Healthcare Personnel Use of Eye Protection for Protection Against Respiratory Infections: A Systematic Review and Meta-Analysis

Plain Language Summary

Background

Respiratory infections, whether seasonal or novel, can negatively impact the resilience of health systems and can cause morbidity and mortality among personnel and patients. When considering the hierarchy of controls to reduce the risk of respiratory infections, personal protective equipment (PPE) are generally less effective than other elements due to their reliance on individual behavior, but they remain a critical component in healthcare settings. Some evidence has suggested there could be an association between the use of eye protection, including face shields, goggles, and safety glasses, and a reduced risk of viral respiratory infections (VRIs) in the user; however, there has not been a systematic review on this topic that includes the most recent data from the SARS-CoV-2 pandemic.

Research Question

- For healthcare personnel caring for patients with respiratory infections, what is the effectiveness of adding eye protection to routine personal protective equipment (PPE), compared to routine PPE alone, in preventing symptomatic illness or laboratory-confirmed infection?

Methods

Authors searched MEDLINE, EMBASE, Global Health (OVID), Cochrane Library, Nursing and Allied Health Database (ProQuest), and Scopus, and included all studies that directly compared the addition of eye protection to routine PPE alone to prevent any respiratory infection among healthcare personnel. Data was extracted, critically appraised, and the primary outcome of laboratory-confirmed respiratory infection was quantitatively aggregated while secondary outcomes of clinical and self-reported infections, and adverse events were narratively aggregated.

Results

Eleven studies were retrieved reporting laboratory-confirmed respiratory infection in healthcare personnel who wore eye protection in addition to routine PPE. Importantly, all studies were observational and conducted in the context of a novel or pandemic VRI. This evidence suggested a benefit to the addition of eye protection, however the meta-analysis revealed substantial heterogeneity which limit the confidence in the quantitative findings (I^2 = 83%). Twenty-two studies were retrieved that reported adverse events related to wearing eye protection. A possible reduction in VRIs is seen despite the occurrence of non-serious adverse events such as fogging, decreased visibility, skin irritation, and headaches. These results may be confounded by the use of other PPE. None of these studies reported adverse events requiring hospitalization.

Context

This is the most recent systematic review to examine the effectiveness of the addition of eye protection to routine PPE and to include and aggregate adverse events. The addition of recent SARS-CoV-2 studies suggests a benefit to the addition of eye protection for prevention of novel viral VRI. However, substantial heterogeneity precludes complete confidence in these findings.

Introduction

The Healthcare Infection Control Practices Advisory Committee (HICPAC) is a federal advisory committee to the Centers for Disease Control and Prevention (CDC), that provides advice and guidance on infection prevention and control in healthcare settings to the agency. One of HICPAC's chartered functions is to provide recommendations to CDC on the update of CDC's infection control guidelines. In 2021, HICPAC created a workgroup to update the CDC Guideline for Isolation Precautions, 2007, with expertise in the fields of infectious disease, infection prevention, occupational health, nursing, healthcare epidemiology, and healthcare management with technical input from CDC including from the Division of Healthcare Quality Promotion and the National Institute of Occupational Safety and Health (NIOSH). One of the primary functions of this workgroup was to reassess the categories of transmission-based precautions (TBP). It is important to highlight that TBP categories are developed to be applied across pathogens and categories of pathogens to prevent transmission during routine patient care. TBP categories are not developed to be specific to one single pathogen. It is in this broader context that the workgroup was tasked by the committee to review the 2007 TBP categories to see if the elements of PPE within each category require changes, or if, in a post-pandemic era, entirely new categories are needed. Eye protection is one of the elements of PPE considered for inclusion in TBP categories, and which the Workgroup reviewed.

Eye protection, which can include face shields, goggles, and safety glasses, may have played an increasingly important role in protecting healthcare personnel from VRI over the course of the SARS-CoV-1, MERS, and SARS-CoV-2 pandemics. Eye protection, which is generally used in conjunction with other PPE such as N95 respirators or medical/ surgical masks, may provide additional protection from direct exposures that occur from splashes and sprays and has been hypothesized to protect from indirect exposure via touching or rubbing the eyes with contaminated hands. It is unclear if the addition of eye protection can prevent or reduce the transmission of all VRI. There is limited data suggesting transocular transmission of influenza, and a benefit to the addition of eye protection.[1] And a recent systematic review highlighted that there are no randomized trials assessing the use of eye protection alone.[2] There are data on the effectiveness of the addition of eye protection, that is, the ability of eye protection to prevent or reduce infections among healthcare personnel under "real world" circumstances in the context of a healthcare system,[3,4] so the only available data considered in the current review are on the effectiveness of this adjunctive PPE. While several systematic reviews have been conducted early in the SARS-CoV-2 pandemic,[5,6] or in community settings,[7] there is no recent systematic review answering the question of the effectiveness of the addition of eye protection to prevent transmission of respiratory infections to healthcare personnel. It is in this context that HICPAC's Isolation Guideline Update Workgroup requested CDC conduct a systematic literature review to answer the question: for healthcare personnel caring for patients with respiratory infections, what is the effectiveness of medical/surgical masks compared with N95 respirators in preventing infection?

Methods

This document was created at the request of the Isolation Guideline Update Workgroup (hereafter referred to as the Workgroup) of HICPAC to inform their work to update to the Guideline for Isolation Precautions, 2007. The workgroup membership consists of subject matter expertise in the fields of infectious disease, infection prevention, occupational health, nursing, healthcare epidemiology, and healthcare management. Federal technical expertise from the Division of Healthcare Quality Promotion (DHQP) and the National Institute of Occupational Safety and Health (NIOSH) was available to answer workgroup questions to CDC.

Topic & Question Development

The workgroup requested technical input from CDC in the form of a systematic literature review to answer the following question:

- For healthcare personnel caring for patients with respiratory infections, what is the effectiveness of adding eye protection to routine personal protective equipment (PPE), compared to routine PPE alone, in preventing symptomatic illness or laboratory-confirmed infection?

