 0.511), with a Bayes factor offering strong evidence for the absence of this association (BF01 = 17.0). Also, people crowding was positively associated with social distancing violations (β = 0.18, CI 95% [0.10, 0.26], p < 0.001). The mask mandate did not affect the individual-level likelihood of social distancing encounters (β = 0.036, CI 95% [− 022, 029], p = 0.781, BF01	Moderate

/s41598-022-05270-3 **Study 2**			**Intervention**: Masking mandate. Announced by onsite signs, municipal workers informing visitors and handing out masks during the first weeks, and police reprimanding or fining non-compliers for 1 day during the third week. **Comparator:** Areas with no mask mandate. **Target Behaviour:** Wearing a face-mask **Spillover behaviours:** Physical distancing. **Spillover outcome:** Objective outcome. Violations of physical distancing was a binary variable distinguishing between whether or not the observed individual was within a 1.5 m radius of a stranger, i.e., the official Dutch meter-threshold for social distancing. Whether the other person is a stranger or affiliated was inferred			= 18.8), and this result remained non-significant after controlling for crowding. Further, the mask mandate treatment was not associated with the level of people crowding (second difference = − 5.77, p = 0.126, BF01 = 3.3). ***COM-B outcomes results summary:*** None.	

			from whether they arrived at the scene together and walked in each other's company. **COM-B outcomes measured:** None.				

Note: a. Where 'Not applicable' has been indicated for a comparator within the 'Intervention mode of delivery' and 'Behaviour change strategy' columns, this means that participants in comparator conditions were not subject to a treatment that could be coded, rather than there was no comparator condition.
b. While there is only one study reported in Bahety et al. (2021), there are two separate entries for spillover effects in this table to facilitate clearing reporting of findings.

Acknowledgements

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Appendices

Appendix 1: Detailed search strategy

Databases searched:

- PubMed https://pubmed.ncbi.nlm.nih.gov/
- iCITE (searches Research Square, MedRxiv, arXiv, bioRxiv, Preprints.org, ChemRxiv, Peer Review (PubMed), and Qeios) https://icite.od.nih.gov/covid19/search/
- Embase via OVID: Embase 1996 to 2023 March 3
- CINAHL https://web.p.ebscohost.com/ehost/search/advanced?vid=0&sid=00133008-88fb-4ed6-b53a-4ff8eebebb42%40redis
- PSYINFO APA PsycInfo 1987 to March Week 9 2023

Search Limits: English language, Human, searched from 01/01/2020

PubMed Search:
#1 ("COVID 19"[MeSH] OR "COVID 19"[All Fields] OR "sars cov 2"[All Fields] OR "sars cov 2"[MeSH] OR "severe acute respiratory syndrome coronavirus 2"[All Fields] OR ncov[All Fields] OR "2019 ncov"[All Fields] OR "coronavirus infections"[MeSH] OR coronavirus[MeSH] OR coronavirus[All Fields] OR coronaviruses[All Fields] OR betacoronavirus[MeSH] OR betacoronavirus[All Fields] OR betacoronaviruses[All Fields] OR "wuhan coronavirus"[All Fields] OR 2019nCoV[All Fields] OR Betacoronavirus*[All Fields] OR "Corona Virus*"[All Fields] OR Coronavirus*[All Fields] OR Coronovirus*[All Fields] OR CoV[All Fields] OR CoV2[All Fields] OR COVID[All Fields] OR COVID19[All Fields] OR COVID-19[All Fields] OR HCoV-19[All Fields] OR nCoV[All Fields] OR "SARS CoV 2"[All Fields] OR SARS2[All Fields] OR SARSCoV[All Fields] OR SARS-CoV[All Fields] OR SARS-CoV2[All Fields]) AND English[la])
#2 (environment, controlled[MeSH] OR air conditioning[MeSH] OR ventilation[MeSH] OR sanitary engineering[MeSH] OR filtration[MeSH] OR filtration[All fields] OR "air condition*"[All fields] OR "air-condition*"[All fields] OR "building ventilation"[All fields] OR "ventilation system"[All fields] OR "indoor ventilation"[All Fields] OR HVAC[TIAB] OR air samples[TIAB] OR ventilation rate[TIAB] OR ventilation[TIAB]) AND (Disease Transmission, Infectious*[Mesh] OR Air Pollution, Indoor[MeSH] OR transmission[Subheading] OR Infections[Mesh:NoExp] OR transmi*[All fields] OR infect*[TIAB] OR contagi*[TIAB] OR outbreak*[TIAB] OR spread*[TIAB] OR decontamination[TIAB]) AND (Aerosols[MeSH] OR Air Microbiology[MeSH] OR Aerosol*[All Fields] OR bioaerosol*[TIAB] OR

airborne[TIAB] OR droplet*[TIAB] OR "air exchange"[TIAB] OR "air change"[TIAB] OR "air flow"[TIAB] OR airflow[TIAB] OR "fluid dynamics"[TIAB] OR air dilution[All Fields])
#3 (Masks[Mesh:NoExp] OR "Respiratory Protective Devices"[Mesh] OR mask[TIAB] OR masks[TIAB] OR masking[TIAB] OR face-mask[TIAB] OR facemask[TIAB] OR face-masks[TIAB] OR facemasks[TIAB] OR "face covering"[TIAB] OR "facial covering"[TIAB] OR "mouth covering"[TIAB] OR "face piece"[TIAB] OR "face protect*"[TIAB] OR "face protection"[TIAB] OR "face shield"[TIAB] OR respirator[TIAB] OR respirators[TIAB] OR "respiratory protection"[TIAB] OR "respiratory equipment"[TIAB] OR "respiratory device"[TIAB] OR "respiratory devices"[TIAB] OR n95[TIAB] OR "n 95"[TIAB] OR kn95[TIAB] OR kf94[TIAB] OR ffp[TIAB] OR ffp1[TIAB] OR ffp2[TIAB] OR ffp3[TIAB] OR n97[TIAB] OR n99[TIAB] OR p2[TIAB] OR airborne[TIAB] OR droplet[TIAB] OR droplets[TIAB]) AND (protection[TIAB] OR precaution[TIAB] OR prevention and control[MeSH Subheading] OR prevention[TIAB] OR "health behavior change" or "promoting health"[TIAB]) NOT (mechanical[TIAB])

