COVID-19 Living Evidence Synthesis 17.1: Effectiveness of Hand Hygiene and Respiratory Etiquette for reducing transmission of COVID-19 and other respiratory infections in non-health care community-based settings

Executive summary

Question

What is the effectiveness of hand hygiene and respiratory etiquette in reducing transmission of COVID-19 and other respiratory infections in non-health care community-based settings?

Background

- Frequent hand washing and respiratory etiquette (coughing into elbow or tissue) are recommended by international public health agencies (e.g., WHO) both prior to and during the SARS-CoV-2 pandemic. This LES will review the evidence to support that these behaviours reduce the transmission of SARS-CoV-2 between humans.

Key points

- We included 14 studies in this LES. All of the studies were observational; no randomized controlled trials were identified in our search. Due to the inherent limitations of the study design, the judgment of risk of bias was serious for all of the studies. Nonetheless, these are the best available evidence on well established infection prevention and control measures.
- The absence of randomized trials or quasi-experimental studies is not unexpected as it would be unethical to randomize people to "not wash their hands" or to use a placebo during a pandemic.
- Of the 14 studies, three included COVID-19 transmission as an outcome and 11 included COVID-19 infection as an outcome.
- Nine studies compared hand washing with no or less frequent hand washing with or without additional Public Health Safety Measures.
- Overall, evidence suggests that hand washing may reduce the risk of COVID transmission and infection. There is too little evidence to comment on the effectiveness of respiratory etiquette measures such as coughing into an elbow or tissue. Note that the absence of evidence is not indicative of ineffectiveness.
- It is unlikely that future studies will be effective at separating out the impact of hand washing or respiratory etiquette from other public health safety measures.

Suggested Tweet

- Yes, there is aerosol transmission of COVID, but you still need to wash your hands!

Date of last literature search: 16 December 2022

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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 RCTs 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.

Findings

After removing duplicates, we screened 2,196 titles and abstracts. After excluding 2,157 articles, 39 were selected for full-text review, and 14 were included in this LES (9 were included in the narrative conclusion). (Figure 1). The studies were predominantly conducted in single countries (China-4, USA-4, Japan-2, Denmark-1, Germany-1, Thailand-1) with one conducted across 13 countries. The majority of studies were performed in early 2020 with the latest one completing data collection in September 2021 (i.e., 13 out of 14 were completed within time frame of wild-type COVID strain and one during time frame of Delta strain). Characteristics, findings, and assessment of risk of bias for each of the included studies are presented in Table 1.

Summary of findings about the primary outcome: Reducing transmission of COVID-19

Three comparative studies (2 cohorts; 1 case-control) reported transmission of COVID-19 as an outcome. These studies showed an association between hand washing and reduced risk of transmission of COVID-19.

Six comparative studies (1 cohort, 5 case-control) reported COVID infection as an outcome. Two studies showed an association between hand washing and reduced risk of infection. Three studies showed no difference for risk of infection when hand washing was compared to no or less frequent hand washing. One study showed an increased risk of infection with frequent hand washing compared to infrequent hand washing. However, this effect disappeared when occupation as a confounding factor was removed. For example, health care workers are more likely

Box 2: Our approach

We retrieved candidate studies by searching: 1) PubMed, Embase, CINAHL, PsyINFO and 2) 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). Our detailed search strategy is included in **Appendix 1**.

Studies were identified up to eight days before the version release date. Studies that report on empirical data with a comparator were considered for inclusion, with modelling studies, simulation studies, cross-sectional studies, case reports, case series, and press releases excluded. Other study designs may be considered for future versions in the absence of other forms of evidence. A full list of included studies is provided in **Tables 1-3**. Studies excluded at the last stages of reviewing are provided in **Appendix 2**.

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

Intervention and control/comparator: hand hygiene method compared to another hand hygiene method or no hand hygiene; respiratory etiquette (coughing into elbow or tissue) compared to no respiratory etiquette.

Primary outcome: Reduction in transmission of COVID-19
Secondary outcomes: Reduction in COVID-19 associated hospitalizations and death and reduction in transmission of other respiratory illnesses.

Data extraction: Data extraction was conducted by one team member and checked for accuracy and consistency by another.