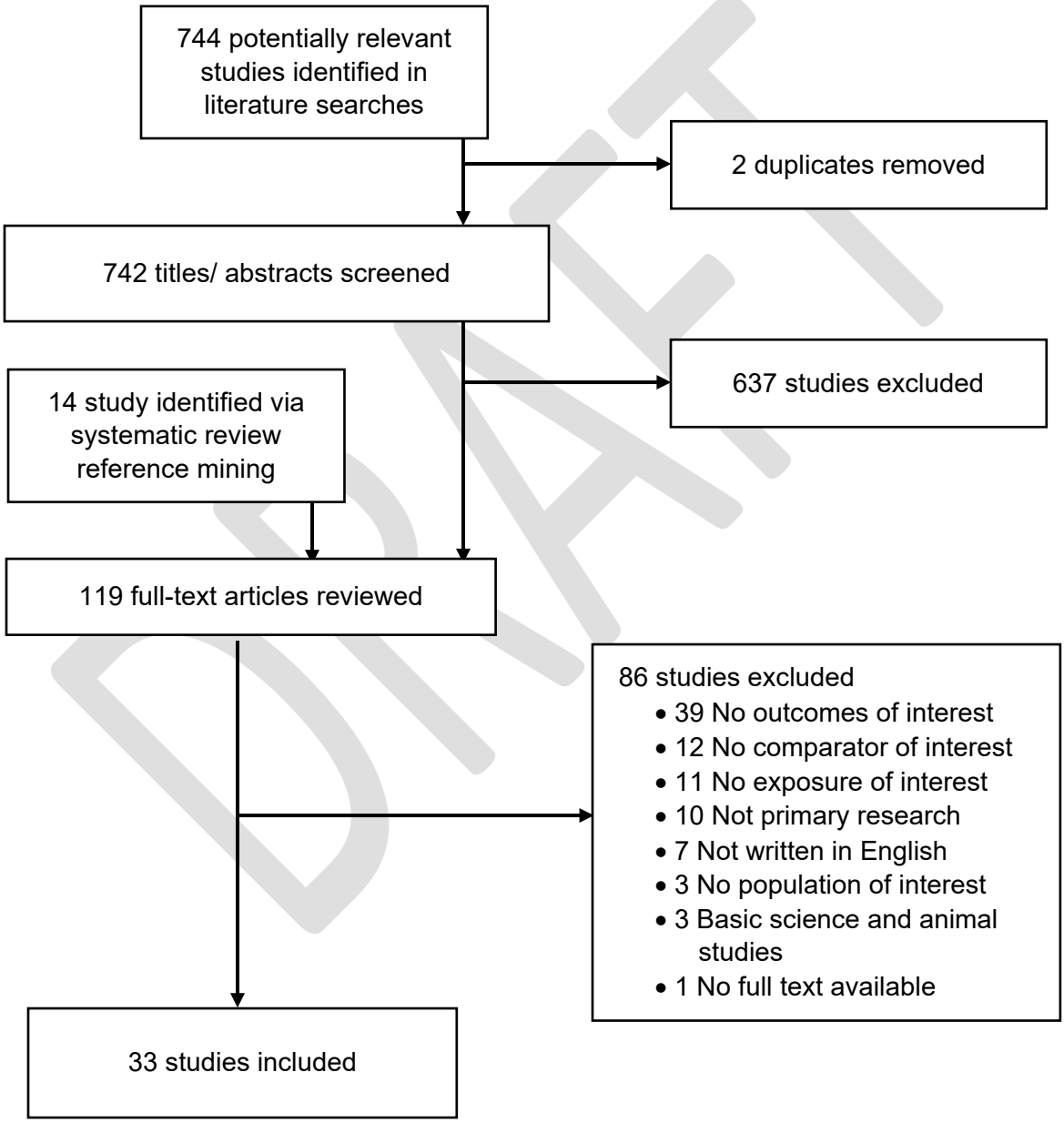
Literature Search & Study Selection

A CDC informationist (J.T.) developed search strategies from the key question and performed these searches in MEDLINE, EMBASE, Global Health (OVID), Cochrane Library, Nursing and Allied Health Database (ProQuest), and Scopus from the start of each database to September 21, 2022. Potentially relevant titles and abstracts retrieved by the literature search were uploaded into Covidence,[8] screened by two reviewers (C.N.S., D.O.S., E.C.S., D.B., M.C.H., or J.H.), and included if they were relevant to the research question. The population of interest was healthcare personnel, the intervention of interest was eye protection in addition to routine PPE, and the comparator of interest was routine PPE alone, and the outcome of interest was laboratory-confirmed respiratory infection. Full-text articles of selected articles were also screened by two reviewers (C.N.S., D.O.S., E.C.S., D.B., M.C.H., or J.H.), and excluded if they met one of the following criteria:

- No full-text available
- Not written in English
- Not primary research
- Basic science and animal studies
- Conference abstracts
- No population of interest
- No exposure of interest
- No comparator of interest
- No outcomes of interest
- Studies without laboratory-confirmed outcomes

To ensure completeness of the review, reviewers examined the bibliographies of relevant systematic literature reviews and meta-analyses. All studies included and analyzed in these bibliography reviews were screened as above. The results of the study selection process are depicted in *Figure 1.*

Figure 1. Results of the Study Selection Process



Data Extraction and Evaluation

Studies meeting inclusion criteria were reviewed, and relevant data was extracted into standardized evidence tables. Data were extracted as presented in the studies or in the supplementary data. Critical appraisal of individual studies was conducted using the Internal Validity Assessment (IVA) Tool developed in the Division of Healthcare Quality Promotion at the CDC. The IVA tool consists of 34 signaling prompts abstracted from validated critical appraisal tools that guide the identification of critical threats to the internal validity of each study. These threats are then used to guide the assessment of confidence in the findings for each outcome. This Appendix includes the signaling prompts used to assess the threats to internal validity across the domains of study conduct, and the results of the validity assessment for the current review are presented in the Supplemental File A.

Data Synthesis

The primary outcome for this effort was lab-confirmed respiratory infection. Secondary outcomes included job performance, physical, and psychological and emotional adverse events. All outcomes were synthesized narratively.

The primary outcome of all lab-confirmed respiratory infection was meta-analyzed using RStudio.[9] Results of random effects models are reported in the narrative summary and tables, and fixed effect model results can be found in the funnel plots in this Appendix. Heterogeneity, and the confidence in the pooled measure of effect, was assessed using the I^2 statistic and the associated p-value for heterogeneity.

GRADE-ing Evidence

The evidence for each outcome was assessed according to its strength, direction, consistency, and directness across all studies. The assessment of each of these domains was scored according to the GRADE methodology. These were narratively summarized into an overall confidence in the evidence which included an assessment of the likelihood that the findings will change.

Results

This systematic review identified 11 studies[10-20] evaluating the effectiveness of eye protection in addition to routine PPE compared to routine PPE for preventing the transmission of laboratory-confirmed VRI from patient to HCP. The body of evidence includes two quasi-experimental studies,[10,13] three cohort studies,[11,14,20] five retrospective case-controls,[12,15,17-19] and one cross-sectional study.[16] These studies reported outcomes of transmission or infection of SARS-CoV-1,[16,19,20] MERS,[11] and SARS-CoV-2[10,12-15,17,18] among HCP, and were conducted across diverse healthcare settings including healthcare facilities or hospitals,[10-12,14-17,19,20] isolation and quarantine facilities,[18] long-term care facilities,[12] urgent care[14] and outpatient clinics,[12,14] and among HCP conducting home visits.[13] Studies were conducted in the U.S.,[10,14,20] France,[12] Saudi Arabia,[11] China,[16,19] India,[13,15,18] and Bangladesh.[17] Study information and relevant extracted outcome data is available in this Appendix.

Primary Outcome

Narrative Synthesis

Overall, the evidence from these eleven studies[10-20] (N = 13,436) suggests that the use of eye protection is associated with a decrease in laboratory-confirmed viral respiratory infection among healthcare personnel. The evidence in the direction of a benefit from the addition of eye protection consists of two quasi-experimental studies,[10,13] one cohort study[11] four retrospective case-control studies[12,15,17,19] and one cross-sectional study[16] (N = 13,200) which reported a decrease in SARS-CoV-1, SARS-CoV-2, and MERS-CoV infections among HCP who reported using eye protection in addition to recommended PPE. Further, a smaller subset of studies suggest no difference including two cohort studies[14,20] and one case

control study[18] (N = 236). These studies reported proportions suggesting no difference in the incidence of SARS-CoV-1 and SARS-CoV-2 infections, regardless of the use of eye protection among HCP.

This benefit suggested by the evidence should be interpreted with caution as all eleven studies[10-20] are at risk of confounding by patient or HCP mask use, N95 respirator use, improper mask use, community interventions, community and coworker contacts, and the healthcare tasks undertaken while wearing eye protection (such as aerosol generating procedures). Additionally, nine studies[11,12,14-20] are retrospective and at risk of recall bias and four[13,14,18,20] have small sample sizes. Of the five studies reporting confidence intervals,[11,12,15-17] three are wide[11,16,17] and three include the null.[11,15,16] Two studies[14,20] report zero infections in either group. The brief summary of evidence can be found in Appendix Table 2 and the complete narrative aggregation can be found in Appendix Table 4.

Quantitative Syntheses

The same eleven studies included in the narrative analysis were included in the quantitative analysis, and report outcomes of laboratory-confirmed SARS-CoV-1, MERS, and SARS-CoV-2.[10-20] While the random-effects model suggested a benefit to the addition of eye protection, it revealed that the heterogeneity was too high to formulate meaningful conclusions about this benefit (I^2 = 83%) (Figure 2).

Secondary Outcome

The systematic review also identified 22 studies reporting on adverse events related to the use of eye protection among HCP.[21-42] Only studies that provided a definition of what constituted an 'adverse event' were included in the current review; studies reporting on general adverse events were not captured. Twelve studies[22-27,29,32,35,40-42] (N = 2,573) suggest an increase in job-related adverse events such as impaired visibility, fogging, and inconvenience among HCP using eye protection; one study[40] suggests poor visibility, fogging, and discomfort resulted in eye protection non-compliance. Eighteen studies[21,22,25-31,33,34,36-42] (N = 4,176) indicate that physical adverse events such as headaches and skin reactions increase with increasing duration of eye protection use.[21,22,25,26,28,30,31,33,34,36,37,39,41,42] Several studies use comparative cutoffs of one,[34] two,[37] four,[25,33,39] or six[36] hours to evaluate the impact of duration of eye protection use on adverse events.[25,33,39] Evidence from two studies[30,42] (N = 565) was inconclusive on the effect of eye protection on psychological and emotional adverse events such as anxiety and stress among HCP wearing eye protection. All studies included self-reported data often collected via cross-sectional surveys and were subject to selection bias, recall bias, and confounding by adverse events from other elements of PPE. The brief summary of evidence can be found in Appendix Table 3 and the complete narrative aggregation can be found in Appendix Table 5.

Discussion

The results of the current review are similar to previously published articles. The most recent systematic review assessing the effectiveness of the addition of eye protection among healthcare personnel to prevent transmission was published in 2021 and included 5 studies.[6] That review also suggested a benefit from the addition of eye protection and reported heterogeneity so high as to prohibit a meaningful meta-analysis. Another recent systematic review was narrower in its focus and examined the addition of face shields to mask use for the prevention of SARS-CoV-2.[43] The review assessing face shields included four studies in healthcare settings and one in the community and concluded that there is a benefit to the use of face shields to prevent SARS-CoV-2 transmission in the healthcare settings, while the data in community settings was insufficient to conclude a benefit.[43] The lack of data in the community may have contributed to the removal of this intervention from the update of a prominent systematic review on the effectiveness of physical interventions to reduce or interrupt the spread of respiratory illnesses.[7,44]

The strengths of the current review include the use of both quantitative and narrative aggregations, and the inclusion of an adverse event analysis. It is important to note that while these adverse events are

not considered severe, they might impact healthcare personnel comfort and their adherence to the use of eye protection. Further, challenges with visibility that result from fogging may result in increased touching or adjusting of the eye protection, creating increased opportunities for transmission. Importantly, the current review examined all studies on a spectrum rather than categorizing them and grading them according to study type. While some study type specific nuances may be missing from this analysis that enable users to understand the limitations of each study more easily, the potential biases are tied to the study conduct and thus more easily generalizable across the body of evidence, especially for the observational studies.

