COVID-19 Living Evidence Synthesis 18.1: Effectiveness of Cleaning and Disinfecting for reducing transmission of COVID-19 and other respiratory infections in non-health care community-based settings.

Executive summary

Question

1. What is the best available evidence about the effectiveness of cleaning and disinfecting products and strategies in reducing transmission of COVID-19 and other respiratory illnesses (e.g., influenza, respiratory syncytial virus (RSV) in non-health care community based settings?
2. What are the identified knowledge gaps in the scientific literature related to the effectiveness of cleaning and disinfecting products and strategies in reducing COVID-19 transmission?
3. What are the negative outcomes associated with the use of cleaning and disinfecting products and strategies to reduce the transmission of COVID-19 and other respiratory illnesses?
4. What is the best available evidence about the effectiveness of cleaning and disinfecting products and strategies for deactivating/eliminating SARS-CoV 2 on surfaces in non-health care community-based settings?
5. What is the best available evidence about the efficacy/effectiveness of cleaning and disinfecting products and strategies for deactivating/eliminating SARS-CoV 2 on surfaces assessed in vitro studies?

Background

- Non-pharmaceutical interventions are part of the control measures for the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the cleaning and disinfecting are activities thought to be effective on COVID-19 risk reduction (Bojorquez-Chapela, 2022).
- In March 2020, following the identification of SARS-CoV-2, the Centers for Disease Control and Prevention, and US Environmental Protection Agency (EPA) issued List N: Disinfectants for Use Against SARS-CoV-2 (EPA, 2020a), which initially identified 250 surface disinfectants that met EPA´s criteria for efficacy under the Emerging Viral Pathogens Guide for Antimicrobial Pesticides (EPA, 2016, 2020a). By August 2020, the List N included 482 surface disinfectants (Dotson, 2020).
- However, there is little evidence to inform or support decision making about which types of cleaning and/or disinfecting products and strategies are most effective at reducing transmission of COVID-19 and/or other respiratory illnesses and how often cleaning and/or disinfecting affects the transmission of COVID-19 in community settings (Wang, 2020).

Key points

- New data on chlorine and ethanol household disinfection frequency for SARS-CoV-2 transmission reduction has been reported, with the data drawn from one cohort study with critical RoB (Wang et al., 2020). In family members who had lived with primary cases, the use of disinfectants containing **chlorine or ethanol** once a day might reduce the SARS-CoV-2 household transmission compared to the use of the same disinfectants once in 2 or more days (77% [95% CI, 16 to 93%]).
- No analytical studies in real life community-based settings evaluating the deactivation/ elimination of SARS-CoV-2 on surfaces were found.
- New data from in vitro studies evaluating different interventions (Virusend™, Ethanol, Isopropanolol, Dish soap, Hand soap, CDC Bleach™, IPA, Quaternary ammonium, Hydrogen peroxide, SiQAC-C18, C360™, Vital Oxide™, PMMA-H_2O_2 microcapsules, Hypochlorous solution) on Deactivating/Eliminating SARS-CoV-2 on surfaces, have been added, with the data drawn from eight studies with Probably Low risk of bias (Anderson et al., 2021, Jahromi et al., 2020, Welch et al., 2021, Criscuolo et al., 2021, Caschera et al., 2021, Hardison et al., 2022, Souza et al., 2022, Urushidani et al., 2022).
- New data from in vitro studies evaluating different interventions (A surface cleanser, Ethanol, Sodium hypochloride, Citric acid, Quaternary ammonium, Sani-24™, Ozone gas) on Deactivating/Eliminating SARS-CoV-2 on surfaces, have been added, with the data drawn from six studies with Probably High risk of bias (Ijaz et al., 2020, Jung et al., 2023, Ijaz et al., 2021, Ijaz et al., 2022, Rutala et al., 2022, Tizaoui et al., 2022).

Executive summary

Key points

- The evidence (from in vitro studies, most of it comparing the active ingredient versus placebo) of deactivating/ eliminating SARS-CoV-2 efficacy addresses: **Virusend**™ on stainless steel (SS); **Ethanol 50% and 70%** on Kraft paper, SS, and glass; **Sodium hypochlorite** on parchment paper, glass, SS, polypropylene (PP), and kraft; **Bleach** on 3D printed material, SS, SBR, and paint; **Quaternary ammonium** on 3D printed material; **Hydrogen peroxide 3%** on 3D printed material and SS; **C360**™ on SS, styrene–butadiene rubber (SBR), paint and Bus seat fabric (SF); **VO**™ on SS, and SF; **Quaternary Ammonium Compound (QAC) Disinfectant wipes** on glass Petri dish; **Citric acid Disinfectant wipes** on glass Petri dish; **Ethanol/ QAC Disinfectant spray** on glass Petri dish; **Ready to use QAC cleaner** on glass Petri dish; Sani-24™ on glass surfaces; **PMMA-H2O2 MCs** on nonwoven fabric samples; High **ozone gas** concentrations on polystyrene plastic, glass and steel; Dry fogging of **8,700 ppm hypochlorous** solution on plastic plates; Dry fogging of **56,400 ppm hydrogen peroxide** solution on plastic plates

Overview of evidence and knowledge gaps

- There is scarce evidence on the effectiveness of cleaning and disinfecting products/strategies, specifically in community settings, to reduce the transmission of SARS-CoV-2. There is a lack of evidence for the outcomes of ICU admission, ventilation, and death associated with COVID-19 in community settings.
- There is a lack of evidence for the outcome of deactivation/elimination of SARS-CoV-2 on surfaces in real life community-based settings.
- Most of the evidence comes from in vitro studies evaluating the intervention compared to placebo. There is scarce evidence on the comparative efficacy among cleaning and disinfecting products/strategies to deactivate/eliminate SARS-CoV 2 on surfaces.

Date of last literature search: 14 March 2023

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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

- Overall, 1812 records were identified through evidence search, 1321 were appraised in title and abstract, 287 in full text, and 15 studies were used to complete this summary. The reasons for excluding the remaining 272 studies are reported in Appendix 2. Figure 1 presents the PRISMA flow diagram.

Summary of findings about the primary outcome: Reducing transmission of SARS-CoV-2

One study was included that reports on reducing transmission of SARS-CoV-2 as an outcome, in this version of the LES. The characteristics, findings and assessment of risk of bias of each study are presented in Table 1.

In family members who had lived with primary cases, the use of disinfectants containing chlorine or ethanol once a day reduced the SARS-CoV-2 household transmission compared to the use of disinfectants containing chlorine or ethanol once in 2 or more days. (Critical RoB)

Summary of findings about secondary outcome 1: Reducing COVID-19 ICU admission, ventilation and deaths

No studies were included that report on reducing COVID-19 associated ICU admission, ventilation and deaths as an outcome, in this version of the LES. The characteristics, findings and assessment of risk of bias for each study will be presented in Table 2 when available.

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

Box 2: Our approach

We retrieved candidate studies by searching: 1) PubMed via COVID-19+ Evidence Alerts; 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 five 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. As there was scarse information In Vitro studies were considered too. A full list of included studies is provided in **Tables 1-5**. 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: Cleaning: Cleaning surfaces and objects with soap (or detergent) and water to reduce the amount of viral particles by physically removing them.
Disinfecting: Disinfecting indicates use of a disinfectant product on surfaces or objects to deactivate COVID-19 or other viruses.

Primary outcome: Reduction in transmission of COVID-19;
Secondary outcomes: Reduction in COVID-19 associated ICU admission, ventilation and deaths. Deactivating/eliminating SARS-CoV-2 on surfaces.

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 be assessed using validated ROB tools. For RCTs we used ROB-2, and for observational studies, we used ROBINS-I and, for In Vitro studies we used OHAT. Judgements for the domains within these tools are decided by consensus within synthesis team and undergo revision with subsequent iterations of the LES as needed. Once a study has met one criterion that makes it "critical" risk of bias, it will be dropped from further risk of bias assessment (exception: if limited data available for an outcome). Our detailed approach to critical appraisal is provided in **Appendix 4**.

Summaries: We summarized the evidence by presenting narrative evidence profiles across studies by outcome measure. Future versions may include statistical pooling of results if deemed appropriate.

No studies were included that report on reducing transmission of other respiratory infections as an outcome, in this version of the LES. The characteristics, findings and assessment of risk of bias for each study will be presented in Table 3 when available.

Summary of findings about secondary outcome 3: Deactivating/eliminating SARS-CoV 2 on surfaces in non-health care community-based settings.

No studies were included that report on the deactivation/elimination of SARS-CoV-2 on surfaces in non-health care community settings as an outcome, in this version of the LES. The characteristics, findings and assessment of risk of bias for each study will be presented in Table 4 when available.

Summary of findings about secondary outcome 4: Deactivating/eliminating SARS-CoV 2 on surfaces in in vitro studies.

Fourteen in vitro studies were included, reporting on Deactivating/Eliminating SARS-CoV-2 on surfaces as an outcome. The characteristics, findings and assessment of risk of bias of these studies are presented in Table 5.

Virusend™ 100µl reduced the virus titre to below the limit of detection on stainless steel (SS) discs after 1 minute of contact time. (Probably Low RoB)

The addition of anionic surfactants improves the virucidal efficacy of twelve fluids (ethanol, isopropanol, dodecylbenzenesulfonate (SDBS), sodium laureth sulfate (SLS), glycerin, liquid hand soap, dish soap, and water of standardized hardness (WSH). Fluid S8 (70% isopropanol, 3% hand soap, and 27% WSH) showed the greatest virucidal efficacy on Polyvinyl chloride (PVC) material with polyurethane (PUR) surface coating after one minute of contact time. (Probably Low RoB)

Single application of Ethanol 50% and 70% achieved elimination of SARS-CoV-2 titer in Kraft paper, SS, and glass, after 1 minute of contact time. (Probably High RoB)

Single application of Ethanol 70% achieved elimination of SARS-CoV-2 titer in LPDE, after 5 minutes of contact time. (Probably High RoB)

Single application of Sodium hypochlorite 1000 ppm achieved elimination of SARS-CoV-2 titer in parchment paper, glass, SS, PP, and kraft after 5 minutes of contact time. (Probably High RoB)

Single application of Bleach, Quaternary ammonium and Hydrogen peroxide 3% achieved elimination of SARS-CoV-2 titer on 3D printed material after 5 minutes of the intervention. (Probably Low RoB)

Single application of IPA did not achieved elimination of SARS-CoV-2 titer after 5 minutes of the intervention, although there was >95% inactivation of viruses. (Probably Low RoB)

Gaseous Ozone 0.2 ppm application reduced SARS-CoV-2 titer in >99.9% in fleece, 96.8% in gauze, 93.3% in wood, 90% in glass and 82.2% in plastic, after 2 hours of the intervention. ()

Pretreated SS discs with spray application of SiQAC-C18 product reduced SARS-CoV-2 titers after 10 minutes of exposure. (Probably Low RoB)

Single application of C360™ by spray method reduced SARS-CoV-2 titer on SS, styrene–butadiene rubber (SBR), paint and Bus seat fabric (SF) compared to hard water. (Probably Low RoB)

Single application of CDC bleach™, by spray method reduced SARS-CoV-2 titer on SS, SBR, and paint, but did not reduce SARS-CoV-2 titers on SF. (Probably Low RoB)

No difference between C360™ and hard water by Spray & Wipe method was observed on SS, SF, SRB and paint. (Probably Low RoB)

Single application of peroxide by spray method reduced SARS-CoV-2 titer on SS compared to hard water. No difference between hard water and peroxide was observed on SF. (Probably Low RoB)

Single application of Vital Oxide™ (VO) by spray method reduced SARS-CoV-2 titer on SS and SF compared to hard water. (Probably Low RoB)

Single application of QAC Disinfectant wipes QAC , Citric acid Disinfectant wipes, Ethanol/ QAC Disinfectant spray, and ready to use (RTU) QAC cleaner reduced SARS-CoV-2 titers in ≥3.0 Log in glass Petri dish, achieving the greatest reductions with Ethanol/ QAC Disinfectant and QAC RTU cleaner. (Probably Low RoB)

Application of Sani-24™ reduced SARS-CoV-2 titer in ≥4.22 Log in glass surfaces after 48 hours of the intervention. (Probably High RoB)

