Clinical Validation

Article Highlights

- “Dr. Adalja thinks face shields have potential to be more effective than face masks alone because “people are much less likely to touch their face when wearing a face shield. They can also be taken off and cleaned. In many ways, they’re a much more attractive option.”

- “While medical professionals often wear a surgical mask or N95 mask under a face shield, Dr. Schaffner says that’s not really necessary for the general public. “That combination is used by doctors in invasive procedures where they’re creating an aerosol, such as an intubation,” he says. “The average person isn’t going to encounter that. If some people choose to use a face shield going out and about, that might provide a degree of protection that’s comparable to a surgical mask.”
  - Miller, Korin. **“Can Face Shields Help Prevent COVID-19? Here’s How They Compare to Face Masks.”** Prevention, Prevention, 28 May 2020.

- “Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting. Now is the time for adoption of this practical intervention.”

- “Most important, face shields appear to significantly reduce the amount of inhalation exposure to influenza virus, another droplet-spread respiratory virus. In a simulation study, face shields were shown to reduce immediate viral exposure by 96% when worn by a simulated health care worker within 18 inches of a cough. Even after 30 minutes, the protective effect exceeded 80% and face shields blocked 68% of small particle aerosols, which are not thought to be a dominant mode of transmission of SARS-CoV-2.”
  - Eli N. Perencevich, MD, MS1,2; Daniel J. Diekema, MD, MS2; Michael B. Edmond, MD, MPH, MPA2. **“Moving Personal Protective Equipment Into the Community Face Shields and Containment of COVID-19.”** JAMA, April 29, 2020

- “Face shields have the potential to overcome some of the major drawbacks of face masks. Face shields provide better coverage of the face, compared with masks, thus reducing the risk of self-contamination. Additionally, face shields are durable, and they can be cleaned and reused. Given their simpler design, durability, and reuse potential, face shields are less likely to be in short supply, like face masks. Additionally, face shields do not impede facial nonverbal communication; they can be worn concurrently with other face and eye protective equipment, and they do not impact vocalization.”
  - Sonali D. Advani MBBS, MPH1,2 , Becky A. Smith MD1,2, Sarah S. Lewis MD, MPH1,2, Deverick J. Anderson MD, MPH1,2 and Daniel J. Sexton MD1,2 **“Universal masking in hospitals in the COVID-19 era: Is it time to consider shielding?”** The Society for Healthcare Epidemiology of America. April 29, 2020

- “What’s clear is that their (Face Shields) success in hospital settings provides the basis for their utility in the community setting as we relax physical distancing going forward.”
  - Robert Glatter, M.D., emergency physician, Lenox Hill Hospital, New York City; Journal of the American Medical Association, April 30, 2020.

- “In 13 unadjusted studies and two adjusted studies... eye protection was associated with lower risk of infection”
  - Derek K Chu, Elie A Akl, Stephanie Duda, Karla Solo, Sally Yaacoub, Holger J Schünemann, on behalf of the COVID-19 Systematic Urgent Review Group Effort (SURGE) study authors* **“Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis.”** The Lancet, June 1, 2020.

VIEWPOINT

Moving Personal Protective Equipment Into the Community
Face Shields and Containment of COVID-19

Eli N. Perencevich, MD, MS
Center for Access & Delivery Research and Evaluation, Iowa City VA Health Care System, Iowa City, Iowa; and Carver College of Medicine, Department of Internal Medicine, The University of Iowa, Iowa City.

Daniel J. Diekema, MD, MS
Carver College of Medicine, Department of Internal Medicine, The University of Iowa, Iowa City.

Michael B. Edmond, MD, MPH, MPA
Carver College of Medicine, Department of Internal Medicine, The University of Iowa, Iowa City.

On March 19, 2020, California became the first state to issue a stay-at-home order in response to the evolving coronavirus disease 2019 (COVID-19) pandemic. It was quickly recognized that widespread diagnostic testing with contact tracing, used successfully in countries such as South Korea and Singapore, would not be available in time to significantly contain the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1,2] Over the following month, additional nonpharmaceutical mitigation strategies, including school closures, bans on large in-person gatherings, and partial closures of restaurants and retail stores, were applied to "flatten the epidemic curve" and limit the peak effects of a surge of patients on health care systems. Yet, even as the benefits of mitigation bundles have not fully been realized, there are widespread calls to reopen businesses, given the immense economic and social consequences of extreme physical distancing strategies.