It is important to note that the included studies represent the best available epidemiologic evidence for these outcomes. It is likely that these results may change if a well-conducted randomized controlled trial is done using whole genome sequencing to ascertain the source of infections in healthcare personnel. For novel VRIs, it might be unethical to conduct a randomized controlled trial under these circumstances of an emerging pathogen for which limited information on transmission is available. It is also possible that the observational studies resulting from the next novel pathogen epidemic or pandemic may change these findings. Future studies examining the effectiveness of the addition of eye protection would be enhanced by clearly identifying whether healthcare personnel exposures and infections are patient-related rather than coworker or community related.

Appendix to Healthcare Personnel Use of Eye Protection for Protection Against Respiratory Infections: A Systematic Review and Meta-Analysis

A. Search Strategies

Table 1. Primary Search of Medline (OVID), Embase (OVID), CINAHL (Ebsco), Scopus, and Cochrane Library

Database	Strategy	Run Date	Records
Medline (OVID) 1946-	Personal protective equipment/ OR Eye Protective Devices/ OR (Personal protective equipment* OR PPE).ti,ab,kf. AND ((Eye* ADJ2 protect*) OR glasses OR goggles OR safety lens* OR face shield* OR faceshield*).ti,ab,kf,hw. AND Exp Health personnel/ OR Healthcare OR health care OR health personnel OR nurse* OR doctor* OR physician* OR health worker* AND exp Respiratory Tract Diseases/ OR (Respiratory ADJ5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*	09/21/2022	334
Embase (OVID) 1974-	protective equipment/ OR Eye Protective Device/ OR (Personal protective equipment* OR PPE).ti,ab,kf. AND ((Eye* ADJ2 protect*) OR glasses OR goggles OR safety lens* OR face shield* OR faceshield*).ti,ab,kf,hw. AND Exp Health care personnel/ OR (Healthcare OR health care OR health personnel OR nurse* OR doctor* OR physician* OR health worker*).ti,ab,kf,hw. AND exp Respiratory Tract Diseases/ OR ((Respiratory ADJ5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*).ti,ab,kf,hw. Remove medline records; remove conference abstract status	09/21/2022	340 - duplicates = 313 unique items

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Database	Strategy	Run Date	Records
Cochrane Library	[mh "Personal protective equipment"] OR [mh "Eye Protective Devices"] OR ("Personal protective equipment*" OR PPE):ti,ab AND [mh "Eye Protective Devices"] OR ((Eye* NEAR/2 protect*) OR glasses OR goggles OR "safety lens*" OR "face shield*" OR faceshield*):ti,ab AND [mh "Health personnel"] OR (Healthcare OR "health care" OR "health personnel" OR nurse* OR doctor* OR physician* OR "health worker*"):ti,ab AND [mh "Respiratory Tract Diseases"] OR ((Respiratory NEAR/5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*):ti,ab	09/21/2022	13 -2 duplicates =9 unique items
CINAHL (EbscoHost)	(MH "Personal protective equipment") OR (MH "Eye Protective Devices") OR (TI ("Personal protective equipment*" OR PPE)) OR (AB ("Personal protective equipment*" OR PPE)) AND (MH "Eye Protective Devices") OR (TI ((Eye* N2 protect*) OR glasses OR goggles OR "safety lens*" OR "face shield*" OR faceshield*)) OR (AB ((Eye* N2 protect*) OR glasses OR goggles OR "safety lens*" OR "face shield*" OR faceshield*)) AND (MH "Health personnel") OR (TI (Healthcare OR "health care" OR "health personnel" OR nurse* OR doctor* OR physician* OR "health worker*")) OR (AB (Healthcare OR "health care" OR "health personnel" OR nurse* OR doctor* OR physician* OR "health worker*")) AND (MH "Respiratory Tract Diseases") OR (TI ((Respiratory N5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*)) OR (AB ((Respiratory N5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*))	09/21/2022	69 - duplicates =30 unique items
Scopus	TITLE-ABS-KEY("Personal protective equipment*" OR PPE) AND TITLE-ABS-KEY((Eye* W/2 protect*) OR glasses OR goggles OR "safety lens*" OR "face shield*" OR faceshield*) AND TITLE-ABS-KEY(Healthcare OR "health care" OR "health personnel" OR nurse* OR doctor* OR physician* OR "health worker*") AND TITLE-ABS-KEY((Respiratory W/5 infection*) OR COVID-19 OR SARS OR MERS OR influenza OR flu-like OR aerosol* OR airborne OR air-borne OR respiration OR ventilat* OR breath* OR expiration OR exhal* OR cough* OR droplet*) AND NOT INDEX(medline)	09/21/2022	188 - duplicates =58 unique items

B. Brief Summary of Findings

B.1. Brief Summary of Findings on the Effectiveness of the Addition of Eye Protection to Routine PPE

Table 2. Evidence Snapshot of the Benefits from the Addition of Eye Protection (citations for study-specific biases in the footnotes can be found in Table 4)

Outcome	Summary	Studies	Strength	Precision	Consistency	Directness	Confidence
Laboratory-confirmed pandemic viral respiratory infection	Suggests a benefit to the addition of eye protection for pandemic pathogens.	11 Studies[10-20] (N = 3,436)	Serious concerns[a]	Serious concerns[b]	Moderate concerns[c]	No concerns	Low confidence[d]

B.2. Brief Summary of Findings on Adverse Events among Users of Eye Protection

Table 3. Evidence Snapshot for Adverse Events from Eye Protection (citations for study-specific biases in the footnotes can be found in Table 5)

Outcome	Summary	Studies	Strength	Precision	Consistency	Directness	Confidence
Job performance related adverse events	The addition of eye protection results in an increase in fogging, poor visibility, and inconvenience that may interfere with job performance	12 Studies[22-27,29,32,35,40-42] (N = 2,573)	Serious concerns[e]	Serious concerns[f]	No concerns	No concerns	High confidence
Physical adverse events	The addition of eye protection results in an increase in headaches and skin reactions with longer duration of use	18 studies[21,22,25,26,28,30,31,33,34,36,37,39,41,42] (N = 4,176)	Serious concerns[g]	Serious concerns[h]	No concerns	No concerns	High confidence
Psychological and emotional adverse events	The evidence is inconclusive	2 Studies[30,42] (N = 565)	Serious concerns[i]	Serious concerns[j]	Moderate concerns[k]	No concerns	Low confidence

[a] All studies are at risk of confounding by mask use, N95 use, improper mask use, community interventions, healthcare tasks, or IPC training. Additionally, nine studies are retrospective and at risk of recall bias impacting results.

[b] Five studies reported confidence intervals, three included the null, and three were wide. Two studies reported zero events in either group.

[c] Results are inconsistent.

[d] The results are inconsistent but additional evidence is not expected to change the findings.

[e] All cross-sectional studies were subject to selection bias, recall bias, and were subject to confounding by type of eye protection, age, gender, occupation or task.

[f] One study reported a wide confidence interval that included the null.

[g] All cross-sectional studies were subject to selection bias, recall bias, and were subject to confounding by type of eye-protection, age, gender, occupation or task.

[h] Six studies reported wide confidence intervals, and two studies reported confidence intervals that included the null.

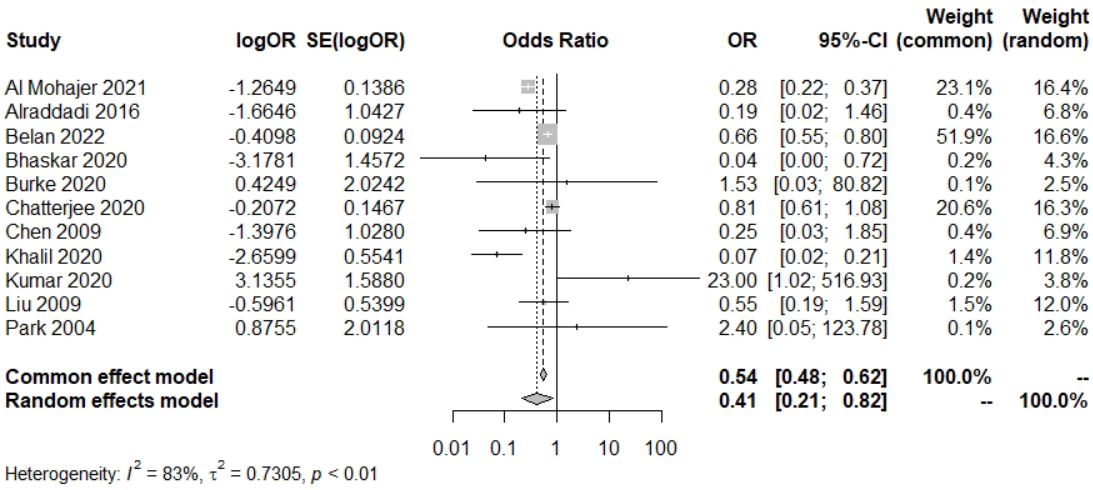
[i] Both cross-sectional studies were subject to selection bias, recall bias, and were subject to confounding by type of eye-protection, age, gender, occupation or task. One study was underpowered to detect a result using a tool that has not been validated to the local cultural context.

[j] One study reported a wide confidence interval.

[k] The evidence is insufficient due to one study reporting on stress and the other study reporting on anxiety.