Single application of PMMA-H2O2 MCs reduced SARS-CoV-2 deoxyribonucleic acid in nonwoven fabric samples by 62.27% after 10 minutes of the intervention; by 75% after 30 minutes of the intervention and by 97.26% after one hour of the intervention. (Probably Low RoB)

At high concentrations (5.0 g.min/m3) and 70% relative humidity Ozone gas application reduced the SARS-CoV-2 titers on polystyrene plastic well compared to air after one hour of the intervention. (Probably High RoB)

At high concentrations (15.0 g.min/m3) and 70% relative humidity Ozone gas application reduced the SARS-CoV-2 titers on glass and steel compared to air after one hour of the intervention. (Probably High RoB)

Lower concentrations of Ozone gas application achieved limited of SARS-CoV-2 titers on glass and steel compared to air after one hour of the intervention. (Probably High RoB)

Dry fogging of 8,700 ppm hypochlorous solution reduced the SARS-CoV-2 titers on plastic plates compared to distilled water at 16 minutes of the intervention, lower reductions were achieved at 12 minutes of the intervention. (Probably Low RoB)

Dry fogging of lower concentration of hypochlorous solution did not achieved reduction of SARS-CoV-2 titers on plastic plates compared to distilled water at any time point of the intervention. (Probably Low RoB)

Dry fogging of 56,400 ppm hydrogen peroxide solution reduced the SARS-CoV-2 titers on plastic plates compared to distilled water at 16 minutes of the intervention. (Probably Low RoB)

Figure 1. PRISMA flow diagram (Page, 2021)

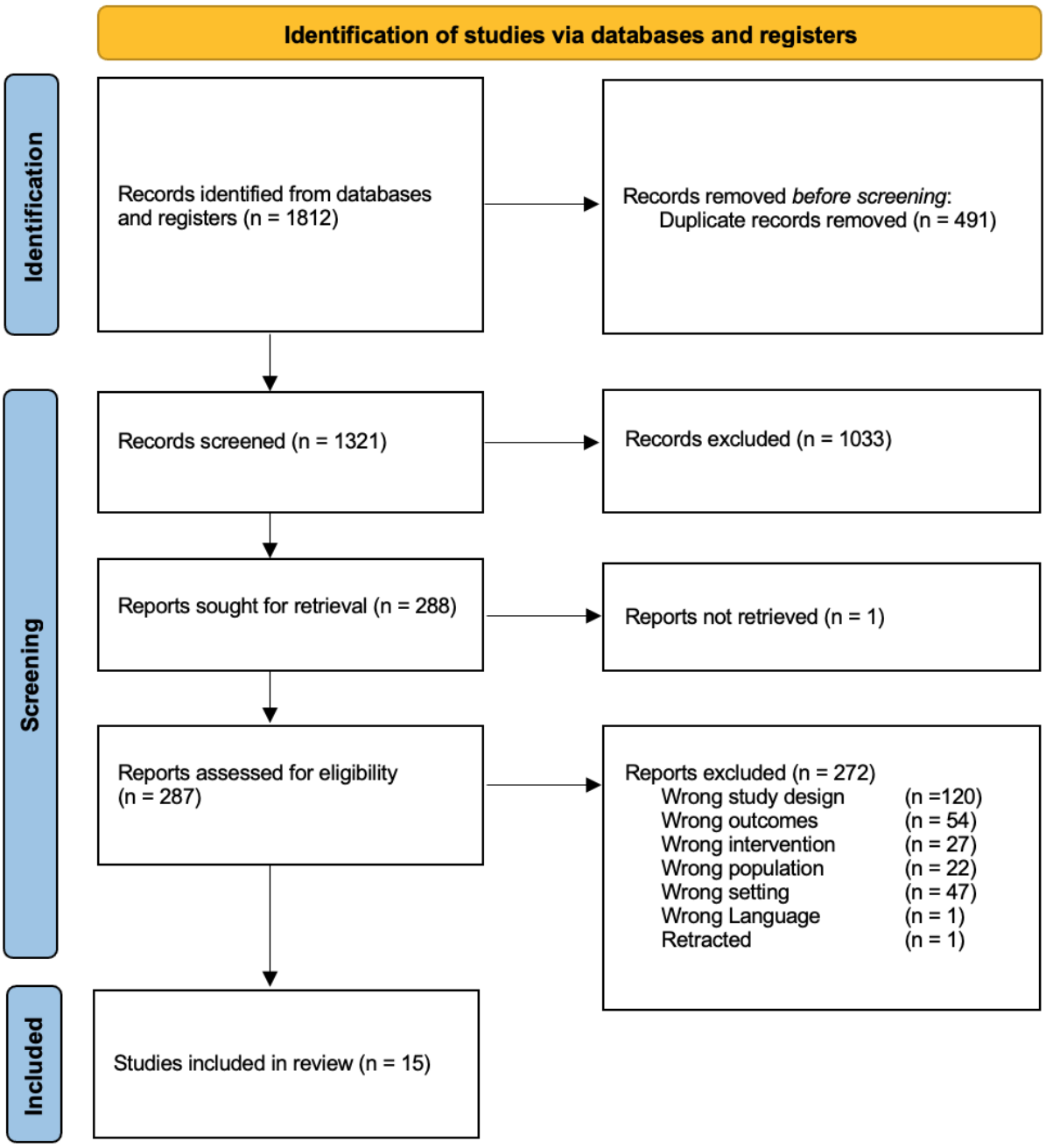

Table 1: Summary of studies reporting on effectiveness of cleaning and disinfecting in preventing COVID-19 infections.

Reference	Date released	Setting and time covered	Study characteristics	Summary of key findings in relation to the outcome	RoB
Wang et al., 2020	28 May 2020	Beijing, China	**Design**: Retrospective cohort **Intervention**: Disinfecting with chlorine or ethanol once a day compared to once in 2 or more days. **Sample**: 335 people in 124 families **Population:** Family members who had lived with primary cases in a house for 4 days before and for more than 24 hours after the primary cases developed illness related to COVID-19. All laboratory confirmed COVID-19 cases reported in Beijing until 21 February 2020, were enrolled in our study and followed-up. **Setting:** Household disinfection of the floor, door and window handles, indoor air, tables and toilets. **Key outcomes**: COVID-19 transmission reduction **VOCs assessed**: None	• In family members who had lived with primary cases, the use of disinfectants containing chlorine or ethanol once a day reduced the SARS-CoV-2 household transmission compared to the use of disinfectants containing chlorine or ethanol once in 2 or more days. [OR 0.23 (95% CI, 0.07, 0.84)] 14 days after the intervention.	Critical

Table 2: Summary of studies reporting on effectiveness of cleaning and disinfecting in reducing COVID-19 associated ICU admissions, ventilation and deaths.

Reference	Date released	Setting and time covered	Study characteristics	Summary of key findings in relation to the outcome(s)	RoB
No data yet					

Table 3: Summary of studies reporting on effectiveness of cleaning and disinfecting in reducing other respiratory infections.

Reference	Date released	Setting and time covered	Study characteristics	Summary of key findings in relation to the outcome	RoB
No data yet					

Table 4: Summary of studies reporting on effectiveness of cleaning and disinfecting in deactivating/ eliminating SARS-CoV 2 on surfaces assessed in real life community settings.

Reference	Date released	Setting and time covered	Study characteristics	Summary of key findings in relation to the outcome	RoB
No data yet					

Table 5: Summary of studies reporting on effectiveness of cleaning and disinfecting in deactivating/ eliminating SARS-CoV 2 on surfaces assessed in In vitro studies.

Reference	Date released	Setting and funding	Study characteristics	Summary of key findings in relation to the outcome	RoB
Anderson et al., 2021	26 Apr 2021	Liverpool, UK; Public	**Design**: In vitro experiment **Intervention**: Disinfecting with 100µl of Virusend™1 30 s or 9.5min compared with Autoclaved water**.** **Population:** SARS-CoV-2 isolate (REMRQ0001/Human/2020/Liverpool) from a clinical sample cultured in Vero E6 cells maintained in DMEM with 4% fetal bovine serum (FBS) and 0.05mgml−1 gentamicin at 37 °C and 5% CO2, using either 9.8 log10 or 7.9 log10 p.f.u. ml−1 of SARS-CoV-2. **Surface:** SS discs. **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None	Virusend™ 100µl reduced the virus titre by at least 4.0 log10 p.f.u. ml−1 with high titre inoculum and by at least 2.3 log10 p.f.u. ml−1 with low titre inoculum on hard surfaces after 1 or 10 minutes of contact time. • Virusend™ 100µl reduced SARS-CoV-2 titres to below the limit of detection (3.0 log10 p.f.u. ml−1) for both high (7.3 log10 p.f.u. ml−1 recovered for control) and low titre inoculum (5.3 log10 p.f.u. ml−1 for control) 1 minute after the intervention. • Virusend™ 100µl reduced SARS-CoV-2 titres to below the limit of detection (3.0 log10 p.f.u. ml−1) for both high (7.0 log10 p.f.u. ml−1 recovered for control) and low titre inoculum (5.9 log10 p.f.u. ml−1 for control) 10 minutes after the intervention.	Probably Low
Ijaz et al., 2020	August 2020	United States; Not reported	**Design**: In vitro experiment **Intervention**: Surface cleanser[2] 0.096% w/w **Population:** SARS-CoV-2 dried on a glass surface with a 5% FBS organic load **Surface:** Glass surface	Surface cleanser reduced the virus titre by ≥4.1 log10 after 5 minutes of contact time.	Probably High

			Key outcomes: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None		
Jahromi et al., 2020	26 Aug 2020	Public; Iran	**Design**: In vitro experiment **Intervention**: **S1:** Ethanol/WSH 70/30 **S2:** Isopropanol/WSH 70/30 **S3:** Ethanol/Isopropanol/WSH 35/35/30 **S4:** Ethanol/Isopropanol/WSH/Glycerin 35/35/27/3 **S5:** SDBS/Ethanol/WSH 3/70/27 **S6:** SDBS/Ethanol/WSH/Glycerin 3/70/24/3 **S7:** SLS/Isopropanol/WSH 3/70/27 **S8:** Isopropanol/Hand soap[3]//WSH 70/3/27 **S9:** Dish soap[4]//Ethanol/WSH 3/70/27 **S10:** Ethanol/Isopropanol/Dish soap//WSH/Glycerin 35/35/3/24/3 **S11:** Dish soap/WSH 3/97 **S12:** Hand soap/WSH 3/97 Isopropanol (>99%), glycerin (>95%), SDBS (>95%), SLS (>95%) and WSH **Population:** SARS-CoV-2 coronavirus obtained from Molecular Epidemiology Laboratory at Shiraz University of Medical Science, Iran. The coronavirus suspension was prepared by infecting monolayers of A549 cell (human lung epithelial carcinoma cells) lines. The virus titers of these suspensions ranged from 105 to 1010 TCID50/ml. **Surface:** PVC material with PUR surface coating	• S2 compared with S1 showed a slightly higher (~7%) reduction factor than ethanol solution, after 1 minute of contact time. • S3 compared with S1 and S2 did not exhibit RF. The virucidal efficiency of S3 was ~13% greater than the expected value (average of S1 and S2), after 1 minute of contact time. • The addition of 3% glycerin (S4) did not influence the RF significantly (6.0) compared to S3 (6.2), after 1 minute of contact time. • S5 compared to S1 increased the virucidal activity by ~21%, after 1 minute of contact time. • S6 compared to S5 increased the RF value from 6.4 to 6.6, after 1 minute of contact time. • S7 compared to S2 exhibited increased ~19% in virucidal properties, after 1 minute of contact time. • S8 compared to S7 increased RF by ~15%. Among tested fluids, recipe S8 demonstrated the greatest virucidal efficiency (RF = 7.8), after 1 minute of contact time.	Probably Low

