Efficacy and Safety of Disinfectants for Decontamination of N95 and SN95 Filtering Facepiece Respirators: Protocol for a Systematic Review

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist Mar 24, 2020

Section and topic	Item No	Checklist item	
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Efficacy and Safety of Disinfectants for the Decontamination of N95 and SN95 Filtering Facepiece Respirators: Protocol for a Systematic Review
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	This is an original review, not an update
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	Protocol will be place in Open Science Framework with no embargo period and PROSPERO
Authors:			
Contact	3a	Provide name, ORCID, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	<p>James Dayre McNally dmcnally@cheo.on.ca ORCID: 0000-0001-8103-9967. Children's Hospital of Eastern Ontario</p> <p>Katie O'Hearn kohearn@cheo.on.ca ORCID: 0000-0002-1149-2843. Children's Hospital of Eastern Ontario Research Institute</p> <p>Richard Webster rwebster@cheo.on.ca ORCID: 0000-0002-7682-8993. Children's Hospital of Eastern Ontario</p> <p>Anne Tsampalieros asampalieros@cheo.on.ca ORCID: TBD. Children's Hospital of Eastern Ontario</p> <p>Margaret Sampson msampson@cheo.on.ca ORCID: 0000-0003-2550-9893. Children's Hospital of Eastern Ontario</p> <p>Lindsey Sikora lindsey.sikora@uottawa.ca ORCID: 0000-0002-9715-8634. University of Ottawa</p> <p>Kristin McMartin Kristen.McMartin@hqontario.ca Health Quality Ontario</p> <p>Shira Gertsman sgert080@uottawa.ca ORCID: 0000-0001-9911-008X. Children's Hospital of Eastern Ontario Research Institute</p> <p>Rhiannon Ng rng@cheo.on.ca Children's Hospital of Eastern Ontario Research Institute</p> <p>Jess Gibson jgibson@cheo.on.ca Children's Hospital of Eastern Ontario Research Institute</p>
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	<p>McNally ✓ Conceptualization ✓ Methodology ✓ Validation ✓ Investigation ✓ Data curation ✓ Writing 1st draft ✓ Revising and editing ✓ Visualization ✓ Supervision ✓ Project administration ✓ Guarantor</p> <p>O'Hearn ✓ Methodology ✓ Validation ✓ Investigation ✓ Data curation ✓ Writing 1st draft ✓ Revising and editing ✓ Visualization ✓ Project administration</p>

Webster

✓ Methodology ✓ Validation ✓ Investigation ✓ Data curation ✓ Writing 1st draft ✓
Revising and editing ✓ Visualization

Tsampalieros ✓ Methodology ✓ Validation ✓ Investigation ✓ Data curation ✓ Writing
1st draft ✓ Revising and editing ✓ Visualization

Sampson

✓ Methodology ✓ Formal analysis ✓ Investigation ✓ Data curation ✓ Revising and
editing ✓ Visualization ✓ Project administration

Sikora

✓ Methodology ✓ Formal analysis ✓ Investigation ✓ Data curation ✓ Revising
and editing ✓ Visualization ✓ Project administration

McMartin

✓ Revising and editing

Gertsman

✓ Methodology ✓ Validation ✓ Investigation ✓ Data curation ✓ Writing 1st draft ✓
Revising and editing ✓ Visualization

Ng

✓ Data curation ✓ Revising and editing

Gibson

✓ Data curation ✓ Revising and editing

Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	The COVID-19 literature is expanding rapidly with over 2000 publications by mid-March 2020. Protocol amendments are likely and will be documented in OSF.
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Support:			
Sources	5a	Indicate sources of financial or other support for the review	This research has received no specific funding
Sponsor	5b	Provide name for the review funder and/or sponsor	This research does not have a funder or sponsor
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	This research does not have a funder or sponsor