#4 (environment, controlled[MeSH] OR air conditioning[MeSH] OR ventilation[MeSH] OR sanitary engineering[MeSH] OR filtration[MeSH] OR filtration[TIAB] OR "air condition*"[TIAB] OR "building ventilation"[TIAB] OR "ventilation system"[TIAB] OR "indoor ventilation"[TIAB] OR HVAC[TIAB] OR air samples[TIAB]) AND (Disease Transmission, Infectious*[Mesh] OR Air Pollution, Indoor[MeSH] OR transmission[Subheading] OR Infections[Mesh:NoExp] OR transmi*[TIAB] OR infect*[TIAB] OR contagi*[TIAB] OR outbreak*[TIAB] OR spread*[TIAB] OR decontamination[TIAB]) AND (Aerosols[MeSH] OR Air Microbiology[MeSH] OR Aerosol*[TIAB] OR bioaerosol*[TIAB] OR airborne[TIAB] OR droplet*[TIAB] OR "air exchange"[TIAB] OR "air change"[TIAB] OR "air flow"[TIAB] OR airflow[TIAB] OR "fluid dynamics"[TIAB])
#5 (quarantine[MeSH] OR social isolation[MeSH] OR "mandated isolation"[TIAB] OR "voluntary isolation"[TIAB] OR "medical isolation"[TIAB] OR "self isolation"[TIAB] OR self-isolation[TIAB] OR "hospital confinement"[TIAB] OR "medical confinement"[TIAB] OR "patient quarantine"[TIAB] OR "home quarantine"[TIAB] OR "hospital quarantine"[TIAB] OR "mandated quarantine"[TIAB] OR "mandatory quarantine"[TIAB] OR "voluntary quarantine"[TIAB] OR "hotel quarantine"[TIAB] OR "medical quarantine"[TIAB] OR "self quarantine"[TIAB] OR "self-quarantine"[TIAB] OR "quarantine facilit*"[TIAB] OR lockdown[TIAB] OR lock-down[TIAB] OR "travel ban"[TIAB] OR "community containment"[TIAB] OR "travel restrictions"[TIAB] OR "border measures"[TIAB])
#6 physical Distancing[MeSH] OR (("personal isolation"[TIAB] OR "social distance"[All Fields] OR "social distancing"[All Fields] OR lockdown[TIAB] OR lock-down[TIAB] OR stay-at-home[TIAB] OR self-isolation[TIAB] OR "physical spacing"[TIAB] OR "physical separation"[TIAB] OR "physical contact"[TIAB] OR "physical separation"[TIAB]) AND (diminish[TIAB] OR limit[TIAB] OR policy[TIAB] OR mandate[TIAB] OR mandated[TIAB] OR restrict[TIAB] OR restricted[TIAB]))
#7 cohorting[TIAB] OR "community containment"[TIAB] OR "social bubble"[TIAB] OR shelter-in-place[TIAB] OR stay-at-home[TIAB] OR Work-from-home[TIAB] OR "working from home"[TIAB] OR curfew[TIAB] OR "capacity restriction"[TIAB] OR "capacity restrictions"[TIAB] OR "capacity limit"[TIAB] OR "capacity limits"[TIAB] OR "reduce contact"[TIAB] OR "reducing contact"[TIAB] OR "reduced contact"[TIAB] OR "reducing contact"[TIAB] OR "reducing contact"[TIAB] OR "reducing contact"[TIAB] OR "reducing contacts"[TIAB] OR "reducing contacts"[TIAB] OR "reducing contacts"[TIAB] OR "reducing contacts"[TIAB] OR "limit contact"[TIAB] OR "limited contact"[TIAB] OR "limiting contact"[TIAB] OR "limited contacts"[TIAB] OR "limiting contacts"[TIAB] OR lockdown[keyword] OR lock-down[keyword] OR ((business[TIAB] OR retail[TIAB] OR school[TIAB] OR schools[TIAB]) AND (closure[TIAB] OR closures[TIAB]))
#8 (cross-border[TIAB] OR "cross border"[TIAB] OR national[TIAB] OR international[TIAB] OR transnational[TIAB] OR government[TIAB] OR governmental[TIAB] OR country[TIAB] OR nation[TIAB] OR cross-sectional[TIAB] OR "non-pharmaceutical interventions"[TIAB] OR "non pharmaceutical interventions"[TIAB] OR "non-pharmaceutical intervention"[All Fields] OR "non-pharmaceutical interventions"[All Fields] OR "non-pharmaceutical measures"[All Fields] OR "nonpharmaceutical interventions"[TIAB] OR "non-pharmacological intervention"[TIAB] OR "non pharmacological intervention"[TIAB] OR "nonpharmacological intervention"[TIAB] OR "non-pharmacological

interventions"[TIAB] OR "non pharmacological interventions"[TIAB] OR "nonpharmacological interventions"[TIAB] OR "wider population"[TIAB]) AND (transmi*[TIAB] OR control*[TIAB] OR policy[TIAB])
#9 hand hygiene[Mesh] OR "hand hygiene"[TIAB] OR "hand wash*"[TIAB] OR handwashing[TIAB] OR "hand disinfection"[TIAB] OR "hand antisepsis"[TIAB] OR "alcohol-based hand rub"[TIAB] OR "surgical scrub"[TIAB] OR "hand sterilization"[TIAB] OR "hand rinses"[TIAB] OR "hand antiseptic"[TIAB] OR "hand sanitiser"[TIAB] OR "hand cleanser"[TIAB] OR "hand disinfectant"[TIAB] OR "nasal tissue"'[TIAB] OR "nasal tissues"[TIAB] OR ((cough*[TIAB] OR cough[MeSH]) AND (hygiene[TIAB] OR etiquette[TIAB] OR droplet*[TIAB])) OR ((sneez*[TIAB] OR sneezing[MeSH]) AND (hygiene[TIAB] OR etiquette[TIAB] OR droplet*[TIAB]))
#10 #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9
#11 #1 and #10
#12 search*[Title/Abstract] OR meta-analysis[Publication Type] OR meta analysis[Title/Abstract] OR meta analysis[MeSH Terms] OR review[Publication Type] OR diagnosis[MeSH Subheading] OR associated[Title/Abstract]
#13 (clinical[TIAB] AND trial[TIAB]) OR clinical trials as topic[MeSH] OR clinical trial[Publication Type] OR random*[TIAB] OR random allocation[MeSH] OR therapeutic use[MeSH Subheading]
#14 comparative study[pt] OR Controlled Clinical Trial[pt] OR quasiexperiment[TIAB] OR "quasi experiment"[TIAB] OR quasiexperimental[TIAB] OR "quasi experimental"[TIAB] OR quasi-randomized[TIAB] OR "natural experiment"[TIAB] OR "field experiment" [TIAB] OR "natural control"[TIAB] OR "Matched control"[TIAB] OR (unobserved[TI] AND heterogeneity[TI]) OR "interrupted time series"[TIAB] OR "difference studies"[TIAB] OR "two stage residual inclusion"[TIAB] OR "regression discontinuity"[TIAB] OR non-randomized[TIAB] OR pretest-posttest[TIAB]
#15 cohort studies[mesh:noexp] OR longitudinal studies[mesh:noexp] OR follow-up studies[mesh:noexp] OR prospective studies[mesh:noexp] OR retrospective studies[mesh:noexp] OR cohort[TIAB] OR longitudinal[TIAB] OR prospective[TIAB] OR retrospective[TIAB]
#16 Case-Control Studies[Mesh:noexp] OR retrospective studies[mesh:noexp] OR Control Groups[Mesh:noexp] OR (case[TIAB] AND control[TIAB]) OR (cases[TIAB] AND controls[TIAB]) OR (cases[TIAB] AND controlled[TIAB]) OR (case[TIAB] AND comparison*[TIAB]) OR (cases[TIAB] AND comparison*[TIAB]) OR "control group"[TIAB] OR "control groups"[TIAB]
#17 #11 and #12
#18 #11 and #13
#19 #11 and #14
#20 #11 and #15
#21 #11 and #16
#22 #17 or #18 or #19 or #20 or #21
#23 Patient Compliance*[MeSH] OR compliance[All Fields] OR adheren*[TIAB] OR "behavior intervention" [TIAB] OR "behavior change" [TIAB] OR "behavioral change" [TIAB] OR "behaviour intervention" [TIAB] OR "behaviour change" [TIAB] OR "behavioural change" [TIAB] OR "behaviour interventions" [TIAB] OR "behaviour changes" [TIAB] OR "behavioural changes" [TIAB] OR "behavior interventions" [TIAB] OR "behavior changes" [TIAB] OR "behavioral changes" [TIAB] OR (alter[TIAB] AND behavior[TIAB]) OR (comply[TIAB] AND behavior[TIAB]) OR (promote[TIAB] AND behavior[TIAB]) OR "behavioural compliance"[TIAB]
#24 #22 and #23
#25 #24 NOT (Animals[Mesh] NOT (Animals[Mesh] AND Humans[Mesh]))