Critical appraisal: Risk of Bias (ROB) of individual studies was be assessed using validated ROB tools. For RCTs we used ROB-2, and for observational studies, we used ROBINS-I. Judgements for the domains within these tools will be decided by consensus within synthesis team and undergo revision with subsequent iterations of the LES as needed. Additional ROB tools will be added as needed to fit with other study designs. Once a study was seemed to meet one criterion that made it "critical" risk of bias, it was dropped without completing the full ROB assessment. Our detailed judgements for ROB are provided in **Appendix 3**.

Summaries: We summarized the evidence by presenting narrative evidence profiles across studies by outcome measure.

Due to limited evidence and no expectation that additional studies will be performed; no further updates of this document are planned.

to be infected and also more likely to be frequently washing their hands.

Two comparative studies (2 case-control) showed conflicting results for association between hand sanitizer use and risk of infection. Only one study compared sneezing into elbow with not sneezing into elbow with no difference in risk of infection.

Five additional observational studies of lower methodological rigor (3 cross-sectional surveys, 1 ecological study, and 1 correlational study) were included in this LES but were not included in the narrative conclusion.

Summary of findings about secondary outcome 1: Reducing COVID-19 associated hospitalizations and deaths

None of the studies included in this version of the LES reported the effect of hand washing or respiratory etiquette on reducing COVID-19 associated hospitalizations and deaths.

Summary of findings about secondary outcome 2: Reducing transmission of other respiratory infections

None of the studies included in this version of the LES reported on transmission of other respiratory infections.

Table 1: Summary of studies reporting on effectiveness of hand hygiene or respiratory etiquette in preventing COVID-19 infections

Reference	Date released	Setting and time covered	Study characteristics	Summary of key findings in relation to the outcome	ROB
OUTCOME = Transmission (all study design in reverse chronological order)					
Liu et al. Pediatric household transmission of severe acute respiratory coronavirus-2 infection – Los Angeles County, December 2020 to February 2021	22 May 2021	USA	**Design**: Prospective cohort **Intervention**: Preventative behaviours survey **Sample**: 15 confirmed pediatric cases and 50 household contacts **Key outcomes**: Transmission **VOCs assessed**: Time frame of wild-type strain (Dec 2020 to Feb 2021)	• Increased hand washing or hand sanitizer use (yes) reduced risk of transmission: Secondary Attack Rate = 19% (95% CI: 9-36) vs 58% (95% CI: 36-77); p=0.01	Serious
Xie et al. Infection and disease spectrum in individuals with household exposure to SARS-CoV-2: a family cluster cohort study	28 Jan 2021	China	**Design**: Retrospective family cluster cohort **Intervention**: Self-reported hand washing, masking **Sample**: 20 confirmed cases and 79 household controls **Key outcomes**: Transmission **VOCs assessed**: Time frame of wild type strain (Jan to Feb 2020)	• Uninfected were more likely than infected to wash their hands more than 5 times per day (77% vs 53%, p=.04)	Serious

Doung-ngern et al. Case-control study of use of personal protective measures and risk for SARS-CoV 2 infection, Thailand	11 Nov 2020	Thailand	**Design**: Retrospective case-control **Intervention**: Self-reported frequent hand washing, wearing masks, social distancing **Sample**: 211 confirmed cases and 839 controls (asymptomatic contacts on Day 1 who tested negative or were not tested) **Key outcomes**: Transmission **VOCs assessed**: Time frame of wild type strain (Mar 2020 to April 2020)	• Bivariate analysis: hand washing "sometimes" (OR 0.41, 95% CI: 0.18-0.91) or hand washing "often" (OR 0.19, 95% CI: 0.08-0.46) vs "no hand washing" were negatively associated with risk of infection • Multivariable analysis: hand washing "often" (aOR 0.33, 95% CI: 0.13-0.87; pIn=0.045) was negatively associated with infection; adjusted for other preventative measures	Serious
Outcome = Infection (cohort studies)					
Baumkotter et al. Protective behavior and SARS-CoV-2 infection risk in the population – Results from the Gutenberg COVID-19 study	31 Oct 2022	Germany	**Design**: Prospective cohort **Intervention**: Self-reported hand washing; physical distancing; masks **Sample**: Population-based sample of 10,250 adults **Key outcomes**: Infection; lab confirmed and self-report **VOCs assessed**: Time frame of wild type strain to Delta (Oct 2020 to June 2021)	• No protective association was observed for hand washing • Prevalence ratio: 1.12 (95% CI: 0.88; 1.44); p=0.36 (adjusted for time of enrollment, sociodemographic, pandemic-related behaviour)	Serious