B.3. Forest Plots for Meta-Analyses

Figure 2: Forest Plot for Novel Pathogens



C. Narrative Evidence Synthesis and Extracted Data

C.1. Narrative Synthesis of the Effectiveness of the Addition of Eye Protection to Routine PPE

Table 4: Qualitative Summary of Findings on the Effectiveness of Eye Protection to Prevent Respiratory Infection in HCP

Outcome	Results
All viral respiratory infection (laboratory-confirmed)	The evidence from eleven studies[10-20] (N = 13,436) suggests the use of eye protection is associated with a reduction of viral respiratory infection among HCP, when compared to no eye protection in the context of additional PPE including masks. • Strength: All studies are at risk of confounding by mask use, N95 use, improper mask use, community interventions, healthcare tasks, or IPC training.[10-20] Additionally, nine studies are retrospective and at risk of recall bias impacting results.[11,12,14-20] • Precision: Five studies reported confidence intervals,[11,12,15-17] three included the null,[11,15,16] and three were wide.[11,16,17] Two studies reported zero events in either group.[14,20] • Consistency: Results are inconsistent. • Applicability: The populations and settings were directly applicable to the question. Two quasi-experimental studies,[10,13] one cohort study,[11] four retrospective case-control studies,[12,15,17,19] and one cross-sectional study[16] (N = 13,200) reported a decrease in SARS-CoV-1, SARS-CoV-2, and MERS-CoV infections among HCP who reported using eye protection in addition to recommended PPE. ▪ Two quasi-experimental studies[10,13] (N = 6,589) reported a decrease in the incidence of lab-confirmed SARS-CoV-2 infection among community HCP in India[13] and HCP in a Texas hospital system[10] after the introduction of universal face shield or goggle use in addition to standard PPE. One study[10] reported a reduction in the SARS-CoV-2 positivity rate among HCP after the introduction of mandatory face shield or goggle use (12.9% vs. 2.3%; $p < 0.001$), however this may be confounded by the implementation of state-mandated face mask use four days prior. The other study[13] reported a reduction in lab-confirmed SARS-CoV-2 infection among HCP following a policy change mandating face shields for community health workers (19.4% to 0) however the sample size was small (N = 62). ▪ Four retrospective case-control studies[12,15,17] (N = 5,570) reported a decrease in SARS-CoV-1[19] and SARS-CoV-2[12,15,17] infection among HCP who reported wearing eye protection compared to HCP who did not report wearing eye protection. Three studies[12,15,17] reported a decrease in the adjusted and unadjusted odds of SARS-CoV-2 infection [aOR: of 0.57 (95% CI: 0.37-0.77), p = NR;[12] OR: 0.44 (95% CI: 0.23-0.84), p = 0.01;[17] and OR: 0.81 (95% CI: 0.61-1.08), p = 0.158].[15] The odds ratio was adjusted for age, sex, whether HCP had any comorbidities, smoking status, COVID-19 immunization, healthcare sector, HCP professional category, COVID-19 exposures during the 10 days preceding inclusion, consistent use of PPE, and status on caring for COVID-19 patients.[12] The other study[19] reported that HCP with laboratory-confirmed SARS-CoV-1 were less likely to wear goggles than HCP who tested negative for SARS-CoV-1 [7.7% vs. 13.3%, p = 0.046] and were less likely to wear glasses than HCP who tested negative for SARS-CoV-1 [7.5% vs. 15.9%, p = 0.006]. All four studies retrospectively recorded self-reported eye protection use after the disease was diagnosed, increasing the likelihood of recall bias. It was unclear whether N95s or medical/surgical masks were used, decreasing confidence in the results. ▪ One retrospective cross-sectional study[16] (N = 758) conducted in two university-affiliated hospitals in China reported an increase in the unadjusted odds of SARS-CoV-1 among HCP who reported never wearing a face shield in SARS-CoV-1 wards when compared to HCP who reported wearing a face shield every time [OR: 4.05 (95% CI: 0.54-30.34), p > 0.05]. This study

Outcome	Results
	also reported a decrease in the odds of SARS-CoV-1 among HCP who reported sometimes wearing face shields when compared to HCP who reported wearing a face shield every time [OR: 0.22 (95% CI: 0.01-3.56), p > 0.05], but this was based on a low number of events [1/108 (0.9%) vs. 1/24 (4.2%)]. This study also reported no difference in HCP reporting wearing a face shield often in SARS wards compared to those who reported wearing their face shield every time [0/21 (0%) vs. 1/24 (4.2%)]. ▪ One retrospective cohort study[11] (N = 283) conducted in a hospital in Saudi Arabia reported a decrease in the unadjusted risk of MERS-CoV antibodies among HCP who self-reported "always" wearing eye protection while in direct contact with MERS-CoV patients compared to HCP who reported "not always" or "never" wearing eye protection [RR: 0.21 (95% CI: 0.03-1.51), p = 0.13]. This study had a low number of events, and self-reported PPE use was collected after the infection, decreasing confidence in the results. Two cohort studies[14,20] and one case control study[18] (N = 236) reported proportions suggesting no difference in the incidence of SARS and SARS-CoV-2 infections, regardless of the use of eye protection among HCP. ▪ Two cohort studies[14,20] (N = 186) reported proportions suggesting no difference in the incidence of SARS and SARS-CoV-2 infections among HCP who reported wearing eye protection compared to HCP who didn't report wearing eye protection [0/23 (0%) vs. 0/26 (0%)[14] and 0/72 (0%) vs. 0/30 (0%)].[20] One case control study[18] (N = 50) reported proportions suggesting no difference in the use of eye protection between COVID positive HCP compared to COVID negative HCP [1/3 (33.3%) vs. 1/47 (2.1%); p = 0.248]. The three studies had small sample sizes, reported little[18] to no events,[14,20] and had HCP self-report PPE use after infection, introducing sampling and recall bias, decreasing confidence in the results.

C.2. Narrative Synthesis of Adverse Events Among Users of Eye Protection

Table 5: Qualitative Summary of Findings for Adverse Events Resulting from the Addition of Eye Protection

Outcome	Results
Job performance-related adverse events	Evidence from twelve studies[22-27,29,32,35,40-42] (N = 2,573) indicates eye protection is associated with an increase in adverse events that interfere with job performance including fogging, poor visibility, and inconvenience among HCP. • Strength: All cross-sectional studies[23-27,29,32,35,41,42] were subject to selection bias, recall bias, and were subject to confounding by type of eye protection, age, gender, occupation or task. • Precision: One study[25] reported a wide confidence interval that included the null. • Consistency: The evidence is consistent. • Applicability: The populations and settings were directly applicable to the question. Four studies[22,23,25,42] (N = 880) reported the use of eye protection among HCP was associated with fogging, poor visibility, and inconvenience.

Preliminary Eye Protection Summary

Outcome	Results
	• Two cross-sectional studies[23,42] (N= 538) reported the use of eye protection, such as goggles and/or face shields, was significantly associated with fogging[23,42] and poor visibility.[42] One study[22] (N = 35) reported a higher rate of fogging with goggles compared to goggle-type face shields and face shields [goggles: 32/35 (91.4%) vs. face shields: 22/35 (62.9%) vs. goggle-type face shields: 11/35 (31.4%), p < 0.001]. The study also reported an increase in the fear of dropping equipment on surgical sites when HCP wore face shields compared to goggles and goggle-type face shields [goggles: 5/35 (14.3%) vs. face shields: 18/35 (51.4%) vs. goggle-type face shields: 10/35 (28.6%), p = 0.001]. One study[25] (N = 307) reported HCP had increased sight problems when wearing goggles and/or face shields for more than four hours when compared to four hours or less [OR: 1.10 (95% CI: 0.69-1.73), p = 0.680]. One study[42] (N = 342) reported an inability to enjoy surgery was associated with poor visibility while wearing goggles and/or face shields (p = 0.004) but not fogging (p = 0.174). Nine studies[24,26,27,29,32,35,40-42] (N = 2,035) reported high incidence rates of fogging, poor visibility, and inconvenience among HCP wearing eye protection. • Five cross-sectional studies[26,27,32,35,41] and one cohort study[40] (N = 968) reported incidence rates of fogging and poor visibility ranging from 31%[27] to 91.7%[35] among HCP wearing eye protection such as goggles, face shields, visors, protective glasses, and power glasses. Two studies[41,42] (N = 562) reported 45.9%[42] and 65.5%[41] of HCP were dissatisfied or very dissatisfied with visibility after wearing eye protection. One study[40] examined reasons for non-compliance with eye protection among surgeons and found fogging and poor visibility were contributing factors. All studies are subject to selection bias which may result in an overestimation of effect. • One study[24] (N = 172) reported that face shields and goggles had comparable low scores for convenience and clarity during various procedures and found face shields to be the most abandoned PPE [38/70 (54.2%)] followed by protective goggles [32/70 (45.7%)]. One study[29] (N = 553) reported 46.9% of HCP agreed or strongly agreed that protective goggles make it hard to do their job, and that among 121 HCP who must wear glasses in their daily life, 70.2% reported using protective goggles caused difficulty in using their daily eyewear. One study[41] (N = 220) reported that goggles and/or face shields or power glasses were incompatible with loupes and glasses [31/220 (14.0%)]. One study[32] (N = 106) reported goggles and visors make it difficult to use a microscope (68%) and HCP removed their eye protection in order to use microscopes (82%). All studies are subject to selection bias which may result in an overestimation of effect.
Physical adverse events	Evidence from eighteen studies[21,22,25,26,28,30,31,33,34,36,37,39,41,42] (N = 4,176) indicates eye protection is associated with an increase in physical adverse events among HCP when comparing duration of use. • Strength: All cross-sectional studies[21,25-31,33,34,36,37,39,41,42] were subject to selection bias, recall bias, and were subject to confounding by type of eye-protection, age, gender, occupation or task. • Precision: Of the six studies reported wide confidence intervals,[25,31,34,36,37,39] two studies reported confidence intervals that included the null.[25,37] • Consistency: The evidence is consistent. • Applicability: The populations and settings were directly applicable to the question.