Appendix 2: Studies excluded at the last stages of reviewing

Author	Title	Exclusion reason
Legate 2022	Can We Communicate Autonomy Support and a Mandate? How Motivating Messages Relate to Motivation for Staying at Home across Time during the COVID-19 Pandemic.	No intervention
Bundgaard 2021	Effectiveness of Adding a Mask Recommendation to Other Public Health Measures to Prevent SARS-CoV-2 Infection in Danish Mask Wearers : A Randomized Controlled Trial.	Wrong outcomes
Wagner 2022	Increased Depression during COVID-19 Lockdown Associated with Food Insecurity and Antiretroviral Non-Adherence among People Living with HIV in Uganda.	Wrong outcomes
Lunn 2020	Motivating physical distancing during the COVID-19 pandemic: An online experiment.	Wrong outcome
Tang 2022	Movement control as an effective measure against Covid-19 spread in Malaysia: an overview	Wrong study design
Woskie 2021	Heterogeneity in response to India's initial COVID-19 nationwide-lockdown: A quasi-experimental study using aggregate mobility data	Not enough information
Marsden 2022	Daily testing of contacts of SARS-CoV-2 infected cases as an alternative to quarantine for key workers in Liverpool: A prospective cohort study	No comparator
Kaiser 2022	Fostering compliance with physical distancing by interactive feedback in the context of the COVID-19 pandemic: A web-based randomized controlled trial	Wrong outcome
Bryant 2020	Estimating the impact of mobility patterns on COVID-19 infection rates in 11 European countries	Wrong study design
Nakanishi 2021	On-site dining in Tokyo during the COVID-19 pandemic: Time series analysis using mobile phone location data.	No intervention
Jang 2021	Factors shaping the COVID-19 epidemic curve: a multi-country analysis.	Wrong study design
GÃ¡zquez-LÃ³pez 2021	Posters as a Tool to Improve Hand Hygiene among Health Science Students: Case-Control Study.	Wrong setting
Dennis 2021	Assessment of the Effectiveness of Identity-Based Public Health Announcements in Increasing the Likelihood of Complying With COVID-19 Guidelines: Randomized Controlled Cross-sectional Web-Based Study.	Wrong study design

Campbell 2022	Stay-at-Home: The Impact of the COVID-19 Lockdown on Household Functioning and ART Adherence for People Living with HIV in Three Sub-districts of Cape Town, South Africa.	Wrong study design
Nassiri 2022	How do the smart travel ban policy and intercity travel pattern affect COVID-19 trends? Lessons learned from Iran.	Wrong intervention
Miles 2022	Using prosocial behavior to safeguard mental health and foster emotional well-being during the COVID-19 pandemic: A registered report of a randomized trial.	Wrong outcomes
Shoji 2022	Mobile health technology as a solution to self-control problems: The behavioral impact of COVID-19 contact tracing apps in Japan.	Wrong intervention
Blayac 2022	Nudging for lockdown: Behavioral insights from an online experiment.	Wrong outcome
Wright 2021	Do predictors of adherence to pandemic guidelines change over time? A panel study of 22,000 UK adults during the COVID-19 pandemic.	Wrong study design
Dixon 2022	Using behavioural theory to understand adherence to behaviours that reduce transmission of COVID-19; evidence from the CHARIS representative national study.	Wrong study design
Hoeben 2021	Physical distancing compliance: A video observational analysis.	Wrong study design
Halbur 2021	Tolerance of face coverings for children with autism spectrum disorder.	Wrong outcome
Singh 2021	Impacts of introducing and lifting nonpharmaceutical interventions on COVID-19 daily growth rate and compliance in the United States.	Wrong study design
Lillie 2021	Increasing passive compliance to wearing a facemask in children with autism spectrum disorder.	Wrong setting
Inauen 2020	Refining hand washing interventions by identifying active ingredients: A cluster-randomized controlled trial in rural Zimbabwe.	No respiratory illness
Fuchs 2021	Assessment of a Hotel-Based COVID-19 Isolation and Quarantine Strategy for Persons Experiencing Homelessness.	Wrong outcomes
Pan 2021	Heterogeneity in the Effectiveness of Non-pharmaceutical Interventions During the First SARS-CoV2 Wave in the United States.	Wrong outcomes
Hamer 2021	Assessment of a COVID-19 Control Plan on an Urban University Campus During a Second Wave of the Pandemic.	Wrong study design
Martin 2021	Engagement with daily testing instead of self-isolating in contacts of confirmed cases of SARS-CoV-2.	Wrong study design

Jarvis 2020	Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK.	Wrong study design
MÃ©ndez-LizÃ¡rraga 2022	Evaluating the impact of mobility in COVID-19 incidence and mortality: A case study from four states of Mexico.	Wrong outcomes
Ibrahim 2021	Digital Phenotypes for Understanding Individuals' Compliance With COVID-19 Policies and Personalized Nudges: Longitudinal Observational Study.	Wrong study design
Woelfert 2020	How Political and Social Trust Can Impact Physical distancing Practices During COVID-19 in Unexpected Ways.	Wrong outcomes
Silva 2022	Concerns and coping mechanisms during the first national COVID-19 lockdown: an online prospective study in Portugal.	No intervention
Kellermann 2022	Mobility in pandemic times: Exploring changes and long-term effects of COVID-19 on urban mobility behavior.	Wrong intervention
Lee 2022	The school education, ritual customs, and reciprocity associated with self-regulating hand hygiene practices during COVID-19 in Japan.	Wrong study design
Torrente 2022	Risk perception, but also political orientation, modulate behavioral response to COVID-19: A randomized survey experiment.	Wrong outcomes
Aranguren 2022	Face Mask Use Conditionally Decreases Compliance With Physical Distancing Rules Against COVID-19: Gender Differences in Risk Compensation Pattern.	Wrong outcomes
Navarrete-Hernandez 2022	An evaluation of the impact of COVID-19 safety measures in public transit spaces on riders' Worry of virus contraction.	Wrong study design
Sassenrath 2022	The impact of activating an empathic focus during COVID19 on healthcare workers motivation for hand hygiene compliance in moments serving the protection of others: a randomized controlled trial study.	Wrong setting
Barak 2022	Experience of the COVID-19 pandemic in Wuhan leads to a lasting increase in physical distancing	Wrong study design
Tashiro 2022	Decreased hospitalizations and deaths from community-acquired pneumonia coincided with rising public awareness of personal precautions before the governmental containment and closure policy: A nationwide observational study in Japan	Wrong outcome
Papenburg 2022	Adequacy of serial self-performed SARS-CoV-2 rapid antigen-detection testing for longitudinal mass screening in the workplace	Wrong outcomes
Chao 2022	Quantifying behavior change during the first year of the COVID-19 pandemic in the United States	Wrong study design

Chen 2022	Highly coordinated nationwide massive travel restrictions are central to effective mitigation and control of COVID-19 outbreaks in China	Wrong study design
Galarraga 2022	Effects of Varying Approaches to Lifting COVID-19 Pandemic Restrictions in the United States	Wrong outcome
FernandezMarin 2021	Dynamics of mask use as a prevention strategy against SARS-Cov-2 in Panama	Wrong study design
Baal 2021	Episodic future thinking and compassion reduce public health guideline noncompliance urges: A randomised controlled trial	Wrong outcome
Ranoa 2021	Mitigation of SARS-CoV-2 Transmission at a Large Public University	Wrong outcome
Segal 2021	Early Epidemiological Evidence of Public Health Value of WA Notify, a Smartphone-based Exposure Notification Tool: Modeling COVID-19 Cases Averted in Washington State	Wrong study design
Szczuka 2021	Handwashing Adherence and the Trajectory of COVID-19 Pandemic: Findings from 14 Countries	Wrong study design
Alrige 2021	Using Geospatial Intelligence to Promote Precautionary Behavior During the COVID-19 Pandemic: Development and Validation of a Customized Messaging Campaign in Saudi Arabia	Wrong study design
Kishore 2021	The relationship between human mobility measures and SAR-Cov-2 transmission varies by epidemic phase and urbanicity: results from the United States	Wrong outcome
Love 2021	The acceptability of testing contacts of confirmed COVID-19 cases using serial, self-administered lateral flow devices as an alternative to self-isolation	Wrong outcome
Park 2021	Old People's Fear of COVID-19 Infection and Public Transportation Avoidance : Korean Subway Evidence	Wrong intervention
Garg 2020	Experience and Challenges for Establishing Quarantine Facility for Suspected COVID-19 Cases: Field Briefing	Wrong study design
Cooch 2020	Supervised self-collected SARS-CoV-2 testing in indoor summer camps to inform school reopening	Wrong outcome
Smith 2020	Adherence to the test, trace and isolate system: results from a time series of 21 nationally representative surveys in the UK (the COVID-19 Rapid Survey of Adherence to Interventions and Responses [CORSAIR] study)	Wrong study design
Jamison 2020	Comparing the impact on COVID-19 mortality of self-imposed behavior change and of government regulations across 13 countries	Wrong outcome