OUTCOME = Infection (case-control studies in reverse chronological order)					
Cajar et al. Behavioral factors associated with SARS-CoV-2 infection. Results from a web-based case-control survey in the Capital Region of Denmark	20 May 2022	Denmark	**Design**: Case-control **Intervention**: Activities and behaviours 14 days prior to testing positive or same period for matched controls **Sample**: 8,942 confirmed cases and 34,165 negative controls and 26,006 never tested controls **Key outcomes**: Infection; lab confirmed (IRR) **VOCs assessed**: Time frame of wild type strain (Nov 2020 to Jan 2021)	• Infected compared to Negative Controls: Frequent hand washing was associated with increased rate ratio of infection compared to infrequent hand washing (IRR 1.09, 95% CI: 1.02-1.17; p=0.0087) [effect disappeared when occupation accounted for in subgroup analysis] • Infected compared to Never Tested Controls: Frequent hand washing was associated with increased rate ratio of infection compared to infrequent hand washing (IRR 1.30, 95% CI: 1.21-1.39; p<0.001) [effect disappeared when occupation accounted for in subgroup analysis] • Infected compared to Negative Controls: Frequent hand sanitizer use was negatively associated with infection compared to infrequent hand sanitizer use (IRR 0.79, 95% CI:0.73-0.85; p<0.001) • Infected compared to Never Tested Controls: Frequent hand sanitizer use did not differ for infection compared to infrequent hand sanitizer use (IRR 0.98, 95% CI: 0.91-1.06; p=0.58) • Infected compared to Negative Controls: Sneezing in elbow did not differ for infection compared to not sneezing in elbow (IRR 1.00, 95% CI: 0.93-1.07; p=0.96) • Infected compared to Never Tested Controls: Sneezing in elbow was associated with increased rate ratio of infection compared to not sneezing in elbow (IRR 1.20, 95% CI: 1.12-1.29; p<0.001) *all above adjusted for age, sex, and municipality	Serious

Hara et al. Real-world effectiveness of the mRNA COVID-19 vaccines in Japan: a case-control study	14 May 2022	Japan	**Design**: Case-control **Intervention**: Vaccination; self-administered behaviour questionnaire **Sample**: 398 confirmed cases (identified as part of an epidemiologic survey of close contacts) and 179 controls (with negative test results who were in close contact with cases) **Key outcomes**: Vaccine effectiveness adjusted for personal protective behavior in relation to the duration since the last vaccination **VOCs assessed**: Time frame of Delta variant (June to Sept 2021)	• Cases were significantly less likely than controls to spend more than 20s washing their hands (60.8% vs 72.1%; p=0.009) • No association of infection with use of a hand sanitizer (89.9% vs 89.4%; p=0.833) • Multivariate analysis: washing hands for over 20s each time was negatively associated with infection (OR 0.60, 0.41-0.88); there was no difference in risk of infection and hand sanitizer use and infection; adjusted for vaccination and other protective behaviors	Serious
Lio et al. Effectiveness of personal protective health behaviour against COVID-19	29 Apr 2021	China	**Design**: Case-control **Intervention**: Self-reported hand hygiene reported separately from other interventions **Sample**: 24 confirmed cases and 113 controls (completing mandatory 14-day quarantine post travel) **Key outcomes**: Infection **VOCs assessed**: Time frame of wild type strain (March 2020 to April 2020)	• Univariate analysis: hand washing after handling food or cooking (infected 75% vs non-infected 94.2%; p<0.001); post toileting (79.2% vs 91.5%; p=0.035); after outdoor activity (83.3% vs 99.5%; p<0.001); after sneezing or coughing (54.2% vs 80.5%; p=0.001); washed for at least 20 secs (16.7% vs 31.9%; p=0.125) • Average number of handwashes with soap or alcohol sanitizers per day (9.1 vs 9.2; P=0.958) • Multivariate analysis: hand washing after outdoor activity (aOR, 0.021, 95% CI: 0.003-0.134; p<0.005) and before touching the mouth or nose area (aOR, 0.303, 95% CI: 0.114-0.808; p<0.05) were negatively associated with infection; *adjusted for other preventative measures	Serious