			Key outcomes: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None	• S9 compared to S5 increased RF by ~16%, after 1 minute of contact time. • S10 compared to S4 increased RF by ~27% from 6 to 7.6, after 1 minute of contact time. • S11 and S12 compared to WSH slightly increased the RF value, the changes were negligible when compared with WSH, after 1 minute of contact time.	
Jung et al., 2023	12 Aug 2022	Korea; Public	**Design**: In vitro experiment **Intervention**: Disinfecting with Ethanol (Ethyl Alcohol) at 50% and 70% concentrations for 1 min and 5 min compared with 0% concentration. Disinfecting with Sodium hypochlorite at 500 ppm and 1000 ppm concentrations for 1 min and 5 min compared with 0% concentration. Wiping test to verify the WHO interim guidelines: A sterile cotton swab moistened with 70% EtOH, 500 or 1000 ppm NaClO was used to wipe the virus-contaminated hard surface 1–3 times, until the dry stains disappeared. **Population:** Confluent Vero E6 (ATCC CL-1586) cells inoculated with two types of SARS-CoV-2 (L type, KOR/KCDC03-NCCP43326/ 2020, accession number: MW466791.1; S type, KOR/KCDC12- NCCP43330/2020, accession number: MW466795.1) at 0.1 multiplicities of infection (MOI) in DMEM with 2% FBS, grown in DMEM (Gibco, NY, USA) with 10% FBS and	Ethanol 50% and 70% achieved complete reduction (No viruses detected) in Kraft paper, SS, and glass, after 1 minute of contact time. Ethanol 50% and 70% achieved complete reduction (No viruses detected) in Kraft paper, SS, glass, and parchment paper after 5 minutes of contact time. Ethanol 70% achieved complete reduction (No viruses detected) in LPDE, after 5 minutes of contact time. Ethanol 50% reduced SARS-CoV-2 L by 2.98 ± 0.13, and SARS-CoV-2 S reduced by 2.85 ± 0.08 log TCID50/mL, in parchment paper after 1 minute of contact time. Ethanol 70% reduced SARS-CoV-2 L by 3.08 ± 0.06, and SARS-CoV-2 S reduced by 3.10 ± 0.03 log TCID50/mL in parchment paper after 1 minute of contact time.	Probably High

			1% antibiotics antimycotics (Gibco).These cells were then cultured at 37 ◦C with 5% CO2 in a humidified incubator. **Surface:** Kraft paper, parchment paper, and low-density polyethylene (LDPE) were purchased from an online market. Each surface was made into a carrier with a diameter of 8 mm using a punch. SS, glass, and polypropylene (PP) were processed to a thickness of 1 mm and a diameter of 1 cm. **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None	Ethanol 50% reduced SARS-CoV-2 L by 2.96 ± 0.32, and SARS-CoV-2 S were reduced by 3.50 ± 0.18 log TCID50/mL in LPDE after 5 minutes of contact time. Sodium hypochlorite 1000 ppm achieved complete reduction (No viruses detected) in SS, after 1 minute of contact time. Sodium hypochlorite 1000 ppm achieved complete reduction (No viruses detected) in parchment paper, glass, SS, PP, and kraft after 5 minutes of contact time. Sodium hypochlorite 500 ppm achieved complete reduction (No viruses detected) in PP, and kraft after 5 minutes of contact time. Sodium hypochlorite 1000 ppm achieved >3 log in parchment paper, glass, PP after 1 minute of contact time. Sodium hypochlorite 500 ppm achieved >3 log in glass, after 5 minutes of contact time. Sodium hypochlorite 1000 ppm reduced SARS-CoV-2 L by 2.21 log, and SARS-CoV-2 S were by 3.06 log TCID50/mL in LPDE after 1 minute of contact time ($p < 0.001$). Sodium hypochlorite 1000 ppm reduced SARS-CoV-2 L band SARS-CoV-2 S to trace amounts (0.55 TCID50/mL for S and L types) in LPDE after 5 minutes of contact time.	

				EtOH 70% was effective in the quantitative carrier test after 1 minute intervention. For complete reduction, surfaces were exposed for at least 5 min after intervention (SS, glass, and PP). NaClO 1000 ppm was effective in the quantitative carrier test after 1 minute intervention. For complete reduction, surfaces were exposed for at least 5 min after intervention1000 ppm, whereas 500 ppm NaClO required 10 min (SS, glass, and PP).	
Welch et al., 2021	12 Aug 2020	Iowa, United States; Public	**Design**: In vitro experiment **Intervention**: Single application (by wipe) allowed to dry (<5 minutes) of: • Bleach (10%; 0.6% hypochlorite) • Isopropanol (Isopropyl alcohol - IPA 70%) • Commercial Quaternary ammonium[5] • Hydrogen peroxide 3% Compared to Control wipe: Phosphate-buffered saline (PBS) **Population:** SARS CoV-2 (Seattle Washington strain MN985325) provided by Dr Stanley Perlman, University of Iowa). VeroE6 were provided by Dr Stanley Perlman. Cells were maintained in media Virus titers were determined by median tissue culture infectious dose (TCID50)	Single application of Bleach reduced SARS-CoV-2 titer in >5.5 Log in 3D printed material after 5 minutes of the intervention. No infectivity remained P < .001. Single application of IPA reduced SARS-CoV-2 titer in 1.4 Log in 3D printed material after 5 minutes of the intervention. No infectivity remained. IPA did not eliminate viral infectivity although there was >95% (≥1.3 log) inactivation of viruses applied P < .01. Single application of Quaternary ammonium reduced SARS-CoV-2 titer in >5.5 Log in 3D printed material after 5 minutes of the intervention. No infectivity remained P < .001. Single application of Hydrogen peroxide 3% achieved SARS-CoV-2 complete inactivation P < .0001.	Probably Low

			Surface: 3D printed material using Multi-Jet Fusion (MJF) technology and a powder-based polyamide-12 (PA12) material (HP 3D HR CB PA 12 - Hewlett-Packard, Palo Alto, CA), (used for VHA supplemental surgical face mask). **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None		
Criscuolo et al., 2021	30 Dec 2020	Italy; Public	**Design**: In vitro experiment **Intervention**: Single application of Gaseous ozone 0.2 ppm or 4 ppm using Ozonext Defender 10 (Cea S.p.A., Lecco, Italy) adapted inside a system composed of a plexiglass chamber. Time exposure 30, 60, 90, and 120min Compared to untreated controls **Population:** hCoV-19/Italy/UniSR1/2020 (GISAID accession ID: EPI_ISL_413489) isolated and propagated in Vero E6 cells. **Surface:** Six types of materials of common use: glass (13 mm round glass coverslips), plastic (cap of 0.2 mL PCR tube), gauze (sterile gauze pad), wood (sterile wood tongue depressor), fleece, and wool (both sterilized by bleaching). **Key outcomes**: Infectious titer reduction rate $1–1/10^{\log10\ (N0/Nt)}) \times 100$ (%).	Gaseous Ozone 0.2 ppm application reduced SARS-CoV-2 titer in >99.9% in fleece, 96.8% in gauze, 93.3% in wood, 90% in glass and 82.2% in plastic, after 2 hours of the intervention. Gaseous Ozone 4 ppm application reduced SARS-CoV-2 titer in 0% in fleece, 68.4% in gauze, 93.3% in wood, 0% in glass and 90% in plastic, after 30 minutes of the intervention. Gaseous Ozone 4 ppm application reduced SARS-CoV-2 titer in 96.8% in fleece, 99.2% in gauze, 93.3% in wood, 93.2% in glass and 68.4% in plastic, after one hour of the intervention. Gaseous Ozone 4 ppm application reduced SARS-CoV-2 titer in 99.7% in fleece, 99.8% in gauze, 0% in wood, 94.4% in glass and 90% in plastic, after two hours of the intervention.	Probably Low

			VOCs assessed: None		
Caschera et al., 2021	28 Oct 2021	Canada; Industry	**Design**: In vitro experiment **Intervention**: • Quaternary ammonium (SiQAC-C18 product 0.5 w/v% active in water) applied by a commercial sprayer until thoroughly wetted: For samples of the Doherty Institute, the product was applied using an air brush sprayer, distance of 20 cm, at a 45° angle, 50 mL application volume per carrier, and for the Rega Institute via an electrostatic sprayer, distance of 2 feet, 10 seconds spray time, 50 mL application volume. Discs were pretreated for Rega Institute at KU Leuven (S1) at 46 days and the Doherty Institute at the University of Melbourne (S2, S3) 47 days. Compared to Untreated controls **Population:** 50 mL viral suspension of SARS-CoV-2 patient isolates cultured by the Doherty Institute (Victoria, Australia) and Rega Institute. At the Doherty Institute, isolate hCoV-19/Australia/VIC01/2020 (VIC01), at the Rega Institute SARS-CoV-2 isolate hCoV19/Belgium/GHB-03021/2020 (GHB-03021).	Pretreated SS discs with spray application of SiQAC-C18 product 0.5 w/v% active in water reduced SARS-CoV-2 titer in 102.93 after 10 minutes of exposure for the GHB-03021 isolate. No infectivity remained $P < .0014$. Pretreated SS discs with spray application of SiQAC-C18 product 0.5 w/v% active in water reduced SARS-CoV-2 titer in 103.38 after 10 minutes of exposure for the VIC01 isolate. No infectivity remained $P < .0001$. Pretreated SS discs with spray application of SiQAC-C18 product 0.5 w/v% active in water degraded SARS-CoV-2 genome in with >107 less intact E gene after 10 minutes of exposure for the VIC01 isolate.	Probably Low

			Surface: SS (2 cm, 2B finish) disks, donated by Pegan Industries. **Key outcomes**: viral reduction, qRT-PCR test **VOCs assessed**: None		
Hardison et al., 2022	15 dec 2022	United States; Public	**Design**: In vitro experiment **Intervention**: Single application using Spray (no touch with contact time) and Spray & Wipe (wipe immediately post-application) methods immediately and 2 h post-contamination of: • C360™ (67619-38)[6] from The Clorox Company 2 min contact time. • Bleach™ solution (67619-32)[7] from The Clorox Company 10 min contact • Peroxide multisurface cleaner™ (1677-238) [8] from EcoLab 30 s contact • Vital Oxide™ (82972-1)[9] from Vital Solutions 5 min contact Compared to Hard Water. **Population:** SARS-CoV-2 (USAWA1/2020, BEI Resources, Manassas, VA) propagated in Vero E6 cells (American Type Culture Collection, Manassas, VA). **Surface:** Bus seat fabric SF (American Seating, Grand Rapids, MI), SS (0.03-cm-thick fatigue resistant 301; hardness rating of C40 on Rockwell Scale; meeting ASTM A666 specifications,	Single application of C360™ by spray method reduced SARS-CoV-2 titer on all materials at T0 of the intervention compared to hard water. (SS, P = 0.0002; SF, P = 0.0009; SBR, P = 0.0117; paint, P = 0.0003). Single application of C360™ by spray method reduced SARS-CoV-2 titer on SS, SBR and paint at T2 of the intervention compared to hard water. (SS, P = 0.018; SBR, P = ≤ 0.0001; paint, P = ≥ 0.0001). No difference between hard water and C360™ was observed on SF. No difference between C360™ and hard water by Spray & Wipe method was observed on SS, SF, SRB and paint at T0. Single application of C360™ by Spray & Wipe method reduced SARS-CoV-2 titer on SF at T2 of the intervention compared to hard water. (SF, P = 0.0051). No difference between hard water and C360™ was observed on SS, SBR, or paint. Single application of CDC bleach™ by spray method reduced SARS-CoV-2 titer on all materials but SF at T0 of the intervention	Probably Low

			McMaster-Carr, Aurora, OH), and styrene–butadiene rubber SBR (0.16 cm thick, McMaster-Carr). Painted drywall tape (paint) (Lowe's Home Improvement, Columbus, Ohio) was painted (Latex Eggshell Ultra White Tintable Interior Paint, Lowe's Home Improvement, Columbus, OH). Materials were cut [3 inch × 0.75 inch (7.7 cm × 1.9 cm)] and cleaned by wiping with a cloth dampened with 70% by volume isopropanol (SBR) or by soaking in a Liqui-Nox (Alconox, White Plains, NY) solution (1:100 at pH 8.5) and rinsing with distilled water (SS). SF and paint coupons were used without cleaning. Coupons were packaged in polyethylene tubing and sterilized via Electron Beam (40kGy dose; E-BEAM Services, Inc., Lebanon, OH). **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None	compared to hard water. (SS, P = ≤ 0.0001; SBR, P = ≤ 0.0001; paint, P = 0.0252). Single application of CDC bleach™ by spray method reduced SARS-CoV-2 titer on SS, and paint at T2 of the intervention compared to hard water. (SS, P = 0.0029; paint, P = 0.0075). No difference was observed between hard water and CDC bleach on SF and SRB at T2. Single application of CDC bleach™ by Spray & Wipe method reduced SARS-CoV-2 titer on paint at T2 of the intervention compared to hard water. (P = 0.0458). No difference was observed between hard water and CDC bleach™ on SS, SF and SRB at T2. Single application of peroxide™ by spray method reduced SARS-CoV-2 titer on SS at T0 of the intervention compared to hard water. (P = 0.0002). No difference between hard water and peroxide was observed on SF. Single application of peroxide™ by spray method reduced SARS-CoV-2 titer on SS at T2 of the intervention compared to hard water. (P = 0.0007). No difference between hard water and peroxide was observed on SF. No significant differences in efficacy were observed between peroxide™ and hard water for the Spray & Wipe method.	