Kabiri 2020	How different age groups responded to the COVID-19 pandemic in terms of mobility behaviors: a case study of the United States	No intervention
Bushman 2020	Effectiveness and Compliance to Physical distancing During COVID-19	Wrong outcome
Ainsworth 2020	Current infection control behaviour patterns in the UK, and how they can be improved by â€˜Germ Defenceâ€™, an online behavioural intervention to reduce the spread of COVID-19 in the home	Wrong outcome
Deforche 2020	Behavioral changes before lockdown, and decreased retail and recreation mobility during lockdown, contributed most to the successful control of the COVID-19 epidemic in 35 Western countries	Wrong outcome
CecchiDimeglio 2020	Comparative Analysis of the Application of Behavioural Insights of 33 Worldwide Governments on the Landing Pages of their COVID-19 Official Websites and their Impact on the Growth Scale of the Pandemic	Wrong outcome
Chen 2020	Causal Estimation of Stay-at-Home Orders on SARS-CoV-2 Transmission	Wrong outcome
Cowling 2020	Impact assessment of non-pharmaceutical interventions against COVID-19 and influenza in Hong Kong: an observational study	Wrong outcome
Nalule 2022	A controlled before-and-after study of a multi-modal intervention to improve hand hygiene during the peri-natal period in Cambodia.	Wrong setting
Agley 2021	Intervening on Trust in Science to Reduce Belief in COVID-19 Misinformation and Increase COVID-19 Preventive Behavioral Intentions: Randomized Controlled Trial	Wrong outcome
Jordan 2021	Donâ€™t get it or donâ€™t spread it: comparing self-interested versus prosocial motivations for COVID-19 prevention behaviors	Wrong outcome
Aglipay 2022	AN ANALYSIS OF COVID-19 PUBLIC HEALTH MEASURE ADHERENCE AMONG PARENTS AND CHILDREN AND THE CORRESPONDING EFFECTS OF LOCKDOWNS AND SCHOOL CLOSURES	Wrong study design
Zhang 2021	A kindergarten-based, family-involved intervention to improve children's hand hygiene behavior: A cluster-randomized controlled trial.	No respiratory illness
Fischer 2021	Mask adherence and rate of COVID-19 across the United States	Wrong study design

Starvaggi 2022	coronabambini.ch: Development and usage of an online decision support tool for pediatric COVID-testing in Switzerland: a cross-sectional analysis	Wrong study design
Okello 2022	Air quality management strategies in Africa: A scoping review of the content, context, co-benefits and unintended consequences	Wrong study design
Bodas 2023	Public conformism with health regulation is crumbling as COVID-19 becomes a chronic threat: Repeated Cross-sectional Studies	Wrong study design
Stuppy 2023	Self-esteem influences the willingness to engage in COVID-19 prevention behavior and persuasion efficacy	Wrong study design
Mourali 2023	Persuasive Messages for Improving Adherence to COVID-19 Prevention Behaviors: Randomized Online Experiment	Wrong outcome
Kumar 2022	Leveraging Mobile Sensing and Bayesian Change Point Analysis to Monitor Community-scale Behavioral Interventions: A Case Study on COVID-19	Wrong Study design

Appendix 3: Data extraction form

Reference	Date released	Setting and time covered	Respiratory condition	Study characteristics	Intervention mode of delivery	Behaviour change strategy	Summary of key findings in relation to the outcome	Additional outcomes?
[APA format, hyperlink on title, list in reverse chronological order, include PMID or URL]	DD Month YYYY	[City/region, Country; or "Global"]. [Include start date and end date of study]	[Covid-19] [H1N1] [Influenza] [SARS] [MERS] [Other?]	**Design**: [Randomized controlled trial] [Cluster RCT] [Non-randomized controlled trial e.g. quasi-experimental design] [Non-randomized cohort study] [Pilot RCT] [Randomized cross-over study] [Sequential case-control] [Single-arm pre- and post-intervention] [interrupted time-series] [other?] **Sample**: [N included; sample inclusion criteria (e.g. students, general population, mothers, unvaccinated); age (ranges, mean/median); gender; race/ethnicity; education; occupation; religion; social capital]	**Exposure** **Source:** [use source coding instruction given below/source ontology document] **Method of dissemination:** [Use mode of delivery ontology for coding] **Comparator**	**Exposure** [Content of intervention – what were the 'active ingredients'/mechanisms were being targeted? e.g. increase knowledge, restructure environment, increase motivation] Behaviour change wheel intervention type – see instructions below: [Education] [Persuasion] [Incentivisation] [Coercion] [Training] [Restriction] [Environmental restructuring] [Modelling] [Enablement] **Comparator**	**Results** *Time 1* Intervention N= [Intervention M=] [Intervention SD=] [Intervention SE=] [Intervention Mdn=] [Intervention IQR=] [Intervention % =] [Intervention CIs=] *Time 1* Comparison N= [Comparison M=] [Comparison SD=] [Comparison SE=] [Comparison Mdn=] [Comparison IQR=] [Comparison % =] [Comparison CIs=] [summary explanation of results which includes description	[list additional outcomes]

				[Does the intervention target a PROGRESS + category sample? If so, which? – see instruction below] **Intervention**: [general description of procedure, what happened to participants, what did participants do, what was the setting, what dates/timeline was the intervention applied, exposure quantity and duration e.g. 1 session per week for 3 weeks, incentives given?] **Comparator:** [general description of procedure, what happened to participants, what did participants do, what was the setting, what dates/timeline was the intervention applied, exposure quantity and duration e.g. 1 session per week for 3 weeks, incentives given?] **Target Behaviour:** [what was the target behaviour?] **Key outcome**: [what is the outcome? If it is a self-report measure - what was the scale range? Or data ranges? How were categories	[Same as above as applicable]	[Same as above as applicable]	of direction of results e.g. intervention group had significantly more hand sanitizer use than control group. If provided, include regression coefficients, standard errors, p-values and confidence intervals where possible] ***COM-B outcomes results summary:*** [summary explanation of results which includes description of direction of results e.g. intervention group had significantly more self-efficacy for hand sanitizer use than control group. Include numeric data where possible e.g. regression coefficients, standard errors, p-values and confidence intervals where possible] **Differences by demographics:**	

				defined e.g. what was 'compliant' or 'non-compliant'] [subjective outcome?] [objective outcome?] **COMB-B secondary outcomes**: [what is the outcome? If it is a self-report measure - what was the scale range/anchors? Or data ranges? How were categories defined e.g. what was considered 'intenders' or 'non-intenders']				

Appendix 4: Approach to critical appraisal

For randomized controlled trials, cluster-randomized trials, and randomized cross-over trials
Cochrane risk of bias tool instructions

<table>
<tr><td colspan="2">Domain 1 – bias in randomization process</td></tr>
<tr><td colspan="2">For all types of randomized trials:
Sequence generation - A rule is described for allocating interventions to participants must be specified, based on some chance (random) process.
Allocation concealment – Researchers report that steps have been taken to secure strict implementation of that schedule of random assignments by preventing foreknowledge of the forthcoming allocations (i.e. researchers could not assign participants to a particular condition because they know what condition will come up in the sequence)

For randomized cross-over trials only:
Period effects - systematic differences between responses in the second compared with the first period that are not due to the interventions being compared. They may occur, for example, when the condition changes systematically over time, or if there are changes over time in background factors such as underlying healthcare strategies.
Carryover effects - the situation in which the effects of an intervention given in the first period persist into the second period, thus interfering with the effects of the second intervention. Carryover effects may arise because the intervention itself persists (such as a drug with a long elimination half-life), or because the effects of the intervention persist.