Speaker et al. Social behaviors associated with a positive COVID-19 test result	02 Jan 2021	USA	**Design**: Case-control **Intervention**: Social behaviours survey **Sample**: 113 confirmed cases and 226 controls (contacted through a hospital EMR) **Key outcomes**: Infection; confirmed **VOCs assessed**: Time frame of wild-type strain (May to June 2020)	• COVID positive participants were not less likely to report "Always washed my hands or used hand sanitizer after possible exposures" compared to COVID negative participants	Serious
Gao et al. The impact of individual lifestyle and status on the acquisition of COVID-19: A case-control study	17 Oct 2020	China	**Design**: Case-control **Intervention**: Self-reported lifestyles **Sample**: 105 confirmed cases and 210 controls (from same communities) **Key outcomes**: Infection; according to guidelines **VOCs assessed**: time frame of wild type strain (Feb to Mar 2020)	• Infected were less likely to report "good practice of hand hygiene" than uninfected (46.7% vs 69.5%; p<.001) • Multivariate analysis: hand hygiene vs no hand hygiene was negatively associated with infection (aOR 0.62, 95% CI:0.41-0.93; p=0.021); adjusted for other lifestyle measures	Serious

OUTCOME = Infection (all other observational study types in alphabetical order)					
Badri et al. Disparities and temporal trends in COVID-19 exposures and mitigating behaviors among Black and Hispanic Adults in an urban setting	28 September 2021	USA	**Design**: Cross-sectional survey **Intervention**: Self-reported behaviours **Sample**: 169 adults who underwent PCR testing **Key outcomes**: Infection, lab confirmed **VOCs assessed**: Time frame for wild-type strain (July to August 2020)	• Washed hands often vs not was not associated with testing positive (aOR 0.55, 0.21-1.44); adjusted for age and test week • Used hand sanitizer often vs not often was negatively associated with testing positive (aOR 0.26, 0.13-0.52); adjusted for age and test week	Not applicable
Karout et al. COVID-19 prevalence, risk perceptions, and preventative behavior in asymptomatic Latino population: a cross-sectional study	29 September 2020	USA	**Design**: Cross-sectional survey **Intervention**: Self-reported precautionary behavior **Sample**: 410 asymptomatic Latino adults within a religious community **Key outcomes**: Infection; lab confirmed **VOCs assessed**: Time frame for wild-type strain (July to August 2020)	• Positive participants were more likely to report "never" hand washing or using hand sanitizers ($p<0.001$) (not reported according to category)	Not applicable
Okumura et al. Polarized nature of the COVID-19 pandemic in Japan: associations with population age structure and behaviors	13 May 2021	Japan	**Design**: Ecological study **Intervention**: Behaviours including masking, avoiding closed spaces, avoiding close contact settings, "washing hands", cough etiquette **Sample**: 6,000 respondents (10 low and 10 high COVID incidence prefectures) **Key outcomes**: High incidence of COVID (cases per 100,000) **VOCs assessed**: Time frame for wild type strain (May 2020)	• Univariate analysis: washing hands was associated with high COVID incidence area: 1.369 (1.157-1.620) • Univariate analysis: practicing cough etiquette was associated with high COVID incidence area: 1.213 (1.089-1.352) • Multivariate analysis: washing hands was associated with high COVID incidence area: aOR 1.233 (1.005-1.511); adjusted for other behaviours (other than close contact/crowds) • Multivariate analysis: practicing cough etiquette was associated with high COVID incidence area: aOR 1.014 (0.890-1.155); adjusted for other behaviours (other than close contact/crowds)	Not applicable