				Single application of VO™ by spray method reduced SARS-CoV-2 titer on all materials at T0 of the intervention compared to hard water. (SS, P = ≤ 0.0001; SF, P = ≤ 0.0001). Single application of VO™ by spray method reduced SARS-CoV-2 titer on SS at T2 of the intervention compared to hard water. (SS, P = 0.0022). No difference between hard water and VO was observed on SF. Single application of VO™ by Spray & Wipe method reduced SARS-CoV-2 titer on SS at T0 of the intervention compared to hard water. (SS, P = 0.0143). No difference between hard water and VO™ was observed on SF. Single application of VO™ by Spray & Wipe method reduced SARS-CoV-2 titer on SS at T2 of the intervention compared to hard water. (SS, P = 0.0143). No difference between hard water and VO™ was observed on SF.	
Ijaz et al., 2021	11 Mar 2021	United States; Industry	**Design**: In vitro experiment **Intervention**: 2.0 mL of the test microbicide were added onto the dried viral film by direct pipetting or spray such that the dried virus film was completely covered by the test microbicide: • QAC Disinfectant wipes[10] 1.75 min contact • Citric acid Disinfectant wipes [11] 0.5 min contact	Single application of QAC Disinfectant wipes reduced SARS-CoV-2 titer in ≥3.5,≥3.5,≥3.5 Log in glass Petri dish after 1.75 minutes of the intervention. Single application of Citric acid Disinfectant wipes reduced SARS-CoV-2 titer in ≥3.0,≥3.0,≥3.0 Log in glass Petri dish after 0.5 minutes of the intervention.	Probably High

			• Ethanol/ QAC Disinfectant spray[12] 1.75 min contact • QAC RTU cleaner[13] 2 min contact Compared to Initial viral loads **Population:** Aliquot of 0.4 mL of SARS-CoV-2 Isolate USA-WA1/2020, obtained from CDC, through BEI Resources, Cultured in Vero E6, medium: MEM + 5% FBS plus soil load **Surface:** pre-sterilized 10-cm glass Petri dish **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None	Single application of Ethanol/ QAC Disinfectant spray reduced SARS-CoV-2 titer in ≥4.6,≥4.7,≥4.5 Log in glass Petri dish after 1.75 minutes of the intervention. Single application of QAC RTU cleaner reduced SARS-CoV-2 titer in ≥4.0,≥4.0,≥4.0 Log in glass Petri dish after 2 minutes of the intervention.	
Ijaz et al., 2022	28 Mar 2022	United states; Industry	**Design**: In vitro experiment **Intervention**: 2.0 mL of the test microbicide were added onto the dried viral film by direct pipetting or spray such that the dried virus film was completely covered by the test microbicide: • Quaternary ammonium[14] 5 min contact Compared to Initial viral loads **Population:** Aliquot of 0.4 mL of SARS-CoV-2 Isolate USA-WA1/2020, obtained from CDC, through BEI Resources, Cultured in Vero E6, medium: MEM + 5% FBS plus soil load **Surface:** pre-sterilized 10-cm glass Petri dish	Single application of Quaternary ammonium reduced SARS-CoV-2 titer in ≥3.0,≥3.0,≥3.0Log in glass Petri dish after 5 minutes of the intervention.	Probably High

			Key outcomes: Log10 reduction in infectious SARS-CoV-2 titer achieved. **VOCs assessed**: None		
Rutala et al., 2022	02 Dec 2021	United States; Public and Industry	**Design**: In vitro experiment **Intervention**: The method simulates dry and wet wiping by incorporating "wear" of the test surface as well as reinoculations of the test and control surfaces over a period of at least 24 hours following product application: • Firebird F130™ (Microban Products, Huntersville, NC) marketed as Sani-24™ by Professional Disposable International (Woodcliff Lake, NJ) 3 sprays, 15.25–20.3 cm from the surface), and allowed to dry overnight. Compared to Sterile water **Population:** ≥5-log10 of virus per carrier, treated with the novel disinfectant (3 sprays, 15.25–20.3 cm from the surface), and allowed to dry overnight. **Surface:** Glass surfaces (2.5 cm × 2.5 cm) The carriers were abraded using a standardized abrasion machine (Gardco Model D10V, Paul N. Gardner Co, Pompano Beach, FL) under multiple alternating dry and wet wiping conditions **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer achieved with the continuously acting disinfectant.	Application of Sani-24™ reduced SARS-CoV-2 titer in ≥4.22 Log in glass surfaces after 48 hours of the intervention. (Mean Viral Recovery per Carrier: Control 5.72; Continuously acting disinfectant ≤1.50)	Probably High

			VOCs assessed: None		
Souza et al., 2022	02 Jun 2022	Portugal; Industry	**Design**: In vitro experiment **Intervention**: PMMA-H_2O_2 MCs[15] were dispersed into an aqueous solution of the textile binder BAYPRET NANO-PU. The resultant suspension was then loaded onto nonwoven fabric samples, covering the entire substrate area and dried for 4 h at 40 °C. Nonwoven fabric samples were prepared with PMMA-H_2O_2 MCs of three different concentrations, 12.5, 25, and 50 mg/cm. Compared to nonfabric substrates, without functionalization with PMMA or PMMA-H2O2 **Population:** 60 µL of SARS-CoV-2 samples derived from excess swab samples diagnosed through RT-qPCR as SARS-CoV-2 positive at the diagnostic laboratory from ICVS, University of Minho. Samples were diluted to contain approximately 1000–3000 viral copies per mL considering the quantification cycle (Cq) of the RT-qPCR assay in relation to the commercial standard reference. **Surface:** Nonwoven fabric samples (1 cm × 1 cm): Laundry such as clothing, towels and linens. **Key outcomes**: SARS-CoV-2 RT-PCR **VOCs assessed**: None	Application of PMMA-H_2O_2 MCs reduced SARS-CoV-2 deoxyribonucleic acid in nonwoven fabric samples by 62.27% after 10 minutes of the intervention; by 75% after 30 minutes of the intervention and by 97.26% after one hour of the intervention.	Probably Low

Tizaoui et al., 2022	15 Apr 2022	United Kingdom; Public and Industry	**Design**: In vitro experiment **Intervention**: Gaseous ozone inside a reactor made of a 3 L plastic box fitted with a fan, a gas sampling port, a manual humidifier, a temperature and humidity probe, and an ozone supply canister. The ozone canister was prepared by adsorbing ozone on silica gel and stored in a freezer at − 18 °C. Compared to air **Population:** England2 strain of SARS-CoV2 provided by Public Health England. The virus was passaged at a low multiplicity of infection (MOI) of 0.01 in VeroE6 cells in Dulbecco's Modified Eagle Medium (DMEM). The initial virus concentration was typically between 1×10^7 and 4×10^7 PFU/mL. **Surface:** Polystyrene plastic well, rigid nonporous (copper, SS, and glass) and porous (coupons of ambulance seat and ambulance floor) surfaces. Approximately 1.5 cm × 1.5 cm) **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer **VOCs assessed**: None	Application of ozone gas (CT = 0.5 g.min/m^3) only reduced SARS-CoV-2 titer in 23% on polystyrene plastic well after 3 minutes of the intervention ($p = 0.033$, ~ 0.12 $\log_{10}$ reduction). Application of ozone gas (CT = 1.0 g.min/m^3) only reduced SARS-CoV-2 titer in 30% on polystyrene plastic well after 5 minutes of the intervention ($p = 0.022$). Application of ozone gas (CT = 4.7 g.min/m^3) reduced SARS-CoV-2 titer in 55% on polystyrene plastic well after 20 minutes of the intervention ($p = 0.015$). Application of ozone gas (CT = ~5.0 g.min/m^3) increasing relative humidity (RH) to ~70 reduced SARS-CoV-2 titer in 95% on polystyrene plastic well after 1 hour of the intervention ($p = 0.0097$). Application of ozone gas (CT = ~15.0 g.min/m^3) RH ~70 reduced SARS-CoV-2 titer in 99% on polystyrene plastic well after 1 hour of the intervention ($p = 0.01$). Application of ozone gas (CT = ~15.0 g.min/m^3) at RH 81%, reduced SARS-CoV-2 titer in 99% on both glass and steel after 1 hour of the intervention ($p = < 0.05$). With copper, ambulance seat and ambulance floor, no viable virus could be recovered after treatment, even from the control sample.	Probably High

Urushidani et al., 2022	07 Apr 2022	Japan; Public and Industry	**Design**: In vitro experiment **Intervention**: Initial dry fogging for 5 seconds left to stand for 4 minutes. Dry fogging was then repeated 3 more times for 2.5 seconds each and left to stand for 4 minutes after each fogging. Dry fogging was performed 4 times, namely, 0, 4, 8, and 12 minutes after the initiation of the experiment, and the total experimental period was 16 minutes: • Commercially available, weakly acidic (pH 6.5) hypochlorous acid solution with a free available chlorine (FAC) concentration (the sum of HOCl and OCl- concentrations) of 250, and 8,700 ppm • Commercially available hydrogen peroxide solution diluted by distilled water with hydrogen peroxide concentrations of 56,400 ppm. Compared to distilled water (DW) **Population:** Viral solutions (5 μl) containing SARS-CoV-2 (1.2×10^5 $TCID_{50}$) **Surface:** Plastic plates placed into a test chamber **Key outcomes**: Log10 reduction in infectious SARS-CoV-2 titer **VOCs assessed**: None	Dry fogging of hypochlorous solution (FAC concentration 250) did not reduce SARS-CoV-2 titer on plastic plates after 16 minutes of the intervention. Dry fogging of 8,700 ppm hypochlorous solution reduced SARS-CoV-2 titer on plastic plates after 16 minutes of the intervention compared to distilled water ($P < 0.0001$). Dry fogging of 56,400 ppm hydrogen peroxide solution reduced SARS-CoV-2 titer on plastic plates after 16 minutes of the intervention compared to distilled water ($P < 0.0001$).	Probably Low

[1]TX-10: Virusend™ was developed by Pritchard Spray Technologies, Colchester, UK
[2]0.077% w/w Alkyl dimethyl benzyl ammonium chloride (C12-16) QAC (tested at 1:1.25 of supplied)