Recently, public health, infectious disease, and policy experts have outlined recommendations for gradually reopening society using combinations of containment and mitigation strategies.[3,4] Proposed containment strategies have followed the South Korean model and include rapidly expanding public health infrastructure for widespread testing and data-driven contact tracing, while ensuring that safe medical care is delivered by health care workers wearing adequate personal protective equipment (PPE), such as N95 respirators, medical masks, eye protection, gowns, and gloves. However, there is growing recognition that containment strategies that rely on testing will be inadequate because the necessary testing capacity may not be available for weeks to months, and in the US the ability to track, trace, and quarantine is unclear. In addition, countries where testing was not limited and containment was achieved, eg, Singapore, have seen substantial second waves of infection and mandated extreme distancing interventions that the US and other countries are trying to scale back.

> Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting.

The Infectious Diseases Society of America (IDSA) has included societal use of PPE, such as masks and face shields, in its recommendations for easing restrictions.[4] Experience and evidence, even during this pandemic, suggest that health care workers rarely acquire infections during patient care when proper PPE is used and that most of their infections are acquired in the community where PPE is typically not worn.[5] Thus, it becomes important to know if practice from occupational safety can be used in the community as a bridge to longer-lasting measures, such as vaccines. Could a simple and affordable face shield, if universally adopted, provide enough added protection when added to testing, contact tracing, and hand hygiene to reduce transmissibility below a critical threshold?

COVID-19 Transmission in the Community

The mode of transmission of respiratory viruses has long been a subject of debate. Evidence to date suggests that SARS-CoV-2 is spread like other respiratory viruses: by infectious droplets emitted in close proximity (ie, within 6 feet) to the eyes, nose, or mouth of a susceptible person, or by direct contact with those droplets (eg, touching a contaminated surface and then touching the eyes, nose, or mouth).[6] Although droplet vs airborne transmission is likely to be a continuum, with smaller droplets able to be propelled further than 3 to 6 feet and remaining airborne longer after certain respiratory emissions,[7] the implications of limited aerosol spread are most important in health care settings after aerosol-generating procedures, such as open suctioning of airways and endotracheal intubation or extubation.

Contact investigations for SARS-CoV-2 have confirmed community transmission rates that are consistent with droplet and contact spread (household attack rates of 10%, health care and community attack rates of <1%, and R_O [the effective reproduction number, or average number of new infections caused by an infected individual during their infection] of 2-3),[5] and much different than for airborne viral pathogens, such as varicella zoster virus or measles (household attack rates of 85%-90% and R_O of 10-18).

This implies that simple and easy-to-use barriers to respiratory droplets, along with hand hygiene and avoidance of touching the face, could help prevent community transmission when physical distancing and stay-at-home measures are relaxed or no longer possible. The 2 major options for such barriers are face masks and face shields.

Face Masks and Face Shields

The supply chain for medical masks is concentrated in China and the origin of the outbreak there resulted in factory closures and critical shortages. To preserve medical masks for health care facilities, the Centers for Disease Control and Prevention has recommended that

Corresponding Author: Eli N. Perencevich, MD, MS, Iowa City VA Health Care System, 601 Hwy 6 W, Iowa City, IA 52246 (eli-perencevich@uiowa.edu).

all persons wear a cloth mask in public for source control. Cloth masks have been shown to be less effective than medical masks for prevention of communicable respiratory illnesses,[8] although in vitro testing suggests that cloth masks provide some filtration of virus-sized aerosol particles.[9] Face shields may provide a better option.

Face shields come in various forms, but all provide a clear plastic barrier that covers the face. For optimal protection, the shield should extend below the chin anteriorly, to the ears laterally, and there should be no exposed gap between the forehead and the shield's headpiece. Face shields require no special materials for fabrication and production lines can be repurposed fairly rapidly. Numerous companies, including Apple, Nike, GM, and John Deere, have all started producing face shields. These shields can be made from materials found in craft or office supply stores. Thus, availability of face shields is currently greater than that of medical masks.

Face shields offer a number of advantages. While medical masks have limited durability and little potential for reprocessing, face shields can be reused indefinitely and are easily cleaned with soap and water, or common household disinfectants. They are comfortable to wear, protect the portals of viral entry, and reduce the potential for autoinoculation by preventing the wearer from touching their face. People wearing medical masks often have to remove them to communicate with others around them; this is not necessary with face shields. The use of a face shield is also a reminder to maintain social distancing, but allows visibility of facial expressions and lip movements for speech perception.