INTRODUCTION

Rationale	6	Describe the rationale for the review in the context of what is already known	During the COVID-19 pandemic, a shortage of personal protective equipment (PPE), namely surgical masks, N95 masks, and gowns, has been experienced by some hospitals and could be expected in others due to a rapidly increased need. One method of addressing the shortage is to decontaminate and re-use PPE. The Centres for Disease Control (CDC) specifically recommends N95 filtering facepiece respirators (FFRs) for healthcare workers who are interacting with patients with COVID-19. There are anecdotal reports and published literature evaluating the potential of using disinfectants, such as hydrogen peroxide and bleach to decontaminate FFRs, with mixed reports of impact on structural integrity. To date this literature has not been comprehensively synthesized and
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		<p>the purpose of this review is to systematically review the existing literature on the use of disinfectants for the decontamination of facemask PPE.</p> <p>This information will be used to contribute to FFR decontamination protocols at the Children's Hospital of Eastern Ontario and shared with other hospitals in Ontario, Canada, and internationally.</p>
Objectives	7	<p>Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)</p> <p>The objective of this review is to identify and synthesize data from published studies evaluating safety and the effectiveness of disinfectants for the decontamination of N95 and SN95 FFR.</p>
METHODS		
Eligibility criteria	8	<p>Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review</p> <p>Population: N95 filtering face masks (particulate and surgical) or their components Exposure: Disinfectants, including hydrogen peroxide (vapour, liquid, gas plasma), bleach (sodium hypochlorite, submersion, wipe), ethanol, isopropyl alcohol, ethylene oxide Comparison: There is no set comparison group. Stand-alone criteria have been set for mask performance (penetration, flow resistance) and we will primarily compare against these benchmarks. Outcome: Studies that report on at least one of the following outcomes will be included. Outcomes will be reported separately for each type of disinfectant.</p> <ol style="list-style-type: none"> 1. Impact of each disinfectant decontamination method on FFR performance, with a specific focus on aerosol penetration and airflow resistance 2. Effectiveness of each disinfectant at removing viral or bacterial load 3. Measures or observations related to change in fit or physical degradation following exposure to each disinfectant 4. User safety and comfort, including odour and irritation following exposure to each disinfectant. <p>Study designs: Original publications examining the use of disinfectants including hydrogen peroxide (vapour, liquid, gas plasma), bleach (sodium hypochlorite), ethanol, isopropyl alcohol, and ethylene oxide to decontaminate N95 FFRs in English or French published after 1972 will be included in this review. We will also include systematic reviews of disinfectant treatment of N95 FFRs. Editorial reviews, narrative reviews, patents and books will be excluded.</p>
Information sources	9	<p>Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage</p> <p>Ovid Medline, Ovid Embase, Global Health, Google Scholar, WHO COVID-19 feed, MedRxiv, Scopus for targeted authors were searched. Two journals will be handsearched (as they are not indexed in any databases): Journal of the International Society for Respiratory Protection, and the Journal of Engineered Fibers and Fabrics. Reference Lists of eligible studies will be examined. Searches will cover the period 1972, year of introduction of the N95- present. Disaster Lit: Database for Disaster Medicine and Public on the National Library of Medicine will also be searched.</p>
Search strategy	10	<p>Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated</p> <p>Medline</p> <ol style="list-style-type: none"> 1. Respiratory Protective Devices/ 2. Personal Protective Equipment/ 3. (filtering adj3 (facepiece or face piece or facepieces or face pieces)).tw,kf. 4. (N95 or N 95).tw,kf. 5. (ffr or ffrs).tw,kf. 6. or/1-5 7. Sodium Hypochlorite/ or Disinfectants/ 8. Hydrogen Peroxide/ 9. (bleach* or clorox or antiformin or oxygenated water or hydrogen peroxyde or hydroperoxide or peroxygen).tw,kf. 10. sodium hypochlorite.tw,kf. 11. hydrogen peroxide.tw,kf. 12. Ethanol/

		13. 2-Propanol/ 14. Ethylene Oxide/ 15. (ethanol* or isopropanol or iso-propanol or 2-propanol or isopropyl alcohol or ethylene oxid* or oxirane or rubbing alcohol*).tw,kf. 16. or/7-15 17. 6 and 16 18. limit 17 to (yr="1972 -Current" and (english or french))
Study records:		
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review
		Records will be downloaded into Endnote for duplicate removal and exported to InsightScope (www.insightscope.ca) for screening. Data abstraction will be performed using REDCap.
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)
		Studies will be selected by 2 levels of screening (title and abstract, full text) against inclusion criteria by at least 2 independent reviewers reaching consensus. and/or resolution by the lead author.
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators
		A test set of at least 30 citations will be used to evaluate the inclusion/exclusion criteria. The test set will be created by a member of the investigative team and verified by a second. All reviewers who contribute to screening will first perform the test set, and must achieve a sensitivity of $\geq 80\%$ before they are given access to the study records. Reviewers who do not achieve $\geq 80\%$ sensitivity on the test set will be provided with additional training and repeat a second test set. If $\geq 80\%$ sensitivity is achieved on the repeat test set, the reviewer will be given access to the study records. The data abstraction forms in REDCap will be piloted by at least two members of the investigative team against a total of 6 eligible studies.
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications Study demographics: <ul style="list-style-type: none"> - Authors and contact information - Title - Country - Journal and year of publication Study Design: <ul style="list-style-type: none"> - Single vs. multiple decontamination protocols - Pre and post, post only - Controlled vs uncontrolled - Number of experimental conditions PPE tested <ul style="list-style-type: none"> - Mask type and model - Full mask or components Decontamination Method <ul style="list-style-type: none"> - Agent used, solution concentration, original concentration (manufacturing specification), duration of exposure, type of exposure (i.e. submersion, gassing), number of cycles - Method of application - Method of supporting/suspending masks - Drying/post-decontamination processing - Implementation of the decontamination process Aerosol Penetration Test used (including sizes evaluated) Airflow Resistance Test Methods of pathogen contamination and extraction Outcomes <ul style="list-style-type: none"> - Penetration (absolute percentage, change relative to baseline) - Airflow resistance and pressure drop - Absolute and relative change in pathogen number - Fit Testing: ability to achieve appropriate fit, particle loss - Observations of physical degradation User safety