[3]Hand soap active ingredient: sodium C12-13 parethsulfate, cocamidopropyl betaine, sodium laureth sulfate, sodium benzoate, sodium salicylate, tetrasodium EDTA, PEG-18 glyceryl oleate, citric acid
[4]Dish soap active ingredient: C10-16 alkyldimethyl amine oxide, sodium laureth sulfate, methylisothiazolinone, PEG-24 copolymer, sodium laureth sulfate, sodium dodecylbenzenesulfonate, sodium hydroxide, sodium chloride.
[5]Sani-Cloth germicidal disposable wipe AF3; n-Alkyl [68% C12, 32% C14] dimethyl ethyl benzyl ammonium chlorides – 0.14%; n-Alkyl [60% C14, 30% C12, 5% C18] dimethyl benzyl ammonium chlorides – 0.14%
[6] Neat 1%–5% Tetrasodium EDTA (CAS 13235-36-4); 0.1%–1% quaternary ammonium compounds, C12-18-alkyl[(ethyl phenyl)methyl]dimethyl (CAS 68956-79-6); 0.1%–1% quaternary ammonium compounds, C12-14-alkyl[(ethyl phenyl)methyl]dimethyl, chlorides (CAS 85409-23-0)
[7]1/3 cup bleach in 1 gallon of hard water 5%–10% Sodium hypochlorite (CAS 7681-52-9)
[8]4 oz per gallon hard water 0.39% Hydrogen peroxide (CAS 7722-84-1)
[9] Neat 0.200% Oxychlorine compounds; 0.125% n-alkyl dimethyl benzyl ammonium chloride (CAS 68391-01-5); 0.125% n-alkyl dimethyl ethyl benzyl ammonium chloride (CAS 85409-23-0)
[10] QAC Alkyl (50% C14, 40% C12, 10% C16) dimethyl benzyl ammonium chloride. (0.19% w/w)
[11] Citric acid (2.4% w/w)
[12] Ethanol (50% w/w)/ QAC Alkyl (50% C14, 40% C12, 10% C16) dimethyl benzyl ammonium saccharinate. (0.082% w/w)
[13] QAC Alkyl (67% C12, 25% C14, 7% C16, 1% C8-C10-C18) dimethyl benzyl ammonium chloride; Alkyl (50% C14, 40% C12, 10% C16) dimethyl benzyl ammonium chloride. (0.092% w/w)
[14] BTC 8358+Bardac 2080 (0.08%) 1:28 of product in 400 ppm AOAC
[15] Polymethyl methacrylate (PMMA) microcapsules developed with an active agent (hydrogen peroxide) encapsulated. PMMA with a weight average (M_w) of 550,000 g/mol (based on GPC analysis) and poly(vinyl alcohol) (PVA, 98–99%) were purchased from Alfa Aesar (Massachusetts, EUA). Hydrogen peroxide (30 wt %) in a water solution was purchased from Scharlab (Barcelona, Spain). The BAYPRET NANO-PU solution (TANATEX Chemicals) was used as the subtract binder.

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 2022 December 05
- Compedex https://www.engineeringvillage.com/
- Web of Science - https://www.webofscience.com/wos/woscc/basic-search

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	(Environmental Health[MeSH] OR Environmental Monitoring[MeSH] OR fomites[MeSH] OR Housekeeping[MeSH] OR "Housekeeping, Hospital"[MeSH] OR housekeeping[TIAB] OR housework[TIAB] OR surface[TIAB] OR fomite[TIAB] OR surface[TIAB] OR "public space*"[TIAB] OR "public transport*"[TIAB] OR "public facilities"[TIAB] OR bathroom[TIAB] OR washroom[TIAB] OR toilet[TIAB] OR "light switch*"[TIAB] OR "household hygiene"[TIAB] OR "household cleaning"[TIAB]) AND ("Disease Transmission, Infectious"[Mesh] OR "transmi*" [TIAB] OR infect*[TIAB] OR contagi*[TIAB] OR outbreak*[TIAB] OR spread*[TIAB]) AND (clean*[TIAB] OR disinfect*[TIAB] OR Infection control*[MeSH] OR steril*[TIAB] OR sanitis*[TIAB] OR sanitation[TIAB] OR sanitiz*[TIAB])
#3	#1 and #2
#4	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]
#5	(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]

#6	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]
#7	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]
#8	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]
#9	Suspension test[All Fields] OR In-vitro[All fields] OR "In vitro"[All fields] OR cyanovirin N [Supplementary Concept] OR In Vitro Techniques[MeSH] OR cells, cultured[MeSH]
#10	#4 or 5 or #6 or #7 or #8 or #9
#11	#3 and #10
#12	#11 NOT (Animals[Mesh] NOT (Animals[Mesh] AND Humans[Mesh]))

Additional PubMed Search:	
#1	"SARS-CoV-2"[Title] AND ("inactivat*"[Title] OR "virucidal"[Title]) AND ("anti infective agents"[MeSH Terms] OR "inactivat*"[Title] OR "virucidal"[Title]) AND ("surface"[Title/Abstract] OR "material*"[Title/Abstract])

Appendix 2: Studies excluded at the last stages of reviewing.

Excluded studies during full text assessment		
Author, year	**Reason for exclusion**	**Version of exclusion**
Abdullahi, 2020	Wrong study design	*Excluded in LES 18.1*
Abney, 2021	Wrong study design	*Excluded in LES 18.1*
Aghajanzadeh, 2022	Wrong outcomes	*Excluded in LES 18.1*
Ainsworth, 2021	Wrong outcomes	*Excluded in LES 18.1*
Al-Ansari, 2021	Wrong intervention	*Excluded in LES 18.1*
Al-Gheethi, 2020	Wrong study design	*Excluded in LES 18.1*
Almeida, 2022	Wrong setting	*Excluded in LES 18.1*
Anan, 2021	Wrong intervention	*Excluded in LES 18.1*
Anand, 2022	Wrong study design	*Excluded in LES 18.1*
Anderson, 2020	Wrong outcomes	*Excluded in LES 18.1*
Andreu, 2021	Wrong population	*Excluded in LES 18.1*
Ansari, 2021	Wrong study design	*Excluded in LES 18.1*
Ardura, 2021	Wrong outcomes	*Excluded in LES 18.1*
Arefi, 2020	Wrong study design	*Excluded in LES 18.1*
Aydogdu, 2021	Wrong study design	*Excluded in LES 18.1*
Azelee, 2020	Wrong study design	*Excluded in LES 18.1*
Badri, 2021	Wrong outcomes	*Excluded in LES 18.1*
Bakkar, 2021	Wrong setting	*Excluded in LES 18.1*
Barbato, 2022	Wrong population	*Excluded in LES 18.1*
Basu, 2021	Wrong outcomes	*Excluded in LES 18.1*
Bayarri, 2021	Wrong outcomes	*Excluded in LES 18.1*
Bazaid, 2020	Wrong intervention	*Excluded in LES 18.1*
Bedrosian, 2021	Wrong study design	*Excluded in LES 18.1*
Bell, 2021	Wrong setting	*Excluded in LES 18.1*
Benedusi, 2022	Wrong population	*Excluded in LES 18.1*
Berg, 2021	Wrong setting	*Excluded in LES 18.1*
Bergman, 2021	Wrong study design	*Excluded in LES 18.1*
Bhavanam, 2022	Wrong setting	*Excluded in LES 18.1*
Bhutta, 2021	Wrong study design	*Excluded in LES 18.1*
Bidra, 2020	Wrong setting	*Excluded in LES 18.1*
Bono, 2021	Wrong study design	*Excluded in LES 18.1*
Brault, 2022	Wrong population	*Excluded in LES 18.1*
Bregnocchi, 2022	Wrong study design	*Excluded in LES 18.1*
Bueckert, 2020	Wrong outcomes	*Excluded in LES 18.1*
Buklaha, 2022	Wrong study design	*Excluded in LES 18.1*
Buonavoglia, 2022	Wrong setting	*Excluded in LES 18.1*

Butot, 2021	Wrong outcomes	*Excluded in LES 18.1*
Cai, 2022	Wrong study design	*Excluded in LES 18.1*
Cai, 2023	Wrong study design	*Excluded in LES 18.1*
Cajar, 2022	Wrong outcomes	*Excluded in LES 18.1*
Ceresa, 2021	Wrong study design	*Excluded in LES 18.1*
Chen, 2021	Wrong study design	*Excluded in LES 18.1*
Chen, 2022	Wrong study design	*Excluded in LES 18.1*
Chiappa, 2021	Wrong outcomes	*Excluded in LES 18.1*
Chirani, 2021	Wrong study design	*Excluded in LES 18.1*
Chojnacki, 2021	Wrong setting	*Excluded in LES 18.1*
Cimolai, 2020	Wrong study design	*Excluded in LES 18.1*
Cimolai, 2022	Wrong study design	*Excluded in LES 18.1*
Claus, 2021	Wrong study design	*Excluded in LES 18.1*
Collins, 2021	Wrong population	*Excluded in LES 18.1*
Conzelmann, 2022	Wrong intervention	*Excluded in LES 18.1*
Cortes, 2020	Wrong outcomes	*Excluded in LES 18.1*
Costa, 2022	Wrong outcomes	*Excluded in LES 18.1*
deJoannon, 2021	Wrong setting	*Excluded in LES 18.1*
DelBrutto, 2021	Wrong intervention	*Excluded in LES 18.1*
DeLeo, 2020	Wrong study design	*Excluded in LES 18.1*
Delikhoon, 2021	Wrong outcomes	*Excluded in LES 18.1*
DevKumar, 2020	Wrong study design	*Excluded in LES 18.1*
Dewey, 2022	Wrong study design	*Excluded in LES 18.1*
Deyab, 2020	Wrong study design	*Excluded in LES 18.1*
DiFiore, 2022	Wrong setting	*Excluded in LES 18.1*
DiMaria, 2020	Wrong study design	*Excluded in LES 18.1*
Dickinson, 2022	Wrong setting	*Excluded in LES 18.1*
Dietz, 2020	Wrong study design	*Excluded in LES 18.1*
DiLorenzo, 2021	Wrong study design	*Excluded in LES 18.1*
Ding, 2023	Wrong outcomes	*Excluded in LES 18.1*
Donde, 2021	Wrong study design	*Excluded in LES 18.1*
Dorgham, 2021	Wrong study design	*Excluded in LES 18.1*
Dotson, 2020	Wrong study design	*Excluded in LES 18.1*
Duangjit, 2022	Wrong setting	*Excluded in LES 18.1*
Ehsani, 2023	Wrong outcomes	*Excluded in LES 18.1*
El Megharbel, 2021	Wrong outcomes	*Excluded in LES 18.1*
Elbadawy, 2021	Wrong outcomes	*Excluded in LES 18.1*
England, 2021	Wrong intervention	*Excluded in LES 18.1*
Epelle, 2023	Wrong study design	*Excluded in LES 18.1*
Escamilla, 2021	Wrong study design	*Excluded in LES 18.1*
Espinosa-Gómez, 2023	Wrong population	*Excluded in LES 18.1*

Ezzatpanah, 2022	Wrong study design	*Excluded in LES 18.1*
Fachiroh, 2021	Wrong intervention	*Excluded in LES 18.1*
Fantozzi, 2022	Wrong population	*Excluded in LES 18.1*
Farahmandfar, 2021	Wrong study design	*Excluded in LES 18.1*
Farid, 2022	Wrong study design	*Excluded in LES 18.1*
Farooq, 2023	Wrong study design	*Excluded in LES 18.1*
Ferrari, 2022	Wrong setting	*Excluded in LES 18.1*
Filipe, 2021	Wrong study design	*Excluded in LES 18.1*
Fiore, 2021	Wrong outcomes	*Excluded in LES 18.1*
Fotsa-Mbogne, 2021	Wrong study design	*Excluded in LES 18.1*
Gao, 2023	Wrong population	*Excluded in LES 18.1*
GarcíadeAbajo, 2020	Wrong study design	*Excluded in LES 18.1*
Gardezi, 2020	Wrong study design	*Excluded in LES 18.1*
Gharpure, 2020	Wrong study design	*Excluded in LES 18.1*
Ghoroghi, 2022	Wrong study design	*Excluded in LES 18.1*
Ghosh, 2021	Wrong outcomes	*Excluded in LES 18.1*
Ginghin, 2021	Wrong population	*Excluded in LES 18.1*
Gokce, 2022	Wrong study design	*Excluded in LES 18.1*
Gold, 2021	Wrong outcomes	*Excluded in LES 18.1*
Gopal, 2023	Wrong study design	*Excluded in LES 18.1*
Graça, 2022	Wrong study design	*Excluded in LES 18.1*
Greenhalgh, 2021	Wrong intervention	*Excluded in LES 18.1*
Guo, 2023	Wrong setting	*Excluded in LES 18.1*
Gurung, 2022	Retracted	*Excluded in LES 18.1*
Gwenzi, 2022	Wrong study design	*Excluded in LES 18.1*
Halperin, 2021	Wrong study design	*Excluded in LES 18.1*
Hamilton, 2022	Wrong outcomes	*Excluded in LES 18.1*
Han, 2022	Wrong study design	*Excluded in LES 18.1*
Han, 2022	Wrong study design	*Excluded in LES 18.1*
Hassandarvish, 2020	Wrong setting	*Excluded in LES 18.1*
Hata, 2021	Wrong study design	*Excluded in LES 18.1*
Henderson, 2022	Wrong study design	*Excluded in LES 18.1*
Hirose, 2021	Wrong setting	*Excluded in LES 18.1*
Hora, 2020	Wrong study design	*Excluded in LES 18.1*
Howard, 2020	Wrong study design	*Excluded in LES 18.1*
Ijaz, 2022	Wrong population	*Excluded in LES 18.1*
Imai, 2021	Wrong population	*Excluded in LES 18.1*
JameleddineChtioui, 2020	Wrong Language	*Excluded in LES 18.1*
Jana, 2023	Wrong intervention	*Excluded in LES 18.1*
Janik, 2021	Wrong study design	*Excluded in LES 18.1*
Jefri, 2022	Wrong study design	*Excluded in LES 18.1*