Outcome	Results
	Evidence from four cross-sectional studies[25,31,33,39] (N = 805) reported an increase in headaches with the use of eye protection and with longer durations of use. • One study[31] (N = 185) reported an increased odds of headaches among HCP wearing face shields or goggles compared to HCP not wearing eye protection when adjusting for type of face mask and combined face and eye PPE usage [aOR: 15.8 (95% CI: 1.63-23.7), p = 0.017]. Two studies[25,39] (N = 465) reported an increased odds of headache and one study[33] (N = 155) reported higher proportions of de novo headaches when HCP wear goggles or face shields/visors for more than four hours compared to four hours or less [OR: 1.51 (95% CI: 0.99-2.14), p = 0.043;[25] OR: 1.60 (95% CI: 1.13-2.25), p < 0.001;[39] 34.6% vs 29.4%, p = 0.58[33]]. All studies were subject to selection bias, possibly overestimating the effect, and one study[33] was not powered to detect a result. • Two studies[41,42] (N = 562) reported 7%[42] and 22.2% (49/220)[41] of HCP reported headaches with the use of eye protection. These results are likely confounded by type of eye protection and duration of its use in combination with other PPE. Evidence from three cross sectional studies[25,34,37] (N = 996) suggests an increase in the odds of skin reactions with increasing duration of use of eye protection. • Two studies[34,37] (N = 689) reported an increased odds of dermatosis or any skin reaction among HCP wearing disposable face shields (headband and spectacles), goggles, or plastic safety goggles for over one[34] or two hours[37] compared to those wearing for less than an hour [OR: 2.9 (95% CI: 1.1-7.8), p = 0.03;[34] OR: 1.7 (95%CI: 0.98-3.12); p = 0.05].[37] • One study[25] (N = 307) reported no difference in redness around the eyes among HCP wearing goggles or face shields regardless of duration of wear [OR: 1.02 (95% CI: 0.72-1.43), p = 0.898], however, goggles and face shields were analyzed together limiting the confidence in these findings. • Four cross sectional studies[21,34,37,41] (N = 1,292) reported incidence rates of skin reactions including erythema, urticaria, itch, xerosis, skin irritation, or rash from 1.1%[21] to 25.7%.[34] These proportions are likely confounded by duration of use and the type of eye protection. One cross sectional study[36] (N = 53) reported a reduced odds of dry eyes in HCP wearing protective glasses for a longer period of time. • One cross sectional study[36] (N = 53) conducted in a hospital in China reported a reduced odds of dry eyes in HCP wearing protective glasses for six or more hours compared to those wearing protective glasses for four to five hours [OR: 0.145 (95% CI: 0.038-0.560), p < 0.05]. One cross-sectional study[28] (N = 266) reported no difference in pain among HCP using face shields, goggles, or face shields only. • One cross sectional study[28] (N = 266) reported that there was no difference in pain in HCP wearing goggles with face shields, goggles only, or face shields only [95.4% vs. 93% vs. 90.6%, p = 0.36]. Evidence from two studies[22,30] (N = 258) is insufficient and inconclusive on the effect of eye protection on comfort among HCP. • One study[22] (N = 35) reported that goggles and face shields were significantly more associated with discomfort when compared to goggle-type face shields [goggles: 28/35 (80.0%) vs. face shields: 33/35 (94.3%) vs. goggle-type face shields: 16/35 (45.7%), p < 0.001]. This study was conducted in operating room nurses who wore this eye protection for less than two hours and the sample size was small, limiting the generalizability of these findings. Another cross-sectional study[30] (N = 223) reported no difference in physical comfort measured via a scale (p = 0.061) among HCP who reported wearing visors or goggles/ protective glasses rarely, sometimes, often, or only when necessary. • Seven cross sectional studies[26,27,29,38,40-42] (N = 1,722) reported incidence rates of discomfort from eye protection ranging from 1.8%[42] to 67.7%.[38] These proportions are likely confounded by duration of use and the type of eye protection.

Outcome	Results
	Evidence from one quasi-experimental study[22] (N = 35) reported a higher proportion of physical adverse events for face shields and goggles than for goggle-type face shields. • One study[22] (N = 35) reported that goggles and face shields were significantly associated with increased sweating/moisture [goggles: 22/35 (62.9%) vs. face shields: 24/35 (68.6%) vs. goggle-type face shields: 8/35 (22.9%), p < 0.001] and skin injury [goggles: 10/35 (28.6%) vs. face shields: 10/35 (28.6%) vs. goggle-type face shields: 1/35 (2.9%), p = 0.002] when compared to goggle-type face shields. This study also reported that face shields were significantly associated with a need for adjustment [goggles: 20/35 (57.1%) vs. face shields: 28/35 (80.0%) vs. goggle-type face shields: 16/35 (45.7%), p = 0.004] and feelings of restricted mobility [goggles: 9/35 (25.7%) vs. face shields: 32/35 (91.4%) vs. goggle-type face shields: 5/35 (14.3%), p < 0.001] when compared to goggles and goggle-type face shields. This study was conducted in operating room nurses who wore this eye protection for less than two hours and the sample size was small, limiting the generalizability of these findings. • One cross-sectional study[25] (N = 307) reported that 47.6% (117/267) participants self-reported sweating/moisture around the eyes after goggle and/ or face shield use. Another cross-sectional study[27] (N = 300) reported that 20.7% (62/NR) of participants self-reported facial and/or suborbital friction or maceration after visor and/ or glasses use.
Psychological and emotional adverse events	Evidence from two studies[30,42] (N = 565) is inconclusive on the effect of the addition of eye protection on psychological and emotional adverse events such as anxiety or stress among HCP wearing eye protection. The eye protection itself may not be the cause of the anxiety, however the adverse events associated with them may be. • Strength: Both cross-sectional studies[30,42] were subject to selection bias, recall bias, and were subject to confounding by type of eye-protection, age, gender, occupation or task. One study[30] was underpowered to detect a result using a tool that has not been validated to the local cultural context. • Precision: One study[42] reported a wide confidence interval. • Consistency: The evidence is insufficient. • Applicability: The populations and settings were directly applicable to the question. Two cross-sectional studies[30,42] reported data on emotional adverse events among HCP wearing eye protection. • One cross-sectional study[42] (N = 342) conducted in surgical oncology units of hospitals in India reported that cancer surgeons attributed poor visibility (p = 0.028) and fogging of goggles and/or face shields (p < 0.001) contributed to stress. Stress due to fogging of goggles and/or face shields was significant after adjusting for poor visibility, uncomforting, incompatible with loupes, and headache [aOR: 3.61 (95% CI: 1.93-6.77), p < 0.001]. HCP stress due to goggles and/or face shields was not associated with lack of comfort (p = 0.674), incompatibility with loupes (p = 0.151), or headaches (p = 0.319). This study also reported poor visibility (p = 0.001), lack of comfort (p = 0.05), and headaches (p < 0.001) contributed to fatigue but fogging (p = 0.139) and incompatibility with loupes (p = 0.34) were not. This study is subject to selection bias. • One cross-sectional study[30] (N = 223) conducted among nurses in Turkish hospitals reported no difference in anxiety as measured using the Coronavirus Anxiety Scale when HCP used goggles/ protective glasses rarely, sometimes, often, or only when necessary (p = 0.094). The Coronavirus Anxiety Scale measures anxiety from a scale from 0-4, where a high score indicates high anxiety. HCP self-reported PPE use, and this study was not powered to detect a result, and this scale was not validated in this cultural context, decreasing confidence in the results.