Most important, face shields appear to significantly reduce the amount of inhalation exposure to influenza virus, another droplet-spread respiratory virus. In a simulation study, face shields were shown to reduce immediate viral exposure by 96% when worn by a simulated health care worker within 18 inches of a cough.[10] Even after 30 minutes, the protective effect exceeded 80% and face shields blocked 68% of small particle aerosols,[10] which are not thought to be a dominant mode of transmission of SARS-CoV-2. When the study was repeated at the currently recommended physical distancing distance of 6 feet, face shields reduced inhaled virus by 92%,[10] similar to distancing alone, which reinforces the importance of physical distancing in preventing viral respiratory infections. Of note, no studies have evaluated the effects or potential benefits of face shields on source control, ie, containing a sneeze or cough, when worn by asymptomatic or symptomatic infected persons. However, with efficacy ranges of 68% to 96% for a single face shield, it is likely that adding source control would only improve efficacy, and studies should be completed quickly to evaluate this.

Major policy recommendations should be evaluated using clinical studies. However, it is unlikely that a randomized trial of face shields could be completed in time to verify efficacy. No clinical trial has been conducted to assess the efficacy of widespread testing and contact tracing, but that approach is based on years of experience. Taken as a bundle, the effectiveness of adding face shields as a community intervention to the currently proposed containment strategies should be evaluated using existing mathematical models. The implicit goal of face shields alone or in combination with other interventions should be to interrupt transmission by reducing the R_0 to less than 1. Notably, effective control of even the most infectious pathogens, such as measles, does not require a vaccine with 100% efficacy. No burden of 100% efficacy should be placed on face shields or any containment policy because this level of control is both impossible to achieve and unnecessary to drive SARS-CoV-2 infection levels into a manageable range.

Conclusions

The COVID-19 pandemic arrived swiftly and found many countries unprepared. Even highly prepared countries are now facing second-wave outbreaks that have forced implementation of extreme social distancing measures. To minimize the medical and economic consequences, it is important to rapidly assess and adopt a containment intervention bundle that drives transmissibility to manageable levels. Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting. Now is the time for adoption of this practical intervention.

ARTICLE INFORMATION

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REFERENCES

1. Wong JEL, Leo YS, Tan CC. COVID-19 in Singapore—current experience: critical global issues that require attention and action. *JAMA*. 2020;323 (13):1243-1244. doi:10.1001/jama.2020.2467

2. Park S, Choi GJ, Ko H. Information technology–based tracing strategy in response to COVID-19 in South Korea—privacy controversies. *JAMA*. Published online April 23, 2020. doi:10.1001/jama.2020.6602

3. Gottlieb S, McClellan M, Silvis L, Rivers C, Watson C. National coronavirus response: a road map to reopening. American Enterprise Institute. Published March 29, 2020. Accessed April 19, 2020. https://www.aei.org/research-products/report/national-coronavirus-response-a-road-map-to-reopening/

4. Infectious Diseases Society of America. Policy and public health recommendations for easing COVID-19 distancing restrictions. Published April 16, 2020. Accessed April 19, 2020. https://www.idsociety.org/contentassets/9ba35522e0964d51a47ae3b22e59fb47/idsa-recommendations-for-reducing-covid-19-distancing_16apr2020_final-.pdf

5. Burke RM, Midgley CM, Dratch A, et al. Active monitoring of persons exposed to patients with confirmed COVID-19—United States, January–February 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(9):245-246. doi:10.15585/mmwr.mm6909e1

6. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report–66. March 26, 2020. Accessed April 19, 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200326-sitrep-66-covid-19.pdf

7. Bourouiba L. Turbulent gas clouds and respiratory pathogen emissions: potential implications for reducing transmission of COVID-19. *JAMA*. Published online March 26, 2020. doi:10.1001/jama.2020.4756

8. MacIntyre CR, Seale H, Dung TC, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open*. 2015;5(4):e006577. doi:10.1136/bmjopen-2014-006577

9. Rengasamy S, Eimer B, Shaffer RE. Simple respiratory protection: evaluation of the filtration performance of cloth masks and common fabric materials against 20-1000 nm size particles. *Ann Occup Hyg*. 2010;54(7):789-798. doi:10.1093/annhyg/meq044

10. Lindsley WG, Noti JD, Blachere FM, Szalajda JV, Beezhold DH. Efficacy of face shields against cough aerosol droplets from a cough simulator. *J Occup Environ Hyg*. 2014;11(8):509-518.

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Commentary

Universal masking in hospitals in the COVID-19 era: Is it time to consider shielding?

Sonali D. Advani MBBS, MPH[1,2], Becky A. Smith MD[1,2], Sarah S. Lewis MD, MPH[1,2], Deverick J. Anderson MD, MPH[1,2] and Daniel J. Sexton MD[1,2]

[1]Division of Infectious Diseases, Department of Medicine, Duke University School of Medicine, Durham, North Carolina and [2]Duke Center for Antimicrobial Stewardship and Infection Prevention, Durham, North Carolina

Abstract

With concerns for presymptomatic transmission of COVID-19 and increasing burden of contact tracing and employee furloughs, several hospitals have supplemented pre-existing infection prevention measures with universal masking of all personnel in hospitals. Other hospitals are currently faced with the dilemma of whether or not to proceed with universal masking in a time of critical mask shortages. We summarize the rationale behind a universal masking policy in healthcare settings, important considerations before implementing such a policy and the challenges with universal masking. We also discusses proposed solutions such as universal face shields.