Kampf, 2020	Wrong study design	*Excluded in LES 18.1*
Kampf, 2020	Wrong intervention	*Excluded in LES 18.1*
Kampf, 2020	Wrong outcomes	*Excluded in LES 18.1*
Kaushik, 2023	Wrong study design	*Excluded in LES 18.1*
Kaya, 2022	Wrong setting	*Excluded in LES 18.1*
Kchaou, 2020	Wrong study design	*Excluded in LES 18.1*
Kersh, 2021	Wrong outcomes	*Excluded in LES 18.1*
Kewat, 2022	Wrong study design	*Excluded in LES 18.1*
Khatib, 2020	Wrong study design	*Excluded in LES 18.1*
Kivuti-Bitok, 2020	Wrong study design	*Excluded in LES 18.1*
Kolanthai, 2022	Wrong study design	*Excluded in LES 18.1*
Komaikul, 2022	Wrong setting	*Excluded in LES 18.1*
Kontos, 2023	Wrong population	*Excluded in LES 18.1*
Kumar, 2022	Wrong study design	*Excluded in LES 18.1*
Kumar, 2021	Wrong study design	*Excluded in LES 18.1*
Kumar, 2022	Wrong study design	*Excluded in LES 18.1*
Kumar, 2021	Wrong outcomes	*Excluded in LES 18.1*
Kunduru, 2022	Wrong study design	*Excluded in LES 18.1*
Kwok, 2021	Wrong setting	*Excluded in LES 18.1*
Kwon, 2021	Wrong study design	*Excluded in LES 18.1*
Lendvay, 2022	Wrong setting	*Excluded in LES 18.1*
Lesho, 2022	Wrong outcomes	*Excluded in LES 18.1*
Li, 2020	Wrong study design	*Excluded in LES 18.1*
Li, 2022	Wrong outcomes	*Excluded in LES 18.1*
Lishchynskyi, 2022	Wrong study design	*Excluded in LES 18.1*
Liu, 2022	Wrong outcomes	*Excluded in LES 18.1*
Liu, 2021	Wrong study design	*Excluded in LES 18.1*
Lu, 2021	Wrong study design	*Excluded in LES 18.1*
Luo, 2020	Wrong outcomes	*Excluded in LES 18.1*
Mahdavi, 2021	Wrong intervention	*Excluded in LES 18.1*
Maher, 2022	Wrong study design	*Excluded in LES 18.1*
Mallakpour, 2021	Wrong study design	*Excluded in LES 18.1*
Mantlo, 2020	Wrong setting	*Excluded in LES 18.1*
Maquart, 2022	Wrong intervention	*Excluded in LES 18.1*
Marchesi, 2021	Wrong population	*Excluded in LES 18.1*
Marques, 2021	Wrong study design	*Excluded in LES 18.1*
Marshall, 2020	Wrong outcomes	*Excluded in LES 18.1*
Marteinson, 2022	Wrong outcomes	*Excluded in LES 18.1*
Martins, 2022	Wrong outcomes	*Excluded in LES 18.1*
Masai, 2021	Wrong population	*Excluded in LES 18.1*
Masotti, 2022	Wrong study design	*Excluded in LES 18.1*

Matsuura, 2021	Wrong setting	*Excluded in LES 18.1*
Matsuyama, 2023	Wrong intervention	*Excluded in LES 18.1*
Meierhofer, 2023	Wrong outcomes	*Excluded in LES 18.1*
Memarzadeh, 2021	Wrong study design	*Excluded in LES 18.1*
Milella, 2021	Wrong outcomes	*Excluded in LES 18.1*
Miri, 2020	Wrong outcomes	*Excluded in LES 18.1*
Mirzay-Razaz, 2022	Wrong outcomes	*Excluded in LES 18.1*
Mohtar, 2021	Wrong population	*Excluded in LES 18.1*
Morrison, 2021	Wrong study design	*Excluded in LES 18.1*
Mortazavi, 2022	Wrong population	*Excluded in LES 18.1*
Mukherjee, 2021	Wrong setting	*Excluded in LES 18.1*
Nakito, 2023	Wrong outcomes	*Excluded in LES 18.1*
Neuberger, 2022	Wrong study design	*Excluded in LES 18.1*
Nguyen, 2021	Wrong study design	*Excluded in LES 18.1*
Nikolaidou, 2023	Wrong outcomes	*Excluded in LES 18.1*
Noorimotlagh, 2021	Wrong outcomes	*Excluded in LES 18.1*
Oberste, 2023	Wrong intervention	*Excluded in LES 18.1*
Oguma, 2021	Wrong study design	*Excluded in LES 18.1*
Okajima, 2021	Wrong setting	*Excluded in LES 18.1*
Oksanen, 2022	Wrong outcomes	*Excluded in LES 18.1*
Oliveira, 2022	Wrong setting	*Excluded in LES 18.1*
Owen, 2021	Wrong population	*Excluded in LES 18.1*
Pan, 2020	Wrong outcomes	*Excluded in LES 18.1*
Paul, 2021	Wrong study design	*Excluded in LES 18.1*
Peddinti, 2021	Wrong outcomes	*Excluded in LES 18.1*
Pedreira, 2021	Wrong study design	*Excluded in LES 18.1*
Pelletier, 2021	Wrong setting	*Excluded in LES 18.1*
Pereira, 2022	Wrong setting	*Excluded in LES 18.1*
Peters, 2021	Wrong study design	*Excluded in LES 18.1*
Petrosino, 2021	Wrong study design	*Excluded in LES 18.1*
Pezzotti, 2021	Wrong intervention	*Excluded in LES 18.1*
Pezzotti, 2022	Wrong setting	*Excluded in LES 18.1*
Phuna, 2022	Wrong outcomes	*Excluded in LES 18.1*
Pourfarzi, 2021	Wrong outcomes	*Excluded in LES 18.1*
Prakash, 2022	Wrong study design	*Excluded in LES 18.1*
Probst, 2021	Wrong study design	*Excluded in LES 18.1*
Qin, 2022	Wrong outcomes	*Excluded in LES 18.1*
Quéromes, 2022	Wrong setting	*Excluded in LES 18.1*
Raeiszadeh, 2020	Wrong study design	*Excluded in LES 18.1*
Raffee, 2021	Wrong study design	*Excluded in LES 18.1*
Rahimi, 2021	Wrong study design	*Excluded in LES 18.1*

Rai, 2020	Wrong study design	*Excluded in LES 18.1*
Ramji, 2022	Wrong setting	*Excluded in LES 18.1*
Raza, 2022	Wrong study design	*Excluded in LES 18.1*
Renninger, 2021	Wrong outcomes	*Excluded in LES 18.1*
Renson, 2022	Wrong study design	*Excluded in LES 18.1*
Rodriguez-Martinez, 2020	Wrong study design	*Excluded in LES 18.1*
RomanoSpica, 2020	Wrong outcomes	*Excluded in LES 18.1*
Romeo, 2022	Wrong outcomes	*Excluded in LES 18.1*
Ronca, 2021	Wrong intervention	*Excluded in LES 18.1*
Rowan, 2021	Wrong study design	*Excluded in LES 18.1*
ŞakalarÇ, 2023	Wrong setting	*Excluded in LES 18.1*
Salido, 2021	Wrong intervention	*Excluded in LES 18.1*
Salonga, 2022	Wrong study design	*Excluded in LES 18.1*
Sarangi, 2021	Wrong outcomes	*Excluded in LES 18.1*
Sarfraz, 2022	Wrong intervention	*Excluded in LES 18.1*
Saxena, 2021	Wrong study design	*Excluded in LES 18.1*
Schanze, 2020	Wrong setting	*Excluded in LES 18.1*
Scholte, 2022	Wrong setting	*Excluded in LES 18.1*
Schwartz, 2023	Wrong intervention	*Excluded in LES 18.1*
Seethalakshmi, 2022	Wrong study design	*Excluded in LES 18.1*
Sellera, 2021	Wrong outcomes	*Excluded in LES 18.1*
Shah, 2021	Wrong study design	*Excluded in LES 18.1*
Shah, 2020	Wrong study design	*Excluded in LES 18.1*
Shao, 2022	Wrong study design	*Excluded in LES 18.1*
Shen, 2020	Wrong study design	*Excluded in LES 18.1*
Shen, 2023	Wrong population	*Excluded in LES 18.1*
Shimabukuro, 2020	Wrong outcomes	*Excluded in LES 18.1*
Shimizu, 2022	Wrong intervention	*Excluded in LES 18.1*
Shukla, 2021	Wrong study design	*Excluded in LES 18.1*
Siniavin, 2021	Wrong intervention	*Excluded in LES 18.1*
Smither, 2021	Wrong intervention	*Excluded in LES 18.1*
Soave, 2021	Wrong outcomes	*Excluded in LES 18.1*
Sobolik, 2022	Wrong study design	*Excluded in LES 18.1*
Stein, 2023	Wrong intervention	*Excluded in LES 18.1*
Steinhauer, 2021	Wrong setting	*Excluded in LES 18.1*
Subpiramaniyam, 2021	Wrong study design	*Excluded in LES 18.1*
Su-Velez, 2020	Wrong outcomes	*Excluded in LES 18.1*
Sun, 2021	Wrong study design	*Excluded in LES 18.1*
Sunkari, 2021	Wrong study design	*Excluded in LES 18.1*
Suzuki, 2021	Wrong setting	*Excluded in LES 18.1*
Takayama, 2021	Wrong setting	*Excluded in LES 18.1*

Takeda, 2021	Wrong setting	*Excluded in LES 18.1*
Takeda, 2021	Wrong setting	*Excluded in LES 18.1*
Tao, 2021	Wrong outcomes	*Excluded in LES 18.1*
Tarka, 2021	Wrong outcomes	*Excluded in LES 18.1*
Tewari, 2022	Wrong population	*Excluded in LES 18.1*
Thaper, 2021	Wrong study design	*Excluded in LES 18.1*
Thomas, 2021	Wrong study design	*Excluded in LES 18.1*
Thomas, 2022	Wrong setting	*Excluded in LES 18.1*
Tiwari, 2022	Wrong outcomes	*Excluded in LES 18.1*
Torres-Costa, 2020	Wrong study design	*Excluded in LES 18.1*
Trmcico, 2021	Wrong study design	*Excluded in LES 18.1*
Valsamatzi-Panagiotou, 2022	Wrong study design	*Excluded in LES 18.1*
Tulalamba, 2021	Wrong setting	*Excluded in LES 18.1*
Wang, 2020	Wrong outcomes	*Excluded in LES 18.1*
Watanabe, 2023	Wrong setting	*Excluded in LES 18.1*
Welch, 2020	Wrong setting	*Excluded in LES 18.1*
Widera, 2021	Wrong setting	*Excluded in LES 18.1*
Wiktorczyk-Kapischke, 2021	Wrong study design	*Excluded in LES 18.1*
Wong, 2022	Wrong outcomes	*Excluded in LES 18.1*
Wu, 2022	Wrong study design	*Excluded in LES 18.1*
Xiao, 2022	Wrong study design	*Excluded in LES 18.1*
Yang, 2022	Wrong study design	*Excluded in LES 18.1*
Yeung, 2022	Wrong population	*Excluded in LES 18.1*
Youssef, 2022	Wrong study design	*Excluded in LES 18.1*
Yu, 2022	Wrong setting	*Excluded in LES 18.1*
Zhai, 2022	Wrong intervention	*Excluded in LES 18.1*
Zhang, 2021	Wrong outcomes	*Excluded in LES 18.1*
Zhang, 2022	Wrong study design	*Excluded in LES 18.1*
Zheng, 2021	Wrong outcomes	*Excluded in LES 18.1*
Zuniga-Montanez, 2022	Wrong outcomes	*Excluded in LES 18.1*