C.3. Extracted Evidence Relevant to the Addition of Eye Protection to Routine PPE

Table 6. Extracted Studies Reporting on the Effectiveness of Eye Protection to Prevent Respiratory Infection or Illness in HCP

Study	Population and setting	Intervention	Definitions	Results
Author: Al Mohajer[10] **Year:** 2021 **Data extractor:** DCB **Reviewer:** CNS **Study design:** Quasi-experimental **Study objective:** To assess the impact of face shield policy on SARS-CoV2 infection among HCP and hospitalized patients. **IVA score:** 17 (high) • Unadjusted confounding (changes in testing, other IP measures, community interventions) • N95 use unknown	**Population:** N = 6,527 HCP **Setting:** Texas, U.S. **Location:** Quaternary healthcare system hospital **Study dates:** April 17 – September 7, 2020 **Matching:** None **Inclusion criteria:** All HCP working in the study hospital during the study period. **Exclusion criteria:** If HCP had a previous positive SARS-CoV-2 test.	**Intervention group:** n = 4,041 July 6-September 7, 2020: Face shields for all HCP upon entry to the facility and during patient and staff-to-staff encounters • **Type of eye protection:** Face shield or goggles as an alternative for those unable to tolerate face shields **Washout:** None **Control group:** n = 2,486 April 17-July 5, 2020 **Exposure assignment or ascertainment:** Universal face shield hospital policy for all HCP began on July 6, 2020. **Standard preventive measures:** Between April 1-17, 2020, measures like limiting entry to the facility, screening for symptoms and temperature, universal face masking for HCP and patients, social distancing (avoid having lunch with others), limiting meeting sizes to <10, and surveillance testing of HCP and patients was implemented.	**Outcome definitions:** *SARS-CoV-2:* NR **Case ascertainment:** A surveillance program including voluntary biweekly testing for HCP in the ED/transplant/COVID-19 units and weekly testing for HCP in cluster areas (≥3 cases of HCP with COVID-19 diagnosis or any case of hospital-acquired infection) was implemented on April 17, 2020. HCP in other areas were allowed to be tested if desired or if there was exposure history. **Sampling methods:** NR **Diagnostic tests:** NR **Comments:** Texas implemented several community public health interventions including closure of bars, limiting restaurant capacity, limiting elective procedures, and mandating face masks face masks in the community four to 10 days before the implementation of universal face shields.	**Respiratory infection outcomes:** *Laboratory-confirmed SARS-CoV-2:* n = 246 • Intervention: 80/4,041 (2.0%) • Control: 166/2,486 (6.7%) *SARS-CoV-2:* Weekly positivity rate: HCP cases in a week/HCP working that week • Intervention: 2.3% • Control: 12.9% • p<0.001 **Other related outcomes:** NA **Adverse events:** In general, face shields were well-tolerated by the majority of staff **Cost information:** NR
Author: Alraddadi[11] **Year:** 2016 **Data extractor:** CNS **Reviewer:** DOS **Study design:** Retrospective cohort	**Population:** N = 242 **Setting:** Hospital **Location:** Saudi Arabia **Study dates:** May – June 2014 **Matching:** None	**Intervention group:** n = 47 Self-reported "always" wearing eye protection while in direct contact with MERS-CoV patients • **Type of eye protection:** NR **Control group:** n = 165 Self-reported "not always" or "never" wearing eye protection while in direct contact with MERS-CoV patients	**Outcome definitions:** *Laboratory-confirmed MERS-CoV:* HCP with a positive serum sample test for MERS-CoV antibodies **Case ascertainment:** All HCP provided a serum sample which was screened for antibodies against MERS-CoV nucleocapsid protein by ELISA. Samples that were positive were confirmed by	**Respiratory infection outcomes:** *RR: Relative risk* *Laboratory-confirmed MERS-CoV for those who had direct contact with a MERS+ patient:* • RR: 0.21 (95% CI: 0.03-1.51), p = 0.13 • Intervention: 1/47 (2.1%) • Control: 17/165 (10.3%) **Other related outcomes:** NR **Adverse events:** NR

Study	Population and setting	Intervention	Definitions	Results
Study objective: To address gaps and better understand risk factors for infection and transmission of Middle East respiratory syndrome coronavirus (MERS-CoV). **IVA score:** 20 (moderate) • Unadjusted confounding (differential N95 use, and improper mask use) • N95 use unknown • Recall bias	**Inclusion criteria:** All HCP who worked in the ED and MICU of the hospital from March 24 – May 14, 2014 were eligible. **Exclusion criteria:** HCP without serum specimens.	**Intervention assignment or ascertainment:** All participating HCP were interviewed using a standardized questionnaire and self-reported PPE use during encounters with MERS-CoV patients **Standard preventive measures:** All patients with suspected or confirmed MERS-CoV infection were placed in private rooms equipped with negative pressure ventilation. Patients in whom MERS-CoV infection was not suspected initially were transferred to negative-pressure rooms as soon as diagnosis was suspected or confirmed.	immunofluorescence assay, microneutralization assay, or both. **Sampling methods:** Serum sample **Diagnostic tests:** ELISA with positive samples confirmed by immunofluorescence assay or microneutralization assay **Comments:** Proper use of mask (covering mouth and nose) was statistically significantly protective for AGPs	**Cost information:** NR
Author: Belan[12] **Year:** 2022 **Data extractor:** JH **Reviewer:** DOS **Study design:** Retrospective case-control **Study objective:** To identify occupational and non-occupational exposures, and PPE use associated with COVID-19 risk for HCP working in primary care, LTCFs, or hospitals. **IVA score:** 22 (moderate)	**Population:** N = 4,152 **Setting:** Primary care, LTCFs, or hospitals **Location:** France **Study dates:** April 10 - July 9, 2021 **Matching:** 1:1 matching for 10-year age-category distribution, sex, and residential region **Inclusion criteria:** Cases: Participants with laboratory confirmed COVID-19 who selected the "healthcare worker or working within health field" criterion in the questionnaire.	**Cases:** n = 2076 HCP with laboratory-confirmed COVID-19 • **Type of eye protection:** Goggles or face shield **Washout period:** NA **Controls:** n = 2076 HCP without laboratory-confirmed COVID-19 • **Type of eye protection:** Goggles or face shield **Case ascertainment:** COVID-19 testing of participants in an ongoing national survey **Standard preventive measures:** NR	**Outcome definitions:** *Laboratory-confirmed SARS CoV-2:* SARS-CoV-2 confirmed by either nasopharyngeal RT-PCR or antigenic test **Intervention assignment or ascertainment:** Questionnaires covered the 10 days preceding symptom onset for cases (or testing 104 if asymptomatic) and the 10 days preceding questionnaire completion for controls. **Sampling methods:** NR **Diagnostic tests:** Nasopharyngeal RT-PCR or antigenic test **Comments:** All HCP were masked. Approximately 25 – 30% wore surgical masks and 69 – 74% wore N95s.	**Respiratory infection outcomes:** *aOR: Adjusted odds ratio; model includes age, sex, whether HCP had any comorbidities, smoking status, COVID-19 immunization, healthcare sector, HCP professional category, COVID-19 exposures during the 10 days preceding inclusion, consistent use of PPE, and status on caring for COVID-19 patients* *OR: Odds ratio* *Consistent use of goggles or face shield:* • aOR: 0.57 (95% CI: 0.37-0.87), p = NR • OR: 0.58 (95% CI: 0.46 – 0.73), p = NR • Cases: 653/1088 (60.0%) • Control: 692/998 (69.3%) **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR

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Study	Population and setting	Intervention	Definitions	Results
• Unadjusted confounding (mask use - differential) • N95 use with eye protection unknown • Recall bias	Controls: Controls were recruited during the same period through two different sources: 1) Ipsos, a French marketing research and public opinion specialist, selected controls from a panel representative of the French population using frequency-matching with cases for age, sex, region, population density, and week of inclusion for the Comcor survey; and 2) 24 professional corporations, scientific associations, and medical platforms were asked to forward the questionnaire to their members in April and May 2021. Participants declaring to be HCP using the above-described criterion and reporting no previous symptoms or positive test were enrolled as controls. Controls were free to complete the questionnaire whenever they decided. **Exclusion criteria:** Participants with missing data.		434 (22%) of cases and 47 (2%) were exposed to an infected person outside of work and it is unclear how many of people were in the PPE sub-analysis.	
Author: Bhaskar[13] **Year:** 2020 **Data extractor:** CNS **Reviewer:** Team	**Population:** N = 62 **Setting:** Community **Location:** India	**Intervention group:** n = 50 May 20-June 30, 2020: Face shields were worn in addition to basic required PPE. After each visit, the shield was decontaminated using alcohol-based solution, and at the end of the day, soaked in detergent mixed with water.	**Outcome definitions:** *Laboratory-confirmed SARS-CoV-2:* HCP with a positive RT-PCR test for SARS-CoV-2 **Case ascertainment:** After baseline testing for SARS-CoV-2 by RT-PCR on May 1 and May 16-19. Screening	**Respiratory infection outcomes:** *Laboratory-confirmed SARS-CoV-2:* • Intervention: 0/50 (0%) • Control: 12/62 (19.4%) **Other related outcomes:** NR **Adverse events:** NR