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As the novel coronavirus (SARS-CoV-2) public health crisis escalates, several hospitals have supplemented pre-existing infection prevention measures, such as visitor restrictions and employee screening, with universal masking of all healthcare professionals (HCPs). A universal masking policy usually requires that all HCPs (clinical and nonclinical) wear some sort of face mask while on hospital premises. These new policies also continue pre-existing policies requiring the use of N95 respirators (when available) when performing aerosol-generating procedures on patients with known or suspected SARS-CoV-2. In a nutshell, the rationale of implementing a universal masking policy in hospitals is to limit the transmission of SARS-CoV-2 from patients to HCP and from HCP to patients and/or to other HCPs. In the following sections, we summarize the rationale for universal masking in hospitals, important considerations before implementing this policy, and the challenges with universal masking, and we discuss proposed solutions such as universal face shields.

Rationale for universal masking

Atypical presentations and presymptomatic transmission of SARS-CoV-2 have now been shown to cause clusters of COVID-19 in community settings, nursing homes, cruise ships, and returning travelers.[1–3] For example, approximately half of the residents in a skilled nursing facility in Washington who tested positive as a result of an exposure investigation were not symptomatic on the day of testing.[1] Of the 114 persons in a cohort of returning travelers who tested positive for SARS-CoV-2, 2 (1.8%) were asymptomatic on screening.[2] Similarly, almost half of the 712 persons with a positive test result on the Diamond Princess cruise ship were asymptomatic at the time of testing.[3] Most recently, an investigation of 7 clusters in Singapore provided further evidence that viral shedding can occur before symptom onset.[4] This may result in transmission from presymptomatic HCPs to patients and other HCPs, although frequency of transmission from such individuals is an unresolved question. However, these exposure investigations usually occur after symptom onset, which increases the burden of contact tracing and the number of exposed HCPs placed on furlough. A surgical mask also provides a physical barrier between hands and mucus membranes of mouth and nose. An average person touches their face spontaneously ~23–26 times per hour. A mask serves as a constant reminder to reduce hand-to-face contact.

Important considerations when implementing universal masking

An adequate supply of masks is an obvious prerequisite for implementing a universal masking policy. Hospitals without an adequate supply of masks should continue to focus on measures such as extended use, reuse, and reprocessing of their existing supply of masks and respirators. A universal masking policy should always be considered an adjunct to concurrent policies such as visitor restrictions and employee screening for fever and other symptoms of a respiratory illness at their point of entry into the hospital. Similar screening of visitors who are given special exemptions to visit pediatric, obstetric, or hospice patients should also occur daily as they enter the hospital. HCP and exempted visitors who "pass" their daily symptom and signs screen are usually given 1 mask to wear during their entire shift or visit. HCPs are instructed to handle masks only after performing hand hygiene. Masking policies differ slightly across institutions, with some facilities promoting the use of cloth masks versus surgical masks, but the basic premise is the same.

Author for correspondence: Sonali D. Advani, E-mail: sonali.advani@duke.edu

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Challenges with universal masking

There are some theoretical drawbacks to a universal masking policy, the most important of which is the increased cost and depletion of supply of masks in health systems that are already dealing with shortages. Specifically, serious unanticipated supply-chain issues could lead to shortages of masks at a time when the risk of both community and healthcare-associated spread of COVID-19 has increased. Also, logistical issues such as storage of masks during meals or breaks may lead to unanticipated problems such as contamination or loss of masks. Inadvertent self-contamination of masks during a long work shift could theoretically and paradoxically increase the risk of acquisition of SARS-CoV-2. A false sense of security by staff could lead to unintended consequences such as poor hand hygiene or poor adherence to other measures such as social distancing. Compliance with universal masking policies is an additional concern and may in turn lead to time and resource utilization toward compliance monitoring programs or audits.

Published data on the efficacy of universal masking policies to prevent healthcare-associated transmission of respiratory viruses are limited, and the generalizability of these results to the ongoing SARS-CoV-2 pandemic is uncertain. One prospective single-center study that implemented a universal masking policy for all individuals in direct contact with stem cell transplant patients showed a significant reduction in all respiratory viral illnesses on the units where this policy was implemented.[5] Similar masking policies have been utilized for HCPs who opted out of mandatory influenza vaccination across British Columbia, Canada.[6] No prospective studies comparing the effectiveness of masking policies during the SARS-CoV-2 pandemic have been undertaken to our knowledge.