Appendix 3: Data extraction form

Study ID	
Included study	Author, year
PMID or URL or DOI	DOI, URL or PubMed ID
Publication date	In format YYYY/MM/DD
Preprint?	Y/N
Country	Country
Funding	Public or industry
Study design	Parallel RCT/crossover RCT/ cluster RCT/quasi-experimental/cohort/case-control/cross-sectional/modelling-simulation
Population and descriptive characteristics of the study	
Population	Description of population
Total (N)	Number of all study participants
Female n (%)	Number and %
Any PROGRESS+ consideration	Any PROGRESS+ consideration
Additional information on age groups and comments	Additional information on age groups and comments
Intervention, comparators, outcomes and setting	
Procedure	Cleaning/Disinfecting/Cleaning and disinfecting
Intervention	1,2-Hexanediol/ Ammonium bicarbonate/ Ammonium carbonate/ Chlorine dioxide/ Citric acid/ Dodecylbenzenesulfonic acid/ Ethanol (Ethyl Alcohol)/ Glutaraldehyde/ Glycolic acid/ Hydrochloric acid/ Hydrogen chloride/ Hydrogen peroxide/ Hypochlorous acid/ Iodine/ Isopropanol (Isopropyl alcohol)/ L-Lactic Acid/ Octanoid acid/ PHMB/ Peroxyacetic acid (Peracetic acid)/ Peroxyoctanoic acid/ Phenolic/ Potassium peroxymonosulfate/ Quaternary ammonium/ Silver/ Silver ion/ Sodium carbonate/ Sodium carbonate peroxyhydrate/ Sodium chloride/ Sodium chlorite/ Sodium dichloroisocyanurate/ Sodium dichloroisocyanurate dihydrate/ Sodium hypochlorite/ Tetraacetyl ethylenediamine/ Thymol/ Triethylene glycol/ Other
Frequency of intervention	Frequency of intervention
Product concentration	Product concentration
Control group	Self-reported use of cleaning and disinfecting products (including comparison of different cleaning/disinfecting frequencies and/or different types of products), cleaning and disinfecting policies
Comparator:	1,2-Hexanediol/ Ammonium bicarbonate/ Ammonium carbonate/ Chlorine dioxide/ Citric acid/ Dodecylbenzenesulfonic acid/ Ethanol (Ethyl Alcohol)/ Glutaraldehyde/ Glycolic acid/ Hydrochloric acid/ Hydrogen

	chloride/ Hydrogen peroxide/ Hypochlorous acid/ Iodine/ Isopropanol (Isopropyl alcohol)/ L-Lactic Acid/ Octanoid acid/ PHMB/ Peroxyacetic acid (Peracetic acid)/ Peroxyoctanoic acid/ Phenolic/ Potassium peroxymonosulfate/ Quaternary ammonium/ Silver/ Silver ion/ Sodium carbonate/ Sodium carbonate peroxyhydrate/ Sodium chloride/ Sodium chlorite/ Sodium dichloroisocyanurate/ Sodium dichloroisocyanurate dihydrate/ Sodium hypochlorite/ Tetraacetyl ethylenediamine/ Thymol/ Triethylene glycol/ Other
Frequency of comparator	Frequency of comparator
Product concentration	Product concentration
Other information about the products or the process	Other information about the products or the process
Co Interventions	Co Interventions
Setting: include non-health care community-based settings	Residential settings/ Retail/ Restaurants/ Gyms and other athletic facilities/ Bars/ Workplaces/ Public parks/ Schools, universities or other education facilities/ Other
High contact surface	Y/N
Surface characteristics (Mark as many as apply)	Indoor/ Outdoor/ Soft surfaces such as carpets, rugs and drapes/ Laundry such as clothing, towels and linens/ Electronics such as tablets, touch screens, keyboards, remote control and ATM machines/ Food surfaces that may have touched flood water. Examples: Countertops, plates/ Food cans that are not bulging, open, or damaged/ Non-food contact surfaces that do not soak up water and that may have touched floodwater. Examples: Floors, sinks, certain toys, and tools/ Other
Outcome (separated by VOC type)	COVID-19 transmission reduction (i.e., attack rates, reproduction number, etc.)/ Other RIDs transmission reduction/ Negative physiological health impact/ Negative emotional/psychological impact/ Negative socio-economic impact/ Negative social impact/ Negative environmental impact/ Reduction in COVID-19 associated ICU admission/ Reduction in COVID-19 ventilation/ Reduction in COVID-19 deaths/ Reduction in COVID-19 hospitalizations. Deactivating/ eliminating SARS-CoV 2 on surfaces.
Outcome measurement (separated by VOC type) for deactivating/ eliminating SARS-CoV 2 on surfaces	SARS-CoV-2 RT-PCR Culture Log10 reduction in infectious SARS-CoV-2 titer achieved
Results	
Variant (Only if applies)	Alpha: variant of concern B.1.1.7 / Beta: variant of concern B.1.351 / Delta: variant of concern B.1.617.2 / Gamma: variant of concern P.1 / Epsilon: variant of concern B.1.427/B.1.429 / Omicron: variant of concern B.1.1.529 / Omicron: variant of

	concern B.1.1.529 Sublinage BA.1 / Omicron: variant of concern B.1.1.529 Sublinage BA.2 / Other
Effectiveness (with 95% CI)	Effect estimate (with 95% CI)
Comparison	Hypothesis test used
	Result
Time of the effectiveness reporting	Time of the effectiveness reporting in days
Adjusted (Regression, stratification, matching and associated variables) Y or N, and explain.	Adjusted (Regression, stratification, matching and associated variables) Y or N, and explain.
Critical appraisal	See appendix 4

Appendix 4: Approach to critical appraisal

We appraise the RoB of the individual non-randomized studies using an adapted version of ROBINS-I. This tool classifies the Risk of Bias of a study as Low, Moderate, Serious, Critical, or No Information. Low Risk of Bias indicates High Quality, and Critical Risk of Bias indicates Very Low (insufficient) Quality. ROBINS-I appraises 7 bias domains and judges each study against an ideal reference randomized controlled trial. To improve the utility of ROBINS-I for assessing studies reporting cleaning and disinfecting products/strategies, we have focused on study characteristics that introduce bias specifically for these interventions. Once a study has met one criterion that makes it "critical" risk of bias, it will be dropped from further risk of bias assessment (exception: if limited data available for an outcome). An overall judgment of "serious" or "critical" is given when the study is judged to be at serious or critical risk of bias in at least one domain or "serious" in 3 separate ROBINS-I domains.

Study Characteristics that may introduce bias	Description
Study design **ROBINS-I: Bias in selection of participants into study** People who choose to use a cleaning/disinfection intervention may differ in risk-taking and health-seeking behavior from people who do not choose to use a cleaning/disinfection intervention	**Were both study groups recruited from the same population during the same time period?** Examples and typical judgment: ● Same country/province/state measured at same time = moderate ● Same or different country/province/state measured at a different time during pandemic = serious ● Same or different country/province/state measured at a different time prior to pandemic = critical ● Not applicable = no information **Were the COVID protective interventions implemented prior to period of data collection?** (Prevalent users) Examples and typical judgment: ● Start of data collection at same time as implementation with no prevalent users = low ● Prevalent users likely but appropriately controlled for = moderate

	• Not addressed and highly likelihood of prevalent users = critical **Were the study groups balanced with respect to participant adherence (based on internal and external factors unrelated to COVID)?** (For example, people who are less likely to adhere to PHSMs anyway may be more likely to be exposed to COVID and require quarantine & isolation but then are less likely to adhere. Similar for e.g., people who work are essential workers without paid time off.) Examples and typical judgment: • Adherence confirmed to be same in both groups at start of study = low • Difference in adherence likely but appropriately controlled for = moderate • Not addressed and highly likelihood of difference in adherence = critical • Not applicable = no information
Method for confirming the use of cleaning/disinfection products and strategies. **ROBINS-I: Bias in classification of interventions** An appropriate comparison of interventions requires that the interventions are well defined.	**Was the method for confirming the intervention (e.g., type, setting, dose, frequency, intensity and/or timing of intervention) clearly defined and applied consistently across study samples (e.g., districts within a country)?** Examples and typical judgment: • Well defined and solely based on information collected at time of intervention = low • Well defined but some aspects of assignment of intervention status determined retrospectively = moderate • Intervention status not well defined or applied inconsistently = serious • Not addressed = critical • Not applicable = no information **In periods of co-occurring interventions, do the authors clearly classify each individual intervention?** Examples and typical judgment: • All co-interventions well defined and solely based on information collected at time of intervention = low • Co-intervention classification well defined but some aspects of assignment of status determined retrospectively = moderate • Co-intervention classification not well defined or applied inconsistently = serious • Not addressed and co-interventions present = critical • Not applicable = no information **Does classification into intervention/control group depend on self-report in a way that might introduce bias?** (For example, where negative consequences of providing truthful responses may lead to negative consequences e.g., self-reporting COVID symptoms would trigger 14 day quarantine and loss of income) Examples and typical judgment: • Not reliant on self-report = low • Reliant on self-report but appropriately controlled for/analyzed separately = moderate • Not addressed and reliant on self-report = critical

	• Not applicable = no information **For household transmission studies, was it clear that exposure to the index case was the most likely the only exposure to COVID for household or close contacts?** Examples and typical judgment: • All participants isolated to same house or hospital prior to index case identification = low • All participants isolated to same house or hospital from time of index case identification = moderate • High risk occupational and social exposures likely and not accounted for = serious • Not addressed = critical • Not applicable = no information
Accounting for calendar time **ROBINS-I: Bias due to confounding (time-varying confounding)** Accounting for calendar time reduces bias in outcome estimation due to differences in intervention accessibility and risk of exposure over time.	**Did the study adjust for calendar time (implications for circulating variant, season)?**** Examples and typical judgment: • Studies with explicit mention of calendar time adjustment if there are concerns about risk, prevalence, outbreaks = low • Use of time-varying statistics without explicit mention of adjustment for calendar time = moderate • Not taken into account but no concerns about risk exposure affecting the intervention = moderate • Not taken into account and concerns about risk exposure affecting the intervention = critical • Not applicable = no information
Adjustment for prognostic factors **ROBINS-I: Bias due to confounding** Adjustment for prognostic factors for COVID transmission, and the intervention, such as age, gender, socioeconomic factors, occupation (HCW, LTC), use of other PHSMs, number of persons in the setting (in studies where population is not an individual), prior COVID-19 infection within the past 90 days, close contact with index case, etc.	**Did the study adjust for demographics, prognostic factors and other relevant factors?**** Examples and typical judgment: • All known important confounding domains measured and sufficient adjustment for all considered important prognostic factors = moderate • At least one known important domain not measured or controlled for (e.g., socioeconomic status, number of persons according to the setting) = serious • No adjustment for other relevant factors = critical • Not applicable = no information **Did the study adjust for other COVID protective interventions (including vaccination)?**** Examples and typical judgment: • All known important interventions controlled for = moderate • One co-intervention not controlled for = serious • Multiple co-interventions with no controlling or adjustment = critical • Not applicable = no information **Were participants free of confirmed COVID infection at the start of the study?****