		<ul style="list-style-type: none"> – Odour – Irritation
		Modifying factors
		– Intervention and outcome evaluated against soiling measures
Outcomes and prioritization	13	<p>List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale</p> <p>The main outcomes for which data will be sought are as follows. Outcomes will be reported separately for each disinfectant:</p> <ol style="list-style-type: none"> 1. Percent filter aerosol penetration (accepted methodology uses a NaCl aerosol method and requires < 5% penetration) – primary 2. Airflow resistance (absolute values and change pre and post use and intervention) 3. Viral or bacterial amounts on the mask surface (both the absolute value and relative change, when a control or untreated mask was included) 4. Fit testing 5. Safety, odour and irritation
Risk of bias in individual studies	14	<p>Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis</p> <p>Risk of bias for each outcome will be ascertained at the study level and reported in the manuscript. The impact of risk of bias on the summarized evidence will be addressed in the discussion section of the manuscript.</p> <p>Risk of bias will be ranked as low, moderate, or high for each of the following criteria (examples of low risk in parentheses):</p> <ul style="list-style-type: none"> • Design (controlled or pre-post) • Methodological consistency (same procedures/conditions across study arms) • Population heterogeneity (masks obtained from same lots and models evaluated separately) • Sampling bias (all missing data accounted for) • Outcome evaluation (blinding/objective measurement) • Selective reporting (results for all objective reported)
Data synthesis	15a	<p>Describe criteria under which study data will be 1. quantitatively synthesised</p> <ol style="list-style-type: none"> 1. Penetration and airflow outcomes: For each given disinfectant, data will need to be available from at least three independent studies using approved testing methods to consider quantitative synthesis. 2. Bacterial decontamination: Significant heterogeneity is expected in methodology related to pathogen type (virus vs bacteria), medium, application method, and method of evaluation of decontamination. For each disinfectant, we will quantitatively synthesize this outcome if similar data is provided from 3 studies using concordant pathogen and testing.
	15b	<p>If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)</p> <p>For both the particle penetration and airflow resistance outcomes the data is anticipated to be primarily presented as an absolute value. If presented as a percent change, and sufficient data is provided, we will calculate the absolute value. Prior to pooling we will perform tests of statistical heterogeneity using I^2 tests. Random effects meta-analysis will be employed to present the pooled absolute value disinfectant treatment and relative change (from control or no treatment arm).</p> <p>Significant heterogeneity could be anticipated with the methods and outcomes related to contamination and decontamination. To account for differences in methods (viral load, application and retrieval from mask) we will report and pool results using log change (in addition to absolute value or change). Again, prior to pooling the results we will perform tests of statistical heterogeneity using I^2 tests. Random effects meta-analysis will be utilized.</p>
	15c	<p>Describe any proposed additional analyses (such as</p> <p>Subgroup/sensitivity analyses:</p>

	sensitivity or subgroup analyses, meta-regression)	<ol style="list-style-type: none"> 1. The primary indication for this work is the current pandemic related to Sars-CoV-2. For the synthesis and presentation of decontamination results we perform a separate analysis limiting to studies that use viral pathogens. This data will be analysed and reported separately for each disinfectant. 2. If sufficient data permits we will describe and quantitatively synthesize the data for low risk studies (again ≥ 3 studies) 3. Differential impact of each disinfectant treatment by FFR mask type could be anticipated. If FFR performance is observed to be reduced below acceptable for any mask, we will present and synthesize the results by specific mask type
	15d If quantitative synthesis is not appropriate, describe the type of summary planned	If there is insufficient quantity or quality of data or the methods are sufficiently heterogeneous, the study findings will be presented descriptively in tables and text.
Meta-bias(es)	16 Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Based on the anticipated small size of the available literature (approximately 10 studies) and limited variability in study sample sizes generally observed in laboratory studies, no statistical test of publication bias are planned.
Confidence in cumulative evidence	17 Describe how the strength of the body of evidence will be assessed (such as GRADE)	<p>The cumulative body of evidence for each pre-defined outcome (impacts of each disinfectant on particle penetration, airflow resistance, germicidal effect, fit, physical changes, potential health risks) will be evaluated using risk of bias and consistency.</p> <p>Conclusions will be considered consistent for each individual outcome if equivalent outcome valences (i.e. success or failure according to pre-determined standards) are reported in at least two studies with no contrasting results in any other study.</p>

Template source: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ*. 2015 Jan 2;349(jan02 1):g7647.