Universal face shields as an alternative

Face shields are face coverings made of clear material attached to a headpiece to cover the eyes, nose, and mouth. This design is intended to protect the facial area and associated mucous membranes from infectious droplets and spatter of body fluids. Face shields have the potential to overcome some of the major drawbacks of face masks. Face shields provide better coverage of the face, compared with masks, thus reducing the risk of self-contamination. Additionally, face shields are durable, and they can be cleaned and reused. Given their simpler design, durability, and reuse potential, face shields are less likely to be in short supply, like face masks. Additionally, face shields do not impede facial nonverbal communication; they can be worn concurrently with other face and eye protective equipment, and they do not impact vocalization. However, lack of a good seal around the face shield may lead to aerosol penetration and may be subject to fogging or glare.[7] Although additional studies are needed to assess universal face shielding, it offers a promising solution in a time of critical mask shortages.

In conclusion, universal masking when implemented together with strict visitor restrictions and employee screening may incrementally reduce healthcare-associated transmission of SARS-CoV-2. Additionally, such a policy will reduce the burden of contact tracing and subsequent furloughs of HCPs in a time of acute HCP shortages. It also provides reassurance to HCPs as they care for patients with known or suspected COVID-19 infection.

A universal masking policy may not be appropriate for all hospitals because successful implementation of this policy requires an adequate supply of face masks. Furthermore, whether such a policy can indeed prevent transmission of SARS-CoV-2 is uncertain, nor is it known whether the benefits of such a policy outweigh the disadvantages discussed above. Masks are not a substitute for other public health interventions; they must always be used in combination with social distancing and hand hygiene. Future studies are needed to examine the frequency of viral contamination of masks worn for long hours or multiple shifts, as are studies needed to compare rates of healthcare-associated SARS-CoV-2 in hospitals and long-term care facilities that do and do not utilize universal masking policies. Finally, exploring other approaches such as universal use of face shields or more durable face masks could provide much-needed scientific evidence related to the efficacy of universal masking polices or the use of other barrier methods.

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References

1. Kimball AHK, Arons M, *et al.* Asymptomatic and presymptomatic SARS-CoV-2 infections in residents of a long-term care skilled nursing facility—King County, Washington. *Morb Mortal Wkly Rep* 2020;69: 377–381.
2. Hoehl S, Rabenau H, Berger A, *et al.* Evidence of SARS-CoV-2 infection in returning travelers from Wuhan, China. *N Engl J Med* 2020;382: 1278–1280.
3. Moriarty LF PM, Marston BJ, *et al.* Public health responses to COVID-19 outbreaks on cruise ships—worldwide. *Morb Mortal Wkly Rep* 2020;69: 347–352.
4. Wei WE LZ, Chiew CJ, Yong SE, Toh MP, Lee VJ. Presymptomatic transmission of SARS-CoV-2—Singapore, January 23–March 16, 2020. *Morb Mortal Wkly Rep* 2020;69:411–415.
5. Sung AD, Sung JAM, Thomas S, *et al.* Universal mask usage for reduction of respiratory viral infections after stem cell transplant: a prospective trial. *Clin Infect Dis* 2016;63:999–1006.
6. Ksienski DS. Mandatory seasonal influenza vaccination or masking of British Columbia healthcare workers: year 1. *Can J Public Health* 2014;105: e312–e316.
7. Roberge RJ. Face shields for infection control: a review. *J Occup Environ Hyg* 2016;13:235–242.

WebMD

Face shields a more effective deterrent to COVID?

By E.J. Mundell
HealthDay Reporter
THURSDAY, April 30, 2020 (HealthDay News) -- Hundreds of millions of Americans heeded recent government advice and rushed to wear cloth face masks, hoping they might prevent transmission of the new coronavirus.

But there's another option: The clear plastic face shield, already in use by many health care personnel.

Now, a team of experts say face shields might replace masks as a more comfortable and more effective deterrent to COVID-19.

"Face shields, which can be quickly and affordably produced and distributed, should be included as part of strategies to safely and significantly reduce transmission in the community setting," said a trio of physicians from the University of Iowa.

Reporting in the April 29 *Journal of the American Medical Association*, experts led by Dr. Eli Perencevich, of the university's department of internal medicine, and the Iowa City VA Health Care System, said the face shield's moment may have come.

While the U.S. Centers for Disease Control and Prevention began advocating the use of cloth masks to help stop COVID-19 transmission in April, laboratory testing "suggests that cloth masks provide [only] some filtration of virus-sized aerosol particles."