Preliminary Eye Protection Summary

Study	Population and setting	Intervention	Definitions	Results
Study design: Quasi-experimental **Study objective:** To describe SARS-CoV-2 transmission to HCP in a community setting before and after the use of face shields. **IVA score:** 15 (high)	**Study dates:** May 3 – June 30, 2020 **Matching:** None **Inclusion criteria:** Community HCP from a research network who tested negative for SARS-CoV-2 at baseline and were assigned to counsel asymptomatic family contacts of patients who tested positive for SARS-CoV-2 at their residence. **Exclusion criteria:** NR	• **Type of eye protection:** Face shields made of polyethylene terephthalate (250-µm thickness) **Washout Period:** May 16-19 no homes were visited **Control group:** n = 62 May 3-15, 2020 **Intervention assignment or ascertainment:** PPE policy changed to include face shields on May 20 **Standard preventive measures:** HCP were given 3-layered surgical masks, gloves, shoe covers, and alcohol hand rub. They were housed in separate rooms of hostels and were provided food. They did not visit their homes or public places outside of work. Prework training was completed, and HCP communicated with each other by phone. HCP traveled in a van with a steel partition to prevent air exchange between the driver and back cabin where HCP maintained constant masking and social distancing. HCP stood 6 feet away from members of each home they visited.	protocol was not described for the period between May 1 – May 16. After the introduction of face shields, HCP were screened for symptoms and underwent RT-PCR tests weekly. **Sampling methods:** Nasopharyngeal swabs **Diagnostic tests:** RT-PCR **Comments:** None	**Cost information:** NR
Author: Burke[14] **Year:** 2020 **Data extractor:** DOS **Reviewer:** CNS **Study design:** Retrospective cohort **Study objective:** To interrupt transmission, investigate risk factors of transmission, and identify both	**Population:** N = 76 reporting PPE **Setting:** Healthcare facilities including outpatient clinics, urgent care, and hospitals **Location:** U.S. **Study dates:** January – February 2020 **Matching:** None **Inclusion criteria:** Healthcare or public health personnel working	**Intervention group:** n = 42 • **Type of eye protection:** Goggles or disposable face shield that covers the front and sides of the face **Control group:** n = 34 Self-reported using no eye protection on at least one occasion **Intervention assignment or ascertainment:** PPE use was collected during interviews for additional details from convenience sample using forms that were standardized within but not across jurisdictions **Standard preventive measures:** *Airborne and contact precautions:* gloves, gown,	**Outcome definitions:** *Laboratory-confirmed SARS-CoV-2:* Respiratory specimens were considered positive if all three genetic markers were positive by real-time RT-PCR, negative if all three genetic markers were negative, and inconclusive otherwise **Case ascertainment:** HCP were contacted daily via phone, text message, email, or in person, and were asked to report temperature and any symptoms. Convenience sample was selected from whom to request respiratory samples outside	**Respiratory infection outcomes:** *Laboratory-confirmed SARS-CoV-2:* • Eye protection: 0/23 (0%) • No eye protection: 0/26 (0%) • p = NR **Other related outcomes:** Eye protection was the most frequently missing PPE among HCP reporting using less PPE than recommended who described PPE usage in detail [34/38 (90%)]. **Adverse events:** NR **Cost information:** NR

Study	Population and setting	Intervention	Definitions	Results
symptomatic and asymptomatic infections among contacts of travel-associated case patients. **IVA score:** 17 (high) • Unadjusted confounding (mask type) • Recall bias	in healthcare settings who had the potential for exposure to one of nine travel-associated case patients or their infectious materials through close contact. Close contact was generally defined as persons having frequent or more than brief contact (>1-2 minutes within 6 feet) with a travel-associated case patient during the travel-associated case patient's presumed infectious period. **Exclusion criteria:** NR	eye protection, and a PAPR or N95 with fit-testing in the past year *Droplet and contact precautions:* gloves, gown, eye protection, and a face mask	of diagnostic specimen collection procedures **Sampling methods:** Nasopharyngeal and oropharyngeal **Diagnostic tests:** Real-time RT-PCR **Comments:** Unclear proportion of HCP wore N95 vs mask in required situations/tasks	
Author: Chatterjee[15] **Year:** 2020 **Data extractor:** CNS **Reviewer:** DOS **Study design:** Retrospective case-control **Study objective:** To compare the risks of and protective factors against SARS-CoV-2 infection among HCP in India. **IVA score:** 15 (high) • Unadjusted confounding (mask use, HCP task, community contact) • Recall bias	**Population:** N = 751 **Setting:** NR **Location:** India **Study dates:** May 8 – 23, 2020 **Matching:** Matched in a 1:1 ratio for location (testing center) and temporality (test date) **Inclusion criteria:** HCP tested for SARS-CoV-2 between the first week of April 2020 and the end of the first week of May 2020 were identified using a nation-wide data portal developed to capture information regarding individuals undergoing testing for	**Cases:** n = 378 • **Type of eye protection:** Face shields or goggles **Controls:** n = 373 • **Type of eye protection:** Face shields or goggles **Case ascertainment:** Cases and controls were identified using a data portal on testing for SARS-CoV-2 infection **Standard preventive measures:** The National Task Force for COVID-19 in India recommended the use of hydroxychloroquine as prophylaxis against SARS-CoV-2 infection in asymptomatic HCP treating suspected or confirmed COVID-19 cases.	**Outcome definitions:** *Laboratory-confirmed SARS-CoV-2:* HCP with a positive qRT-PCR test for SARS-CoV-2 **Intervention assignment or ascertainment:** HCP self-reported PPE use restricted to seven days before SARS-CoV-2 testing during a phone interview **Sampling methods:** NR **Diagnostic tests:** qRT-PCR **Comments:** 80%-90% used any mask	**Respiratory infection outcomes:** *OR: Odds ratio* *Face shields and/or goggles:* • OR: 0.81 (95% CI: 0.61-1.08), p = 0.158 • Cases: 163/378 (43.1%) • Controls: 180/373 (48.3%) **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR

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Study	Population and setting	Intervention	Definitions	Results
	SARS-CoV-2 infection across India. Cases: Symptomatic HCP testing positive on real-time qRT-PCR for SARS-CoV-2 Controls: Symptomatic HCP who tested negative on qRT-PCR for SARS-CoV-2 under similar considerations. **Exclusion criteria:** Non-Indian nationals, HCP with missing or wrong contact details in the database, HCP who did not pick up the call, non-HCP, or HCP who refused to consent.			
Author: Chen[16] **Year:** 2009 **Data extractor:** DOS **Reviewer:** CNS **Study design:** Retrospective cross-sectional **Study objective:** To determine which preventive measures used were effective in protecting HCP from SARS, and which were not effective. **IVA score:** 16 (high) • Unadjusted confounding (mask use, HCP	**Population:** N = 758 **Setting:** Two university-affiliated hospitals **Location:** China **Study dates:** May 2003 **Matching:** None **Inclusion criteria:** Frontline HCP from all departments involved in the care of SARS patients and who were on duty during the investigation. **Exclusion criteria:** HCP who were off-duty during the investigation and HCP who had previously been diagnosed as SARS but	**Intervention group:** n = 24 Self-reported wearing face shield in SARS ward every time. • **Type of eye protection:** Face shield **Control group:** n = 724 Self-reported wearing face shield in SARS ward often (n = 21), sometimes (n = 108), or never (n = 595) **Intervention assignment or ascertainment:** Standardized interview with structured questionnaire used to obtain information on use of PPE, including the question, 'With what frequency did you wear a face shield while you worked in SARS wards?' **Standard preventive measures:** NR	**Outcome definitions:** *Laboratory-confirmed SARS:* HCP with IgG against SARS **Case ascertainment:** Blood samples were collected from all HCP **Sampling methods:** 10 mL of peripheral venous blood **Diagnostic tests:** ELISA **Comments:** None	**Respiratory infection outcomes:** *OR: Odds ratio* *Laboratory-confirmed SARS:* • OR: 4.05 (95% CI: 0.54-30.34), p > 0.05 • Never wearing face shield: 89/595 (15.0%) • Every time wearing face shield: 1/24 (4.2%) • OR: 0.22 (95% CI: 0.01-3.56), p > 0.05 • Sometimes wearing face shield: 1/108 (0.9%) • Every time wearing face shield: 1/24 (4.2%) • Often wearing face shield: 0/21 (0%) • Every time wearing face shield: 1/24 (4.2%) **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR

Study	Population and setting	Intervention	Definitions	Results
task, community contact) • Recall bias	their IgG against SARS test was negative.			
Author: Khalil[17] **Year:** 2020 **Data extractor:** MC **Reviewer:** CNS **Study design:** Retrospective case control **Study objective:** To determine the role of personal protective measures in the prevention of COVID-19 spread among the physicians working at different health facilities in Bangladesh. **IVA score:** 16 (high) • Unadjusted confounding (mask use, HCP task, community contact) • Recall bias	**Population:** N = 190 **Setting:** Various hospitals **Location:** Bangladesh **Study dates:** May – June 2020 **Matching:** None **Inclusion criteria:** Cases**:** Physicians from different hospitals whose reverse transcriptase-polymerase chain reaction (RT-PCR) test was positive for COVID-19. Controls: Physicians that were COVID-19 negative (having no symptoms of COVID-19 or tested negative) who worked in the same hospitals as the cases. **Exclusion criteria:** NR	**Cases**: n = 98 • **Type of eye protection:** Face-shield/goggles **Washout period:** NA **Controls**: n = 92 • **Type of eye protection:** Face-shield/goggles **Case ascertainment:** Physicians from different hospitals whose RT-PCR was positive. **Standard preventive measures:** NR	**Outcome definitions:** *Laboratory-confirmed COVID-19:* Physicians whose reverse transcriptase-polymerase chain reaction (RT-PCR) test was positive **Intervention assignment or ascertainment:** Self-reported by questionnaire **Sampling methods:** NR **Diagnostic tests:** RT-PCR **Comments:** None	**Respiratory infection outcomes:** *OR: Odds ratio* *Face shield or goggles:* • OR: 0.437 (95% CI: 0.228-0.837), p = 0.012 • Cases: 55/98 (56.1%) • Control: 68/92 (73.9%) **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR
Author: Kumar[18] **Year:** 2020 **Data extractor:** DCB **Reviewer:** DOS **Study design:** Retrospective case control	**Population:** N = 50 **Setting:** COVID isolation/quarantine facility at a tertiary care center **Location:** India **Study dates:** April – May 2020	**Cases:** n = 2 • **Type of eye protection:** Goggles or face shields **Washout period:** NA **Controls:** n = 48 • **Type of eye protection:** Goggles or face shields **Case ascertainment:** HCP working with positive patients tested 5-7 days after exposure, or on the development of	**Outcome definitions:** *Laboratory-confirmed SARS-CoV-2:* Positive PCR result **Exposure assignment or ascertainment:** Predesigned proforma from the medical records **Sampling methods:** Nasal/nasopharyngeal and oropharyngeal swab **Diagnostic tests:** RT-PCR	**Respiratory infection outcomes:** *Wearing goggles or face shields:* • SARS-CoV-2 positive: 1/3 (33.3%) • SARS-CoV-2 negative: 1/47 (2.1%) • p = 0.248 **Other related outcomes:** *General goggles/face shield use:* 2.1% *Goggle/ face shield use during AGP:* 0/40 **Adverse events:** NR