	Examples and typical judgment: ● Negative COVID status of both groups known at study start (lab confirmed)= low ● COVID status of intervention group known but unclear for control group OR COVID status of both groups known by self-report only = serious ● Unclear or high likelihood pts had COVID at start of study = critical ● Not applicable = no information
Testing frequency **ROBINS-I: Bias in measurement of outcomes** Similar frequency of testing between groups reduces risk of bias introduced by detecting asymptomatic infection in one group but not in another (e.g., when only one group undergoes surveillance screening).	**Was the outcome of COVID confirmed by laboratory testing?**** Examples and typical judgment: ● All participants had PCR = low ● Most participants had PCR = moderate ● All participants had other SARS-CoV-2 test = serious ● Only sample or subset of population had PCR = serious ● Not reported = critical ● Only sample or subset of population had other SARS-CoV-2 test = serious ● Not applicable = no information **If the outcomes were derived from databases, were the databases constructed specifically for the collection of COVID data?**** Examples and typical judgment: ● National/state/province level surveillance database or specifically for COVID = low ● Database for non-COVID purpose with individual level data (e.g., health records, employee records) = moderate ● Database for non-COVID purpose without individual level data = serious ● No or unclear = critical ● Not applicable = no information **Were appropriate tools/methods with validated/justified cut-points used to determine outcomes of interest (other than COVID infection/transmission which is covered under laboratory testing)? **** Examples and typical judgment: ● Objective validated measure used consistently across all groups = low ● Objective measure applied but validation uncertain = moderate ● Outcomes solely dependent on self-report without a validated measure = serious ● Not reported = critical **If the outcome was self-reported, did the authors attempt to control for social desirability?**** Examples and typical judgment: ● Outcome not influenced by social desirability = low ● Attempt made to control for social desirability = moderate ● Not reported and outcome likely to be influenced by social desirability = critical ● Not applicable = no information

	Was the frequency of testing for the outcome different between the study groups? Examples and typical judgment: ● No difference in frequency of testing between groups = low ● Some differences but rationale appropriate = moderate ● Routinely done more frequently in one group more than the other = critical **If outcome was observed, was there more than one assessor and if so, was interrater agreement reported?** Examples and typical judgment: ● Reported with excellent agreement = low ● Reported with moderate agreement = moderate ● Reported with low agreement = serious ● Not reported = critical
Missing data **ROBINS-I: Bias due to missing data** Missing data can introduce bias due to differences in the comparison groups that are related to the outcome. Evidence for robustness may come from how missing data was handled in the study analysis.	**Was outcome data at the end of the study period available for all or nearly all participants?** Examples and typical judgment: ● No missing data = low ● Missing data did not differ between groups or was accounted for by appropriate statistical methods = moderate ● Critical differences in missing data between groups = critical **Were participants excluded due to missing data?** Examples and typical judgment: ● No exclusions due to missing data = low ● Participants excluded due to missing data, but rationale was appropriate and applied the same across all groups = moderate ● Participants excluded based on data missing unevenly across groups = critical
Bias due to deviations from intended intervention? **ROBINS-I: Bias due to deviations from intended intervention**	**Did the authors assess adherence to the protective behaviours/interventions after intervention implementation?**** Examples and typical judgment: ● Adherence verified in all study participants = low ● Adherence verified in at least a subset of each study group or appropriately adjusted for = moderate ● Reliant on self-report of adherence without verification or adjustment = serious ● Not addressed = critical ● Not applicable = no information

****relevant to single arm cohort studies**

We appraise the methodological quality of the individual analytical cross-sectional studies using an JBI tool.

Study Characteristics that may introduce bias	Description
Bias in selection of participants into study	Were the criteria for inclusion in the sample clearly defined? • Yes • No • Unclear • Not applicable
Bias in selection of participants/classification of interventions	Were the study subjects and the setting described in detail? • Yes • No • Unclear • Not applicable
Bias in measurement of outcomes	Was the exposure measured in a valid and reliable way? • Yes • No • Unclear • Not applicable
Bias due to confounding	Were confounding factors identified? • Yes • No • Unclear • Not applicable
Bias due to confounding	Were strategies to deal with confounding factors stated? • Yes • No • Unclear • Not applicable
Bias in measurement of outcomes	Were the outcomes measured in a valid and reliable way? • Yes • No • Unclear • Not applicable
	Was appropriate statistical analysis used? • Yes • No • Unclear • Not applicable

Overall appraisal:	• Include • Exclude • Seek further info

We appraise the RoB of the In vitro studies using an adapted version of OHAT RoB Tool for Human and Animal Studies. This tool classifies the Risk of Bias as Definitely Low, Probably Low, Probably High or Definitely High. Definitely Low Risk of Bias indicates High Quality, and Definitely High Risk of Bias indicates Very Low (insufficient) Quality. OHAT RoB appraises 6 domains with 11 questions. To improve the utility of OHAT for assessing In Vitro studies reporting cleaning and disinfecting products/strategies, we have focused on study characteristics that introduce bias specifically for these interventions in the In Vitro context. Once a study has met one criterion that makes it "Definitely High" risk of bias, it will be dropped from further risk of bias assessment (exception: if limited data available for an outcome).

Study Characteristics that may introduce bias	Description
Selection bias: applies to potential differences between cells across different groups.	**Was administered dose or exposure level adequately randomized?** • If homogeneous cell suspension, no variation or difference between groups, therefore, no need for randomization = No information • Groups were allocated using a method with a random component, AND there is direct evidence that the study used a concurrent control group = Definitely Low • Groups were allocated using a method with a random component, without description of the method used, AND there is direct or indirect evidence that the study used a concurrent control group, OR it is deemed that allocation without a clearly random component during the study would not appreciably bias results. = Probably Low • Indirect evidence that groups were allocated using a method with a non-random component, OR there is indirect evidence that there was a lack of a concurrent control group, OR there is insufficient information. =Probably High • Groups were allocated using a non-random method, OR there is direct evidence that there was a lack of a concurrent control group. = Definitely High **Was allocation to study groups adequately concealed?** • If homogeneous cell suspension, no variation or difference between groups. = No information • The time of assigning study groups the research personnel did not know what group were allocated to, and it is unlikely that they could have broken the blinding of allocation until after assignment was complete and irrevocable. = Definitely Low • Indirect evidence that at the time of assigning study groups the research personnel did not know what group were allocated to and it is unlikely that they could have broken the blinding of allocation, OR it is deemed that lack of adequate allocation concealment would not appreciably bias results = Probably Low

	• There is indirect evidence that at the time of assigning study groups it was possible for the research personnel to know what group were allocated to, or it is likely that they could have broken the blinding of allocation before assignment was complete and irrevocable, OR there is insufficient information provided. = Probably High • At the time of assigning study groups, it was possible for the research personnel to know what group were allocated to, or it is likely that they could have broken the blinding of allocation before assignment was complete and irrevocable. = Definitely High
Performance Bias identical conditions include: • Same media for controls and experimental culture wells • Same solvent (i.e., used to dissolve treatment chemicals) for control cells. • Culture plates must be uniformly incubated and handled – Same medium and schedule for changes, washes – Same time spent out of incubator – Same incubator and plate conditions (e.g., incubator plate location effects, plate edge-effects, etc.)	**Were experimental conditions identical across study groups?** • Same conditions were used in control and experimental groups. = Definitely Low • There is indirect evidence that the same conditions were used in control and experimental groups, OR it is deemed that conditions would not appreciably bias results.= Probably Low • There is indirect evidence that the conditions differed between control and experimental groups, OR authors did not report the conditions used. = Probably High • Control was untreated or treated with different conditions than experimental.= Definitely High **Were the research personnel and human subjects blinded to the study group during the study?** • Robotic systems eliminate need = No information • Research personnel were adequately blinded to study group, and it is unlikely that they could have broken the blinding during the study.= Definitely Low • There is indirect evidence that the research personnel were adequately blinded to study group, and it is unlikely that they could have broken the blinding during the study, OR it is deemed that lack of adequate blinding during the study would not appreciably bias results.= Probably Low • There is indirect evidence that the research personnel were not adequately blinded to study group, OR there is insufficient information provided about blinding to study group during the study (record "NR" as basis for answer).= Probably High • Research personnel were not adequately blinded to study group.= Definitely High
Attrition/Exclusion Bias includes evidence of well or plate loss without explanation.	**Were outcome data complete without attrition or exclusion from analysis?** • Loss of plates was adequately addressed, and reasons were documented when were removed from a study, OR missing data have been imputed using appropriate methods. = Definitely Low • There is indirect evidence that loss of plates was adequately addressed, and reasons were documented when were removed from a study, OR it is deemed that the proportion lost would not appreciably bias results.= Probably Low • There is indirect evidence that loss of plates was unacceptably large and not adequately addressed, OR there is insufficient information provided about loss of plates.= Probably High • Loss of plates was unacceptably large and not adequately addressed.=Definitely High

Detection Bias exposure characterization – purity, stability, solubility, volatility of substance	**Can we be confident in the exposure characterization?** ● Exposure was independently characterized across treatment groups AND was consistently administered across treatment groups. = Definitely Low ● There is indirect evidence that the exposure was independently characterized, AND there is indirect evidence that exposure was consistently administered across treatment groups.= Probably Low ● There is indirect evidence that the exposure was assessed using poorly validated methods, OR there is insufficient information provided about the validity of the exposure assessment method, but no evidence for concern.= Probably High ● Exposure was assessed using poorly validated methods. = Definitely High **Can we be confident in the outcome assessment?** ● Automated methods used for outcome assessment. = Definitely Low ● Outcome was assessed using well-established methods (the gold standard) AND assessed at the same length of time after initial exposure in all study groups, AND outcome assessors were adequately blinded to the study group, and it is unlikely that they could have broken the blinding prior to reporting outcomes. = Definitely Low ● There is indirect evidence that the outcome was assessed using acceptable methods AND assessed at the same length of time after initial exposure in all study groups, OR it is deemed that the outcome assessment methods used would not appreciably bias results. For some outcomes, particularly histopathology assessment, outcome assessors are not blind to study group as they require comparison to the control to appropriately judge the outcome, but additional measures such as multiple levels of independent review by trained pathologists can minimize this potential bias. = Probably Low ● There is indirect evidence that the outcome assessment method is an insensitive instrument, OR the length of time after initial exposure differed by study group. = Probably High ● Outcome assessment method is an insensitive instrument, OR the length of time after initial exposure differed by study group. = Definitely High **Were all measured outcomes reported?** ● All of the study's measured outcomes outlined in the protocol, methods, abstract, and/or introduction have been reported. = Definitely Low ● There is indirect evidence that all of the study's measured outcomes outlined in the protocol, methods, abstract, and/or introduction have been reported, OR analyses that had not been planned in advance are clearly indicated as such and it is deemed that the unplanned analyses were appropriate and selective reporting would not appreciably bias results. = Probably Low ● There is indirect evidence that all of the study's measured outcomes outlined in the protocol, methods, abstract, and/or introduction have been reported, OR and there is indirect evidence that unplanned analyses were included that may appreciably bias results, OR there is insufficient information provided about selective outcome reporting. = Probably High

	● All of the study's measured outcomes outlined in the protocol, methods, abstract, and/or introduction have not been reported. In addition to not reporting outcomes, this would include reporting outcomes based on composite score without individual outcome components or outcomes reported using measurements, analysis methods or subsets of the data (e.g., subscales) that were not pre-specified or reporting outcomes not pre-specified, or that unplanned analyses were included that would appreciably bias results. = Definitely High
Other biases project specific considerations (e.g., appropriate statistical methods)	**Were there no other potential threats to internal validity (e.g., statistical methods were appropriate, and researchers adhered to the study protocol)?** ● Definitely Low ● Probably Low ● Probably High ● Definitely High

Appendix 5: Glossary

AOAC: Association of Official Analytical Chemists

DMEM: Dulbecco's Modified Eagle Medium

FBS: Fetal Bovine Serum

HCW: Healthcare Workers

IPA: Isopropanol (Isopropyl alcohol - IPA 70%)

Log: Logarithm

LTC: Long-term care

LTCF: Long-term care facility

mL: Milliliters

OR: Odds Ratio

PBS: Phosphate-buffered saline

p.f.u: Plaque-Forming Unit

PHSMs: Public Health and Social Measures

PP: Polypropylene

ppm: parts per million

QAC: Quaternary Ammonium Compound

RF: virus Reduction Factor

RH: Relative Humidity

RoB: Risk of Bias

RSV: Respiratory Syncytial Virus

RTU: Ready to Use.

SBR: Styrene–Butadiene Rubber

SDBS: Dodecylbenzenesulfonate

SF: bus Seat Fabric

SLS: Sodium Laureth Sulfate

SS: Stainless Steel

TCID50: 50% Tissue Culture Infectious Dose

VOC: Variant of Concern

VOI: Variant of Interest

WSH: Water of Standardized Hardness

w/w: weight-to-weight