According to Perencevich's group, "face shields may provide a better option."

To be most effective in stopping viral spread, a face shield should extend to below the chin. It should also cover the ears and "there should be no exposed gap between the forehead and the shield's headpiece," the Iowa team members said.

Shields have a number of advantages over masks, they added. First of all, they are endlessly reusable, simply requiring cleaning with soap and water or common disinfectants. Shields are usually more comfortable to wear than masks, and they form a barrier that keeps people from easily touching their own faces.

When speaking, people sometimes pull down a mask to make things easier -- but that isn't necessary with a face shield. And "the use of a face shield is also a reminder to maintain social distancing, but allows visibility of facial expressions and lip movements for speech perception," the authors pointed out.

And what about the ability of a face shield to prevent coronavirus transmission?

According to the Iowa team, large-scale studies haven't yet been conducted. But "in a simulation study, face shields were shown to reduce immediate viral exposure by 96% when worn by a simulated health care worker within 18 inches of a cough."

"When the study was repeated at the currently recommended physical distancing distance of 6 feet, face shields reduced inhaled virus by 92%," the authors said.

No studies have yet been conducted to see how well face shields help keep exhaled or coughed virus from spreading outwards from an infected wearer, Perencevich and his colleagues said, and they hope that studies on that issue will be conducted.

And they stressed that face shields should only be one part of any infection control effort, along with social distancing and hand-washing.

There will never be any intervention -- even a vaccine -- that can guarantee 100% effectiveness against the coronavirus, the authors said, so face shields shouldn't be held to that standard.

Dr. Robert Glatter is on the front lines of the COVID-19 pandemic in his role as emergency physician at Lenox Hill Hospital in New York City. Reading over the new report, he agreed that "common sense" measures are crucial in curbing infections.

"One approach that makes the most sense, especially in light of the limitations of face masks and face coverings, is the use of face shields," Glatter said.

"While we don't have hard trials or data on the efficacy of face shields at this time, early data from their use in patients with influenza [which is droplet-spread] is promising," he noted. "What's clear is that their success in hospital settings provides the basis for their utility in the community setting as we relax physical distancing going forward."

WebMD News from HealthDay

Sources

SOURCES: Robert Glatter, M.D., emergency physician, Lenox Hill Hospital, New York City; *Journal of the American Medical Association*, April 29, 2020, online

HealthDay

Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis

*Derek K Chu, Elie A Akl, Stephanie Duda, Karla Solo, Sally Yaacoub, Holger J Schünemann, on behalf of the COVID-19 Systematic Urgent Review Group Effort (SURGE) study authors**

Summary

Background Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causes COVID-19 and is spread person-to-person through close contact. We aimed to investigate the effects of physical distance, face masks, and eye protection on virus transmission in health-care and non-health-care (eg, community) settings.

Methods We did a systematic review and meta-analysis to investigate the optimum distance for avoiding person-to-person virus transmission and to assess the use of face masks and eye protection to prevent transmission of viruses. We obtained data for SARS-CoV-2 and the betacoronaviruses that cause severe acute respiratory syndrome, and Middle East respiratory syndrome from 21 standard WHO-specific and COVID-19-specific sources. We searched these data sources from database inception to May 3, 2020, with no restriction by language, for comparative studies and for contextual factors of acceptability, feasibility, resource use, and equity. We screened records, extracted data, and assessed risk of bias in duplicate. We did frequentist and Bayesian meta-analyses and random-effects meta-regressions. We rated the certainty of evidence according to Cochrane methods and the GRADE approach. This study is registered with PROSPERO, CRD42020177047.

Findings Our search identified 172 observational studies across 16 countries and six continents, with no randomised controlled trials and 44 relevant comparative studies in health-care and non-health-care settings (n=25 697 patients). Transmission of viruses was lower with physical distancing of 1 m or more, compared with a distance of less than 1 m (n=10 736, pooled adjusted odds ratio [aOR] 0·18, 95% CI 0·09 to 0·38; risk difference [RD] –10·2%, 95% CI –11·5 to –7·5; moderate certainty); protection was increased as distance was lengthened (change in relative risk [RR] 2·02 per m; $p_{interaction}$=0·041; moderate certainty). Face mask use could result in a large reduction in risk of infection (n=2647; aOR 0·15, 95% CI 0·07 to 0·34, RD –14·3%, –15·9 to –10·7; low certainty), with stronger associations with N95 or similar respirators compared with disposable surgical masks or similar (eg, reusable 12–16-layer cotton masks; $p_{interaction}$=0·090; posterior probability >95%, low certainty). Eye protection also was associated with less infection (n=3713; aOR 0·22, 95% CI 0·12 to 0·39, RD –10·6%, 95% CI –12·5 to –7·7; low certainty). Unadjusted studies and subgroup and sensitivity analyses showed similar findings.