Szczuka et al. The trajectory of COVID-19 pandemic and handwashing adherence: findings from 14 countries	05 Oct 2021	Australia, Canada, China, France, Gambia, Germany, Israel, Malaysia, Poland, Portugal, Romania, Singapore, Switzerland	**Design**: Observational, correlational study **Intervention**: Self-reported hand washing adherence **Sample**: 6,064 adults **Key outcomes**: Trajectory of COVID based on total/new/change in cases of COVID morbidity/mortality at country level **VOCs assessed**: Time frame of wild type strain (March to July 2020)	• Bivariate correlation analysis: higher hand washing adherence was associated with lower levels of COVID morbidity and mortality compared to beginning of pandemic • Increase in recent (2-week) cases of COVID morbidity/mortality was associated with higher levels of handwashing	Not applicable
Xu et al. Relationship between COVID-19 infection and risk perception, knowledge, attitude, and four nonpharmaceutical during the late period of the COVID-19 epidemic in China: online cross-sectional survey of 8158 adults	12 June 2020	China	**Design**: Cross-sectional survey, comparative **Intervention**: Social media app reported knowledge of and adherence to hand washing, proper coughing habits, social distancing, mask wearing **Sample**: 8,158 adults **Key outcomes**: Infection **VOCs assessed**: Time frame of wild type strain (Feb 2020 to Mar 2020)	• Bivariate analysis: Hand washing (2.28% vs 0.65%) vs no hand washing was associated with lower risk of infection (RR 3.53, 1.53-8.15; P=.009) • Bivariate analysis: Proper coughing (1.79% vs 0.73%) vs improper coughing vs 0.73% proper coughing was associated with lower risk of infection (RR 2.44, 1.15-5.15; P=.03) • Multivariable analysis: Hand washing and proper coughing vs not were not associated with lower risk of infection (adjusted for all 4 measures and social demographic variables)	Not applicable

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Appendix 1: Detailed search strategy

The following databases were searched: PubMed, CINAHL, EMBASE, PsyInfo using variations on the following PubMed search strategy below:

#14 NOT (Animals[Mesh] NOT (Animals[Mesh] AND Humans[Mesh]))
#9 or #10 or #11 or #12 or #13
#3 and #8
#3 and #7
#3 and #6
#3 and #5
#3 and #4
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]
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]
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 "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]
(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]
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]
#1 and #2
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]))
("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] 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] AND (2020/01/01:2023/01/01[dp])

Appendix 2: Studies excluded at the last stages of reviewing

EXCLUDED (alphabetical order)					
Dupraz et al. Prevalence of SARS-CoV-2 in household members and other close contacts of COVID-19 cases: a serologic study in Canton of Vaud, Switzerland	26 Mar 2021	Switzerland	**Design**: Cross-sectional community-based seroepidemiological study **Intervention**: Self-reported behaviours **Sample**: 219 confirmed cases and 302 household contacts and 69 close contacts (not in same household as index) **Key outcomes**: Anti-SARS-CoV-2 IgG antibodies **VOCs assessed**: Time frame for wild type strain (May to June 2020)	• Multivariate analysis : rather yes, rather no or no for respect of simple hygiene rules (washing hands regularly, sneezing into the elbow, etc) was associated with increased likelihood of positive serology test for household members (aOR 1.80, 95% CI: 1.02-3.17; p=0.41); adjusted for individual and household characteristics	Wrong outcome measure (antibodies)
Mahdi et al. Syndromic surveillance of respiratory-tract infections and hand hygiene practice among pilgrims attended Hajj in 2021: a cohort study	27 Jun 2022	Saudi Arabia	**Design**: Prospective cohort **Intervention**: Self-reported hand hygiene **Sample**: 510 Hajj pilgrims **Key outcomes**: Infection (RTI including suspected COVID for 4); unconfirmed **VOCs assessed**: Time frame of Alpha to Delta (July 2021)	• Univariate analysis: hand hygiene practices were not associated with RTI compared to no hand hygiene practices	Critical ROB (no lab confirmed COVID)
Migisha et al. Investigation of a COVID-19 outbreak at a regional prison, Northern Uganda, September 2020	06 Sept 2022	Uganda	**Design**: Retrospective cohort **Intervention**: Behavioural factors **Sample**: Prisoner and staff contacts of confirmed index case **Key outcomes**: Infection, lab confirmed **VOCs assessed**: time frame of wild type strain (Sept 2020)	• 220 prisoners escaped (including 53 who tested positive): 24% of non-cases and 25% of cases: excluded	Critical ROB (25% missing data)