Note: for making judgements on randomized cross-over trials, sequence generation and allocation concealment must be considered in addition to period effects and carryover effects.</td></tr>
<tr><td>Criteria for a judgment of 'Low risk' of bias.</td><td>• The investigators describe a random sequence generation process AND allocation was adequately concealed

Sequence generation examples :
•Referring to a random number table;
•Using a computer random number generator;
•Coin tossing;
•Shuffling cards or envelopes;
•Throwing dice;
•Drawing of lots;
•Minimization*.
*Minimization may be implemented without a random element, and this is considered to be equivalent to being random.

Allocation concealment examples:
Participants and investigators enrolling participants could not foresee assignment because one of the following, or an equivalent method, was used to conceal allocation:</td></tr>
</table>

	•Central allocation (including telephone, web-based and pharmacy-controlled randomization); •Sequentially numbered drug containers of identical appearance; •Sequentially numbered, opaque, sealed envelopes.
	For randomized cross-over trials only: • Allocation of participants to each sequence has a ratio of 1:1 (i.e. balanced N across sequences) **AND** period effects have been accounted for within analyses • Carryover effects are not a concern (this is most likely to be a risk of bias where the same participants are involved in each sequence)
Criteria for a judgment of 'Moderate risk' of bias.	The investigators describe a non-random component in the sequence generation process AND allocation was adequately concealed, for example: •Sequence generated by odd or even date of birth; •Sequence generated by some rule based on date (or day) of admission; •Sequence generated by some rule based on hospital or clinic record number. • Baseline imbalances suggest a problem with the randomization process but baseline imbalances across intervention groups appear to be compatible with chance
	For randomized cross-over trials only: • Allocation of participants to each sequence is slightly unbalanced but this is unlikely to affect the outcome **AND** period effects have been accounted for within analyses • Carryover effects are not a concern (this is most likely to be a risk of bias where the same participants are involved in each sequence)
Criteria for a judgment of 'Serious risk' of bias.	The investigators describe a non-random component in the sequence generation process but allocation Other non-random approaches happen much less frequently than the systematic approaches mentioned above and tend to be obvious. They usually involve judgement or some method of non-random categorization of participants, for example: •Allocation by judgement of the clinician; •Allocation by preference of the participant;

	•Allocation based on the results of a laboratory test or a series of tests; •Allocation by availability of the intervention.
	For randomized cross-over trials only: • Allocation of participants to each sequence is unbalanced and this is likely to affect the outcome • Period effects have not been adequately accounted for within analyses • Carryover effects are a concern due to absence or insufficient washout period (this is most likely to be a risk of bias where the same participants are involved in each sequence
Criteria for a judgment of 'Critical risk' of bias.	• Allocation sequence was not concealed. Participants or investigators enrolling participants could possibly foresee assignments and thus introduce selection bias, such as allocation based on: •Using an open random allocation schedule (e.g. a list of random numbers); •Assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or non-opaque or not sequentially numbered); •Alternation or rotation; •Date of birth; •Case record number; •Any other explicitly unconcealed procedure. **OR** No information is provided about concealment of allocation AND Baseline imbalances across intervention groups appear to be compatible with chance
	For randomized cross-over trials only: • Allocation of participants to each sequence is unbalanced and has substantial risk of effecting the outcome • Period effects have not been adequately accounted for within analyses • Carryover effects are a substantial concern due to absence or insufficient washout period that have not been addressed through analyses
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient information about the sequence generation process to permit judgement of risk AND there are no baseline imbalances suggesting problem in randomization process. Example:

	When studies are done entirely online and the allocation concealment and randomization method are not reported
Domain 2 – bias due to deviations from intended interventions	
Blinding of participants and personnel - do the researcher report preventing knowledge of the allocated interventions by participants and personnel after allocation and during the study. Note: Some review authors confuse allocation concealment with blinding of assigned interventions. Allocation concealment seeks to prevent bias in intervention assignment by protecting the allocation sequence *before* and until assignment, and can always be successfully implemented regardless of the study topic. In contrast, blinding seeks to prevent bias by protecting the sequence *after* assignment, and cannot always be implemented. This is often the situation, for example, in trials comparing surgical with non-surgical interventions. Thus, allocation concealment up to the point of assignment of the intervention and blinding after that point address different sources of bias and differ in their feasibility.	
Criteria for a judgment of 'Low risk' of bias.	Any one of the following: •No blinding or incomplete blinding, but the review authors judge that the outcome is not likely to be influenced by lack of blinding; •Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken. Double blind studies can be coded as low risk
Criteria for a judgment of 'Moderate risk' of bias.	Examples: • No blinding or incomplete blinding, and the influence by lack of blinding on the outcome will be slight • There were deviations from intended intervention (in terms of implementation), but their impact on the outcome is expected to be slight. • The important co-interventions were not balanced across intervention groups, or there were deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome and the analysis was appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation, co-intervention) that were likely to impact on the outcome.
Criteria for a judgment of 'Serious risk' of bias.	Examples: • Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the

	outcome is likely to be influenced by lack of blinding. • There were deviations that were unbalanced between the intervention groups and likely to have affected the outcome. • The important co-interventions were not balanced across intervention groups, or there were deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome and the analysis was not appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation and cointervention) that were likely to impact on the outcome. • Code as serious risk if either participants or personnel have been explicitly reported as unblinded.
Criteria for a judgment of 'Critical risk' of bias.	Examples: • Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome will be influenced by lack of blinding. • There were substantial deviations that were unbalanced between the intervention groups and likely to have affected the outcome. • There were substantial imbalances in important co-interventions across intervention groups, or substantial deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome. The analysis was not appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation and cointervention) that were likely to impact on the outcome.
Criteria for a judgment of 'Unclear risk' of bias.	Any one of the following: •Insufficient information to permit judgment of risk; •The study did not address this outcome. Code as unclear if nothing is reported.
Domain 3 – bias from missing/incomplete outcome data – Have the researchers clearly reported when measurements of the outcome are missing, for example due to dropout during the study or exclusions from the analysis e.g. are there differences in dropout rate between conditions?; have reasons for dropout been reported?; was intention-to-treat analysis used?	
Criteria for a judgment of 'Low risk' of bias.	Any one of the following:

	•No missing outcome data; •Reasons for missing outcome data unlikely to be related to true outcome (e.g. dropout is not higher in one condition because of the inherent nature of the intervention such as side effects); •Missing outcome data is balanced in numbers across intervention groups, with similar reasons for missing data across groups; •For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate; •For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size; •Missing data have been imputed using appropriate methods.
Criteria for a judgment of 'Moderate risk' of bias.	• Proportions of and reasons for missing participants differ slightly across intervention groups and the analysis is unlikely to have removed the risk of bias arising from the missing data
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following: •Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups; •For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate; •For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size; •'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomization; •Potentially inappropriate application of simple imputation.
Criteria for a judgment of 'Critical risk' of bias.	• (Unusual) There were critical differences between interventions in participants with missing data and missing data were not, or

	could not, be addressed through appropriate analysis.
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient reporting of attrition/exclusions to permit judgement of risk' of bias (e.g. number randomized not stated, no reasons for missing data provided): • If neither ITT nor reasons for exclusion are mentioned – Judgment = Unclear • If dropout rate is evenly distributed – Judgment = Unclear • If completers vs dropouts are not compared – Judgment = Unclear
Domain 4 – bias in measurement of the outcome – does the study report that the people who assess outcomes are aware of intervention assignments?	
Criteria for a judgment of 'Low risk' of bias.	Any one of the following: •No blinding of outcome assessment, but the review authors judge that the outcome measurement is not likely to be influenced by lack of blinding; •Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken. • Objective outcomes were assessed by more than one assessor and there was good inter-rater agreement If objective measures are used in conjunction with subjective measures for the same outcomes (to triangulate the effect), can code as low risk.
Criteria for a judgment of 'Moderate risk' of bias.	• The outcome measure is only minimally influenced by knowledge of the intervention received by study participants; and any error in measuring the outcome is only minimally related to intervention status.
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following: •No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding; •Blinding of outcome assessment, but likely that the blinding could have been broken, and the outcome measurement is likely to be influenced by lack of blinding. • Subjective, self-report items should be coded as serious risk.

	• Error in measuring the outcome was related to intervention status (e.g. poor inter-rater agreement)
Criteria for a judgment of 'Critical risk' of bias.	• The methods of outcome assessment were so different that they cannot reasonably be compared across intervention groups.
Criteria for a judgment of 'Unclear risk' of bias.	Any one of the following: •Insufficient information to permit judgment of risk; If it was an objective outcome (e.g. observation of mask use) but it is stated that the staff conducting the assessments were not blinded, code as unclear.
Domain 5 – bias in selection of reported results – do the researchers report all intended outcomes and analyses? This domain combines (i) selective reporting of a particular outcome measurement from multiple measurements assessed within an outcome domain; and (ii) selective reporting of a particular analysis from multiple analyses of a specific outcome measurement. Such selective reporting will lead to bias if selection is based on the direction, magnitude or statistical significance of the effect estimate. Look for registered protocol or pre-registrations. If it is registered, this should be reported in the paper. Search "NCT" for clinicaltrials.gov, "ISRCTN" for International Standard Randomized Controlled Trial Number, "protocol", "pre-registered", "pre-registration", "osf", "open science framework", "AsPredicted".	
Criteria for a judgment of 'Low risk' of bias.	Any of the following: •The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way;
Criteria for a judgment of 'Moderate risk' of bias.	•The study protocol is not available but the analyses are consistent with an a priori plan including all expected outcomes; *and* there is no indication of selection of the reported analysis from multiple analyses; *and* there is no indication of selection of unplanned subgroup analysis and reporting on the basis of those results. • There are slight deviations in the planned analyses of the outcome, but authors have been transparent and the reasons are justified (e.g. one item in a validated self-report scale demonstrates poor internal consistency and dropping that item is not detrimental to the comprehensiveness of construct measurement and improves measurement of the outcome)
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following:

	•Not all of the study's pre-specified primary outcomes have been reported; •One or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified (e.g. differences in the definition of the outcome between methods and results without good justification); •One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect); •One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis; •The study report fails to include results for a key outcome
Criteria for a judgment of 'Critical risk' of bias.	•Not all of the study's pre-specified primary outcomes have been reported; and the unreported results are likely to be substantially different from the reported results.
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient information to permit judgement of risk. It is likely that the majority of studies will fall into this category. If there is no trial protocol registered or pre-registration– Judgment = Unclear
Other sources of bias – are there biases that arise from differences or confounding factors between conditions that may have impacted the outcomes. Check limitations section of study.	
Criteria for a judgment of 'Low risk' of bias.	The study appears to be free of other sources of bias.
Criteria for a judgment of 'High risk' of bias.	There is at least one important risk of bias. For example, the study: •Had a potential source of bias related to the specific study design used; or •Has been claimed to have been fraudulent; or •Had some other problem. If a study is underpowered (whether because of poor recruitment or high attrition), code as high risk in this section
Criteria for a judgment of 'Unclear risk' of bias.	There may be a risk of bias, but there is either: •Insufficient information to assess whether an important risk of bias exists; or •Insufficient rationale or evidence that an identified problem will introduce bias.

Coming to a decision about overall risk of bias

Judgement	Within each domain	Across domains	Criterion
Low risk of bias	The study is a well-performed randomized trial with regard to this domain	The study is a well performed randomized trial	The study is judged to be at low risk of bias for all domains.
Moderate risk of bias	The study is largely well performed but there are some concerns	The study provides useful evidence for the effects of intervention but there are some concerns	The study is judged to be at low or moderate risk of bias for all domains.
Serious risk of bias	The study has some important problems in this domain	The study has some important problems	The study is judged to be at serious risk of bias in at least one domain, but not at critical risk of bias in any domain.
Critical risk of bias	The study is too problematic in this domain to provide any useful evidence on the effects of intervention	The study is too problematic to provide any useful evidence and should not be included in any synthesis	The study is judged to be at critical risk of bias in at least one domain.
Unclear	No information on which to base a judgement about risk of bias for this domain	No information on which to base a judgement about risk of bias	There is no clear indication that the study is at serious or critical risk of bias and there is a lack of information in one or more key domains of bias (a judgement is required for this).

Risk of Bias for non-randomized studies
Cochrane ROBINS-I tool instructions

Domain 1 – Bias due to confounding
Confounding of intervention effects occurs when one or more variables that predict the outcome also predict whether an individual receives one or the other of the interventions of interest. Uncontrolled confounding is a threat to validity of findings. Baseline confounding occurs when there are fundamental differences at baseline in participants in the control and intervention conditions that may affect the strength of the relationship between

the intervention and outcome. For example, if people in the control condition have worse health condition resulting in either drop out or switching to intervention due to placebo being ineffective. Time-varying confounding may need to be considered when changes in potentially confounding factors or the intervention across time are independently related to the outcome. Examples include getting sick with COVID between pre- and post, vaccination status changes between baseline and intervention periods, co-intervention is introduced between baseline and intervention periods, side effects of intervention become more aggressive over time which leads to differences in drop out between control and intervention.	
Criteria for a judgment of 'Low risk' of bias.	No confounding is expected because study design sufficiently controls for known and unknown external confounders. Examples: • Controlled interrupted time-series – a repeated-measures design that controls for baseline confounding and time-varying confounders by an equivalent control group (e.g. another district/state that didn't implement the intervention or delayed implementation of the intervention) observed during the same baseline and intervention time periods • ABAB sequential case-control - a repeated-measures design that controls for baseline confounding and time-varying confounders by replicating comparison between control and intervention by repeating control and intervention periods multiple times. • A controlled before and after study – study design that controls for baseline confounding with either repeated measures or equivalent control group (e.g. the same locations are observed multiple days in a row) and time-varying confounders are not a concern because of short timeframes e.g. intervention and control time periods occur within the same week with no risk of events/co-interventions occurring that confound results.
Criteria for a judgment of 'Moderate risk' of bias.	Confounding is expected, but all known important confounding variables are appropriately measured and controlled for. Examples: • In between-group designs, appropriate methods to control for measured confounders (e.g. age, vaccination status) have been use e.g. stratification, matching, standardization. They may control for individual variables or for the estimated propensity score.