Interpretation The findings of this systematic review and meta-analysis support physical distancing of 1 m or more and provide quantitative estimates for models and contact tracing to inform policy. Optimum use of face masks, respirators, and eye protection in public and health-care settings should be informed by these findings and contextual factors. Robust randomised trials are needed to better inform the evidence for these interventions, but this systematic appraisal of currently best available evidence might inform interim guidance.

Funding World Health Organization.

Introduction

As of May 28, 2020, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected more than 5·85 million individuals worldwide and caused more than 359 000 deaths.[1] Emergency lockdowns have been initiated in countries across the globe, and the effect on health, wellbeing, business, and other aspects of daily life are felt throughout societies and by individuals. With no effective pharmacological interventions or vaccine available in the imminent future, reducing the rate of infection (ie, flattening the curve) is a priority, and prevention of infection is the best approach to achieve this aim.

SARS-CoV-2 spreads person-to-person through close contact and causes COVID-19. It has not been solved if

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*Study authors are listed in the appendix and at the end of the Article

Department of Health Research Methods, Evidence and Impact (D K Chu MD, S Duda MSc, K Solo MSc, Prof E A Akl MD, Prof H J Schünemann MD), **and Department of Medicine** (D K Chu, Prof H J Schünemann), **McMaster University, Hamilton, ON, Canada; The Research Institute of St Joe's Hamilton, Hamilton, ON, Canada** (D K Chu); **Department of Internal Medicine** (Prof E A Akl), **and Clinical Research Institute** (Prof E A Akl, S Yaacoub MPH), **American University of Beirut, Beirut, Lebanon; and Michael G DeGroote Cochrane Canada and GRADE Centres, Hamilton, ON, Canada** (Prof H J Schünemann)

Correspondence to: Prof Holger J Schünemann, Michael G DeGroote Cochrane Canada and McMaster GRADE Centres, McMaster University, Hamilton, ON L8N 3Z5, Canada **schuneh@mcmaster.ca**

See Online for appendix

Research in context

Evidence before this study

We searched 21 databases and resources from inception to May 3, 2020, with no restriction by language, for studies of any design evaluating physical distancing, face masks, and eye protection to prevent transmission of the viruses that cause COVID-19 and related diseases (eg, severe acute respiratory syndrome [SARS] and Middle East respiratory syndrome [MERS]) between infected individuals and people close to them (eg, household members, caregivers, and health-care workers). Previous related meta-analyses have focused on randomised trials and reported imprecise data for common respiratory viruses such as seasonal influenza, rather than the pandemic and epidemic betacoronaviruses causative of COVID-19 (severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]), SARS (SARS-CoV), or MERS (MERS-CoV). Other meta-analyses have focused on interventions in the health-care setting and have not included non-health-care (eg, community) settings. Our search did not retrieve any systematic review of information on physical distancing, face masks, or eye protection to prevent transmission of SARS-CoV-2, SARS-CoV, and MERS-CoV.

Added value of this study

We did a systematic review of 172 observational studies in health-care and non-health-care settings across 16 countries and six continents; 44 comparative studies were included in a meta-analysis, including 25 697 patients with COVID-19, SARS, or MERS. Our findings are, to the best of our knowledge, the first to rapidly synthesise all direct information on COVID-19 and, therefore, provide the best available evidence to inform optimum use of three common and simple interventions to help reduce the rate of infection and inform non-pharmaceutical interventions, including pandemic mitigation in non-health-care settings. Physical distancing of 1 m or more was associated with a much lower risk of infection, as was use of face masks (including N95 respirators or similar and surgical or similar masks [eg, 12–16-layer cotton or gauze masks]) and eye protection (eg, goggles or face shields). Added benefits are likely with even larger physical distances (eg, 2 m or more based on modelling) and might be present with N95 or similar respirators versus medical masks or similar. Across 24 studies in health-care and non-health-care settings of contextual factors to consider when formulating recommendations, most stakeholders found these personal protection strategies acceptable, feasible, and reassuring but noted harms and contextual challenges, including frequent discomfort and facial skin breakdown, high resource use linked with the potential to decrease equity, increased difficulty communicating clearly, and perceived reduced empathy of care providers by those they were caring for.