Mushcab et al. A cohort study of seroprevalence of antibodies against SARS-CoV-2 infection among healthcare workers at a tertiary hospital in Saudi Arabia	10 Aug 2022	Saudi Arabia	**Design**: Prospective cohort **Intervention**: Self-reported behaviour questionnaire **Sample**: 682 health care workers **Key outcomes**: Anti-SARS-CoV-2 IgG antibodies **VOCs assessed**: Time frame for wild-type strain (June 2020 to April 2021)	• 112 of 682 participants had positive PCR before taking part in study; only 87 of all participants tested positive for SARS-CoV-2 antibodies • Bivariate analysis: using alcohol-based hand rub or soap and water after (risk of) body fluid exposure reduced risk of antibody positivity (P=0.02)	Wrong outcome (antibodies) and wrong study population (HCW)
Ran et al. Risk factors of healthcare workers with coronavirus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China	17 Mar 2020	China	**Design**: Retrospective cohort **Intervention**: Self-reported behaviours **Sample**: 72 health care workers with acute respiratory symptoms **Key outcomes**: Infection, lab confirmed **VOCs assessed**: Time frame for wild-type strain (January 2020)	• Univariate analysis: "Unqualified hand washing" (RR 2.64, 1.04-6.71; P<.05); suboptimal hand hygiene before contact with patients (RR 3.10, 1.43-6.73; P<.01) and suboptimal hand hygiene after contact with patients (RR 2.43, 1.34-4.39; p<.01) increased risk of infection	Wrong study population (HCW)
Shimizu et al. Effectiveness of infection preventive behaviors on COVID-19-like illness symptoms during the winter third wave of the epidemic in Japan: a 2-month follow-up nationwide cohort	12 Dec 2021	Japan	**Design**: Prospective cohort **Intervention**: Self-reported preventive behaviours **Sample**: 19,941 adults (aged 20 to 65) **Key outcomes**: Self-reported COVID-like illness symptoms **VOCs assessed**: Time frame of wild type strain (Dec 2020 to Feb 2021)	• Rarely/never hand washing or disinfecting after touching doorknobs, handrails, and other objects increased risk of CLI compared to always practicing these behaviours (aOR 1.20, 1.10-1.32; p<.001); adjusted for age, sex, education, annual household income, marital status, job type, smoking status, underling diseases, regional incidence of COVID-19	Critical ROB (no lab confirmation of COVID)

Appendix 3: Risk of Bias Judgements (ROBINS-I) for Cohort and Case-Control Studies Included in this LES

RISK of BIAS for LES 17.1		low risk of bias	moderate risk of bias	serious risk of bias	critical risk of bias			
First Author	**Confounding**	**Selection of participants**	**Classification of intervention**	**Deviations from intended intervention**	**Missing Data**	**Measurement of outcome**	**Reported results**	**Overall**
	influence on treatment decisions baseline confounding or time-varying confounding adjusted?	based on characteristics after start of intervention same start times for intervention and follow-up	intervention groups clearly defined; recall bias classification of intervention status have affected knowledge of outcome or risk of outcome	adherence	outcome data available for all or nealy all excluded due to missing data	influenced by knowledge of intervention outcome assessors unaware and comparable methods across groups		
Liu	did not adjust for other factors or behaviours	same time start; behaviours collected at baseline and follow-up	contacts could have been infected by another source at time of study entry	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Xie	did not adjust for other factors or behaviours	same time start but unknown if behaviours were present prior to pandemic	contacts could have been infected by another source at time of study entry; recall bias	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Doung-ngern	adjusted for some behaviours	same time start but unknown if behaviours were present prior to pandemic	contacts could have been infected by another source at time of study entry; recall bias; not all controls tested at baseline	no direct method of confirming adherence therefore subject to recall bias and social desirability	some missing data for cases and controls	lab confirmed	not applicable	serious
Baumkotter	adjusted for some factors and behaviours including vaccination	same time start but unknown if behaviours were present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Cajar	matched on age, sex, residency, ethnicity, household size	same time start (2 weeks prior to test date); unknown if behaviours present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Hara	adjusted for some factors and behaviours including vaccination	same time start; unknown if behaviours present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Lio	adjusted for some factors and behaviours	same time start; unknown if behaviours present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Speaker	did not adjust for other factors or behaviours	same time start; unknown if behaviours present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	lab confirmed	not applicable	serious
Gao	matched on sex, age and underlying diseases and other behaviours	same time start; unknown if behaviours present prior to pandemic	participants were aware of their COVID status at baseline which could have influenced behaviour (in either or both groups)	no direct method of confirming adherence therefore subject to recall bias and social desirability	no missing data reported	according to guidelines	not applicable	serious