	• Appropriate statistical control of known confounders have been used (e.g. g-estimation, or inverse probability weighting, multivariable regression, modelling time trends and autocorrelation)
Criteria for a judgment of 'Serious risk' of bias.	One or more known important confounding factors were not appropriately controlled for or measurement of one or more important confounding factors did not have acceptable reliability or validity to expect no serious residual confounding. Examples: • Report of other protective behaviours (where applicable) • Vaccination status • Essential worker status • Socioeconomic status (where applicable)
Criteria for a judgment of 'Critical risk' of bias.	Confounding inherently not controllable or no attempt has been made to measure and adjust for confounding factors.
Criteria for a judgment of 'unclear risk' of bias.	Not enough information has been provided to ascertain whether important confounding variables were appropriately controlled for or not
Domain 2 – bias in selection of participants	
When inclusion of participants to either control or intervention (or to the study at all), or in whether those participants are present at follow-up, are related to both features of the intervention and the outcome. There are several sources of selection bias including nonresponse during data collection, losses to follow-up or when the procedure used to select study participants result in the probabilities of exposed and unexposed cases and controls from the target population to be differential and not proportional. The latter source of selection bias can occur when exposure status influences selection.	
Criteria for a judgment of 'Low risk' of bias.	Examples: • Selection into the study was unrelated to the intervention and outcome • Eligibility criteria do not differ between control and intervention conditions (e.g. all students attending a particular university) • If a subsample of all eligible participants from target population (e.g. all students attending a particular university) were invited, sampling was random and the included participants were representative of target population • For each participant, start of baseline, start of intervention, and start of follow up coincided • Performance of adherence to protective behaviours was measured pre-intervention and was balanced across groups

Criteria for a judgment of 'Moderate risk' of bias.	• A subsample of all eligible participants from target population were invited, and sampling was not random but the sample was representative of the target population • Statistical methods have been used to correct for non-representativeness of a sample that was not randomly sampled from the target population • Selection into the study may have been related to intervention and outcome but appropriate statistical methods to adjust for the selection bias have been used • Start of follow-up and start of intervention do not coincide for all participants and the proportion of participants for which this was the case was too low to introduce significant bias or authors used appropriate statistical methods to adjust for the selection bias • Start of follow-up and start of intervention do not coincide for all participants and the review authors are confident that the rate (hazard) ratio for the effect of intervention remains constant over time e.g. some participants' intervention or follow-up may not have coincided but prominent strain of COVID and/or policies and guidelines that may increase/decrease risk of exposure are equivalent
Criteria for a judgment of 'Serious risk' of bias.	• Selection into the study was related (but not very strongly) to intervention and outcome and this could not be adjusted for in analyses • Start of follow up and start of intervention do not coincide; and a potentially important amount of follow-up time is missing from analyses; and the rate ratio is not constant over time. Examples: • A sample of all eligible participants were invited, and it was not random and the sample were a) not representative of the target population and b) no statistical methods have been used to correct this (eligible participants refers to the target population and sample should be representative e.g. if the intervention is an app, not everyone uses the app so there is a non-random factor in selection into the study which introduced bias)

	• Some participants cannot complete follow-up/attend lab/be observed at follow-up because they test positive for covid but this is not a substantial number. • Performance of adherence to protective behaviours was measured pre-intervention and there were differences between groups and this has been adjusted for in analyses
Criteria for a judgment of 'Critical risk' of bias.	• Eligibility criteria differ between control and intervention conditions (e.g. students for intervention and workers for control) • Selection into the study was very strongly related to intervention and outcome and this could not be adjusted for in analyses • A substantial amount of follow-up time is likely to be missing from analyses and the rate (hazard) ratio is not constant over time. • Some participants cannot complete follow-up/attend lab/be observed at follow-up because they test positive for covid, and this is a significant number or it disproportionately affects either treatment or control group. • Performance of adherence to protective behaviours was measured pre-intervention and there were differences between groups or disproportionate missing data on this measure between groups but there has been no statistical adjustment.
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient information about selection bias to permit judgement of level of risk. Example: • No information is reported about selection of participants into the study or whether start of follow up and start of intervention coincide
Domain 3 – bias in classification of interventions	
When there may be errors in assignment to either control or intervention group due to any factor that causes a subject to be placed into the wrong cell, such as a) imprecise measurement (of exposure and/or disease), b) mistaken or missed diagnoses (or missing information/records/data), c) conscious or unconscious inaccuracies in self-reported information (socially desirable responding, recall bias, not being truthful in responses because of negative consequences), or d) misclassification of intervention status is related to the outcome or the risk of the outcome, and is likely to lead to bias. Note: the issues of bias in this section may not be relevant to study designs in our review as this domain largely deals with classification retrospectively or from medical records.	
Criteria for a judgment of 'Low risk' of bias.	• Intervention groups were clearly defined before data collection (no ambiguity)

	• Classification to intervention/control group *does not* depend on self-report (where socially desirable responding or negative consequences of providing truthful responses may cause bias e.g. self-reporting COVID symptoms would trigger 14 day quarantine and loss of income)
Criteria for a judgment of 'Moderate risk' of bias	• Intervention status is well defined; and some aspects of the assignments of intervention status were determined retrospectively. • Classification into intervention/control group *does* depend on self-report but inaccuracies are not disproportionately high in the intervention group (where socially desirable responding or negative consequences of providing truthful responses may cause bias e.g. self-reporting COVID symptoms would trigger 14 day quarantine and loss of income)
Criteria for a judgment of 'Serious risk' of bias.	• Intervention was not well defined • Major aspects of the assignments of intervention status were determined in a way that could have been affected by knowledge of the outcome such as: Classification into intervention/control group *does* depend on self-report where inaccuracies may disproportionately affect the intervention (where socially desirable responding or negative consequences of providing truthful responses may cause bias e.g. self-reporting COVID symptoms would trigger 14 day quarantine and loss of income)
Criteria for a judgment of 'Critical risk' of bias	• An extremely high amount of misclassification of intervention status, e.g. because of unusually strong recall biases. • Classification into intervention/control group *does* depend on self-report where inaccuracies do disproportionately affect the intervention (where socially desirable responding or negative consequences of providing truthful responses may cause bias e.g. self-reporting COVID symptoms would trigger 14 day quarantine and loss of income)
Criteria for a judgment of 'Unclear risk' of bias.	Any one of the following:

	•Insufficient information to permit judgment of 'Low risk' or 'High risk'; •The study did not address this outcome. Code as unclear if nothing is reported.
Domain 4 - Bias due to deviations from intended intervention (performance bias)	
Bias may occur when there are systematic differences in what is required in intervention and comparator groups. These differences arise because of knowledge of the intervention applied and the expectation of finding a difference between experimental intervention and comparator consistent with the hypothesis being tested in the study. Deviations from intended interventions may arise because an intervention was not implemented successfully (for example if equipment errors meant that the intervention administered did not go as intended), because participants did not have adequate knowledge of the expected actions they should take, or because important co-interventions were not balanced between intervention groups.	
Criteria for a judgment of 'Low risk' of bias.	Examples: • Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken (e.g. participants are not aware that they are assigned to see intervention or control signage next to hand sanitizer, research personnel who are assessing outcome are also not aware). Double blind studies can be coded as low risk • No blinding or incomplete blinding, but the review authors judge that the outcome is not likely to be influenced by lack of blinding; • Where blinding isn't possible (i.e. population-level instruction to stay at home) participants have accurate knowledge of what action they need to take in both control and intervention conditions • There are no co-interventions present during the study that could affect performance OR if there are co-interventions present, they are unlikely to introduce performance bias (e.g. the impact of co-interventions is balanced across conditions) • No deviations from implementation of the intended intervention due to experimenter error, technical malfunction, complexity of the intervention, etc.
Criteria for a judgment of 'Moderate risk' of bias.	Examples: • No blinding or incomplete blinding, and the influence by lack of blinding on the outcome will be slight • Participants knowledge of what action they need to take is unbalanced across conditions,