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Study	Population and setting	Intervention	Definitions	Results
Study objective: To evaluate quarantined HCP's risk factors and behaviors which make them high risk for COVID-19 infection and find the infection rate among the quarantined HCPs. **IVA score:** 18 (moderate) • Recall bias • Unadjusted confounding, (mask use, HCP task) • Small number of events	**Matching:** NR **Inclusion criteria:** HCPs who were quarantined following exposure to confirmed or suspected COVID-19 cases at their workplace/home or quarantined due to the development of symptoms suggestive of Influenza-Like illness (ILI). **Exclusion criteria:** COVID-19 positive cases in the isolation ward were not included.	symptoms, whichever was earlier. HCP working with negative patients were tested if they became symptomatic. **Standard preventive measures:** Mandatory use of N-95 masks in all hospital areas, appropriate use of personal protective equipment (PPE) as per designated work areas, cleaning of hospital beds, floors and other surfaces, and social distancing at the workplace.	**Comments:** None	**Cost information:** NR
Author: Liu[19] **Year:** 2009 **Data extractor:** CNS **Reviewer:** DOS **Study design:** Retrospective case-control **Study objective:** To investigate possible risk and protective factors associated with infection of SARS among HCP. **IVA score:** 17 (high) • Recall bias • Unadjusted confounding (mask use, training, task)	**Population:** N = 477 **Setting:** Hospital **Location:** China **Study dates:** March 5 – July 2003 **Matching:** None **Inclusion criteria:** Cases: All HCP who were diagnosed as probable SARS cases admitted between March 5 – May 17, 2003. Controls: Uninfected HCP who worked in the same hospital and had self-reported exposure (history of being within 1m of a patient who was subsequently confirmed	**Cases:** n = 51 • **Type of eye protection:** Goggles **Controls:** n = 426 • **Type of eye protection:** Goggles **Case ascertainment:** Initial diagnosis based on documented fever (temperature >38°C), presence of cough, shortness of breath or breathing difficulty, and a significant history of exposure to a SARS patient not more than 10 days prior to onset of symptoms, plus radiographic evidence of infiltrates consistent with pneumonia or respiratory distress syndrome on chest X-ray. All cases and controls were subsequently tested for IgG antibody against SARS-CoV. **Standard preventive measures:** NR	**Outcome definitions:** *Laboratory-confirmed SARS-CoV:* SARS-CoV positive IgG antibody test **Intervention assignment or ascertainment:** Self-reported during interviews using pre-tested questionnaires between June – July 2003 **Sampling methods:** NR **Diagnostic tests:** Radiographic evidence of infiltrates consistent with pneumonia or respiratory distress syndrome and ELISA test for IgG antibody against SARS-CoV **Comments:** Masks used by 11.6% of cases & 10.5% of controls, while N95s were used by 6.1% of cases and 11.0% of controls.	**Respiratory infection outcomes:** *Goggles:* • Cases: 7.7% • Controls: 13.3% • p = 0.046 *Glasses:* • Cases: 7.5% • Controls: 15.9% • p = 0.006 **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR

Study	Population and setting	Intervention	Definitions	Results
	with SARS) between March – May 2003. **Exclusion criteria:** Cases suspected of contracting the infection outside the hospital or subsequently detected as IgG antibody negative.			
Author: Park[20] **Year:** 2004 **Data extractor:** DOS **Reviewer:** CNS **Study design:** Retrospective cohort **Study objective:** To characterize the types of exposures and infection-control practices that occurred in U.S. hospitals related to SARS patient care and to determine the extent of SARS-CoV transmission to U.S. HCP. **IVA score:** 17 (high) • Recall bias • Unadjusted confounding (mask use, task)	**Population:** N = 110 **Setting:** Eight healthcare facilities **Location:** U.S. **Study dates:** March 15 – June 23, 2003 **Matching:** None **Inclusion criteria:** HCP who had known unprotected exposure within droplet range (3 feed) to laboratory-confirmed SARS-CoV positive patients, HCP with multiple protected exposures, and those who requested inclusion because of concerns about exposure. HCP were identified by hospital infection-control practitioners and public health officials through informal interviews with hospital staff, by review of employee records, and by self-identification. **Exclusion criteria:** NR	**Intervention group:** n = 30 Reported droplet-range exposure with eye protection • **Type of eye protection:** Goggles or face shield **Control group:** n = 72 Reported droplet-range exposure without eye protection **Intervention assignment or ascertainment:** Standardized questionnaire was used to collect data on PPE use. **Standard preventive measures:** Full equipment was defined as the use of all the PPE recommended for the care of SARS patients, which included a full-length gown, gloves, N95 or higher respirator, and eye protection with goggles or a face shield.	**Outcome definitions:** *Laboratory-confirmed SARS:* Serologic evidence of healthcare-related SARS-CoV transmission **Case ascertainment:** Information was collected regarding any clinical signs or symptoms in the worker up to 10 days after exposure, including fever, cough, shortness of breath, or radiographically confirmed pneumonia. **Sampling methods:** Single convalescent-phase serum samples were collected from HCP at least 28 days after last exposure to patient. In some situations, early in the outbreak, samples were collected between days 22-28. **Diagnostic tests:** ELISA and indirect fluorescent antibody test **Comments:** 45 (44%) HCP reported an exposure without any mask	**Respiratory infection outcomes:** *Laboratory-confirmed SARS:* Convalescent-phase serum samples were available for 102 HCP and none (0%) tested positive for SARS-CoV. • Intervention: 0/72 • Control: 0/30 **Other related outcomes:** NR **Adverse events:** NR **Cost information:** NR

D. Internal Validity Assessment (IVA) Signaling Prompts

- Study Design
    - Design appropriate to research question
    - Well described population
    - Well described setting
    - Well described intervention/ exposure
    - Well described control/ comparator
    - Well described outcome
    - Clear timeline of exposures/ interventions and outcomes
- Selection Bias: Sampling
    - Randomization appropriately performed
    - Allocation adequately concealed
    - Population sampling appropriate to study design
- Selection Bias: Attrition
    - Attrition not significantly different between groups
    - Attrition <10-15% of population
    - Attrition appropriately analyzed
- Information Bias: Measurement and Misclassification
    - Measure of intervention/ exposure is valid
    - Measure of outcome is valid
    - Fidelity to intervention is measured
    - Fidelity to intervention is valid
    - Prospective study
    - Adequately powered to detect result
    - Outcome assessor blinded
- Information Bias: Performance and Detection
    - Study participant blinded
    - Investigator/ data analyst blinded
    - Data collection methods described in sufficient detail
    - Data collection methods appropriate
    - Sufficient follow up to detect outcome
- Information Bias: Analytic
    - Appropriate statistical analyses for collected data
    - Appropriate statistical analyses are conducted correctly
    - Confidence interval is narrow
- Confounding
    - Potential confounders identified
    - Adjustment for confounders in study design phase

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- Adjustment for confounders in data analysis phase
- All pre-specified outcomes are adequately reported

- Other Sources of Bias (including historical events, etc.)
  - No other sources of bias
- Conflict of Interest (COI)
  - Funding sources disclosed and no obvious conflict of interest

E. Acronyms and Abbreviations

Acronym	Expansion
AGP	Aerosol-generating procedures
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
COI	Conflict of interest
COVID-19	Coronavirus disease 2019
ELISA	Enzyme-linked immunosorbent assay
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HCP	Healthcare personnel
HICPAC	Healthcare Infection Control Practices Advisory Committee
I^2	Measure of heterogeneity in meta-analyses
ILI	Influenza-like illness
IPC	Infection prevention and control
IVA	Internal validity assessment
LTCF	Long-term care facility
MERS	Middle East respiratory syndrome
MICU	Medical intensive care unit
N95	N95 respirator
NA	Not applicable
NR	Not reported
OR	Odds ratio
PAPR	Powered air purifying respirator
PCR	Polymerase Chain Reaction
PPE	Personal protective equipment
qRT-PCR	Quantitative real-time polymerase chain reaction
RR	Relative risk
RT-PCR	Real-time polymerase chain reaction
SARS-CoV-1	Severe acute respiratory syndrome coronavirus 1
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
VRI	Viral respiratory infection

F. References

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