	but this is slight and appropriate statistical methods have been used to account for this. • There were deviations from intended intervention, but their impact on the outcome is expected to be slight. • The important co-interventions were not balanced across intervention groups, or there were deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome and the analysis was appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation, co-intervention) that were likely to impact on the outcome.
Criteria for a judgment of 'Serious risk' of bias.	Examples: • Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome is likely to be influenced by lack of blinding. • Participants knowledge of what action they need to take is unbalanced across conditions, and this likely affects the outcome. • There were deviations that were unbalanced between the intervention groups and likely to have affected the outcome. • The important co-interventions were not balanced across intervention groups, or there were deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome and the analysis was not appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation and cointervention) that were likely to impact on the outcome.
Criteria for a judgment of 'Critical risk' of bias	Examples: • Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome will be influenced by lack of blinding. • Participants knowledge of what action they need to take is substantially unbalanced across conditions, and this likely affects the outcome. • There were substantial deviations that were unbalanced between the intervention groups and likely to have affected the outcome.

	• There were substantial imbalances in important co-interventions across intervention groups, or substantial deviations from the intended interventions (in terms of implementation) that were likely to impact on the outcome. The analysis was not appropriate to estimate the effect of the intervention, allowing for deviations (in terms of implementation and cointervention) that were likely to impact on the outcome.
Criteria for a judgment of 'Unclear risk' of bias.	Any one of the following: •Insufficient information to permit judgment of risk; •The study did not address this outcome. Code as unclear if nothing is reported.
Domain 5 – bias from missing/incomplete outcome data – Have the researchers clearly reported when measurements of the outcome are missing, for example due to dropout during the study or exclusions from the analysis e.g. are there differences in dropout rate between conditions?; have reasons for dropout been reported?; were intention-to-treat analysis (where justified)/sensitivity analysis/appropriate statistical methods of handling missing data (e.g. multiple imputation) used?	
Criteria for a judgment of 'Low risk' of bias.	Any one of the following: •No missing outcome data; •Reasons for missing outcome data unlikely to be related to true outcome (e.g. dropout is not higher in one condition because of the inherent nature of the intervention such as side effects); •Missing outcome data is balanced in numbers across intervention groups, with similar reasons for missing data across groups; •For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate; •For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size; •Missing data have been imputed using appropriate methods.
Criteria for a judgment of 'Moderate risk' of bias.	• Proportions of and reasons for missing participants differ slightly across intervention groups and the analysis is unlikely to have removed the risk of bias arising from the missing data
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following:

	•Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups; •For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate; •For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size; •Potentially inappropriate application of simple imputation.
Criteria for a judgment of 'Critical risk' of bias.	• (Unusual) There were critical differences between interventions in participants with missing data and missing data were not, or could not, be addressed through appropriate analysis.
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient reporting of attrition/exclusions to permit judgement of risk' of bias (e.g. number no reasons for missing data provided): • If dropout rate is evenly distributed – Judgment = Unclear • If completers vs dropouts are not compared – Judgment = Unclear
Domain 6 – bias in measurement of the outcome – does the study report that the people who assess outcomes are aware of intervention assignments? Since for some of these study designs, it's not possible to blind the condition, socially desirable responding is probably the biggest threat.	
Criteria for a judgment of 'Low risk' of bias.	Any one of the following: •No blinding of outcome assessment, but the review authors judge that the outcome measurement is not likely to be influenced by lack of blinding; •Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken. • Objective outcomes were assessed by more than one assessor and there was good inter-rater agreement If objective measures are used in conjunction with subjective measures for the same outcomes (to triangulate the effect), can code as low risk.
Criteria for a judgment of 'Moderate risk' of bias.	• The outcome measure is only minimally influenced by knowledge of the intervention

	received by study participants; and any error in measuring the outcome is only minimally related to intervention status.
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following: •No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding; •Blinding of outcome assessment, but likely that the blinding could have been broken, and the outcome measurement is likely to be influenced by lack of blinding. • Subjective, self-report items should be coded as serious risk. • Error in measuring the outcome was related to intervention status (e.g. poor inter-rater agreement)
Criteria for a judgment of 'Critical risk' of bias.	• The methods of outcome assessment were so different that they cannot reasonably be compared across intervention groups.
Criteria for a judgment of 'Unclear risk' of bias.	Any one of the following: •Insufficient information to permit judgment of risk; If it was an objective outcome (e.g. observation of mask use) but it is stated that the staff conducting the assessments were not blinded, code as unclear.
Domain 7 – bias in selection of reported results – do the researchers report all intended outcomes and analyses? This domain combines (i) selective reporting of a particular outcome measurement from multiple measurements assessed within an outcome domain; and (ii) selective reporting of a particular analysis from multiple analyses of a specific outcome measurement. Such selective reporting will lead to bias if selection is based on the direction, magnitude or statistical significance of the effect estimate. Look for registered protocol or pre-registrations. If it is registered, this should be reported in the paper. Search "NCT" for clinicaltrials.gov, "ISRCTN" for International Standard Randomized Controlled Trial Number, "protocol", "pre-registered", "pre-registration", "osf", "open science framework", "AsPredicted".	
Criteria for a judgment of 'Low risk' of bias.	Any of the following: •The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way.
Criteria for a judgment of 'Moderate risk' of bias.	•The study protocol is not available but the analyses are consistent with an a priori plan including all expected outcomes; *and* there is no indication of selection of the reported analysis

	from multiple analyses; *and* there is no indication of selection of unplanned subgroup analysis and reporting on the basis of those results. • There are slight deviations in the planned analyses of the outcome, but authors have been transparent and the reasons are justified (e.g. one item in a validated self-report scale demonstrates poor internal consistency and dropping that item is not detrimental to the comprehensiveness of construct measurement and improves measurement of the outcome)
Criteria for a judgment of 'Serious risk' of bias.	Any one of the following: •One or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified (e.g. differences in the definition of the outcome between methods and results without good justification); •One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect); •One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis; •The study report fails to include results for a key outcome
Criteria for a judgment of 'Critical risk' of bias	•Not all of the study's pre-specified primary outcomes have been reported; and the unreported results are likely to be substantially different from the reported results.
Criteria for a judgment of 'Unclear risk' of bias.	Insufficient information to permit judgement of 'Low risk' or 'High risk'. It is likely that the majority of studies will fall into this category. If there is no trial protocol registered or pre-registration– Judgment = Unclear

Coming to a decision about overall risk of bias

Judgement	Within each domain	Across domains	Criterion
Low risk of bias	The study is comparable to a well-performed randomized trial with regard to this domain	The study is comparable to a well performed randomized trial	The study is judged to be at low risk of bias for all domains.
Moderate risk of bias	The study is sound for a nonrandomized study	The study provides sound evidence for a	The study is judged to be at low or moderate

	with regard to this domain but cannot be considered comparable to a well-performed randomized trial	non-randomized study but cannot be considered comparable to a well performed randomized trial	risk of bias for all domains.
Serious risk of bias	The study has some important problems in this domain	The study has some important problems	The study is judged to be at serious risk of bias in at least one domain, but not at critical risk of bias in any domain.
Critical risk of bias	The study is too problematic in this domain to provide any useful evidence on the effects of intervention	The study is too problematic to provide any useful evidence and should not be included in any synthesis	The study is judged to be at critical risk of bias in at least one domain.
Unclear	No information on which to base a judgement about risk of bias for this domain	No information on which to base a judgement about risk of bias	There is no clear indication that the study is at serious or critical risk of bias and there is a lack of information in one or more key domains of bias (a judgement is required for this).