Implications of all the available evidence

In view of inconsistent guidelines by various organisations based on limited information, our findings provide some clarification and have implications for multiple stakeholders. The risk for infection is highly dependent on distance to the individual infected and the type of face mask and eye protection worn. From a policy and public health perspective, current policies of at least 1 m physical distancing seem to be strongly associated with a large protective effect, and distances of 2 m could be more effective. These data could also facilitate harmonisation of the definition of exposed (eg, within 2 m), which has implications for contact tracing. The quantitative estimates provided here should inform disease-modelling studies, which are important for planning pandemic response efforts. Policy makers around the world should strive to promptly and adequately address equity implications for groups with currently limited access to face masks and eye protection. For health-care workers and administrators, our findings suggest that N95 respirators might be more strongly associated with protection from viral transmission than surgical masks. Both N95 and surgical masks have a stronger association with protection compared with single-layer masks. Eye protection might also add substantial protection. For the general public, evidence shows that physical distancing of more than 1 m is highly effective and that face masks are associated with protection, even in non-health-care settings, with either disposable surgical masks or reusable 12–16-layer cotton ones, although much of this evidence was on mask use within households and among contacts of cases. Eye protection is typically underconsidered and can be effective in community settings. However, no intervention, even when properly used, was associated with complete protection from infection. Other basic measures (eg, hand hygiene) are still needed in addition to physical distancing and use of face masks and eye protection.

SARS-CoV-2 might spread through aerosols from respiratory droplets; so far, air sampling has found virus RNA in some studies[2–4] but not in others.[5–8] However, finding RNA virus is not necessarily indicative of replication-competent and infection-competent (viable) virus that could be transmissible. The distance from a patient that the virus is infective, and the optimum person-to-person physical distance, is uncertain. For the currently foreseeable future (ie, until a safe and effective vaccine or treatment becomes available), COVID-19 prevention will continue to rely on non-pharmaceutical interventions, including pandemic mitigation in community settings.[9] Thus, quantitative assessment of physical distancing is relevant to inform safe interaction and care of patients with SARS-CoV-2 in both health-care and non-health-care settings. The definition of close contact or potentially exposed helps to risk stratify, contact trace, and develop guidance documents, but these definitions differ around the globe.

To contain widespread infection and to reduce morbidity and mortality among health-care workers and others in contact with potentially infected people, jurisdictions have issued conflicting advice about physical or social distancing. Use of face masks with or

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without eye protection to achieve additional protection is debated in the mainstream media and by public health authorities, in particular the use of face masks for the general population;[10] moreover, optimum use of face masks in health-care settings, which have been used for decades for infection prevention, is facing challenges amid personal protective equipment (PPE) shortages.[11]

Any recommendations about social or physical distancing, and the use of face masks, should be based on the best available evidence. Evidence has been reviewed for other respiratory viral infections, mainly seasonal influenza,[12,13] but no comprehensive review is available of information on SARS-CoV-2 or related betacoronaviruses that have caused epidemics, such as severe acute respiratory syndrome (SARS) or Middle East respiratory syndrome (MERS). We, therefore, systematically reviewed the effect of physical distance, face masks, and eye protection on transmission of SARS-CoV-2, SARS-CoV, and MERS-CoV.

Methods

Search strategy and selection criteria

To inform WHO guidance documents, on March 25, 2020, we did a rapid systematic review.[14] We created a large international collaborative and we used Cochrane methods[15] and the GRADE approach.[16] We prospectively submitted the systematic review protocol for registration on PROSPERO (CRD42020177047; appendix pp 23–29). We have followed PRISMA[17] and MOOSE[18] reporting guidelines (appendix pp 30–33).

From database inception to May 3, 2020, we searched for studies of any design and in any setting that included patients with WHO-defined confirmed or probable COVID-19, SARS, or MERS, and people in close contact with them, comparing distances between people and COVID-19 infected patients of 1 m or larger with smaller distances, with or without a face mask on the patient, or with or without a face mask, eye protection, or both on the exposed individual. The aim of our systematic review was for quantitative assessment to ascertain the physical distance associated with reduced risk of acquiring infection when caring for an individual infected with SARS-CoV-2, SARS-CoV, or MERS-CoV. Our definition of face masks included surgical masks and N95 respirators, among others; eye protection included visors, faceshields, and goggles, among others.

We searched (up to March 26, 2020) MEDLINE (using the Ovid platform), PubMed, Embase, CINAHL (using the Ovid platform), the Cochrane Library, COVID-19 Open Research Dataset Challenge, COVID-19 Research Database (WHO), Epistemonikos (for relevant systematic reviews addressing MERS and SARS, and its COVID-19 Living Overview of the Evidence platform), EPPI Centre living systematic map of the evidence, ClinicalTrials.gov, WHO International Clinical Trials Registry Platform, relevant documents on the websites of governmental and other relevant organisations, reference lists of included papers, and relevant systematic reviews.[19,20] We hand-searched (up to May 3, 2020) preprint servers (bioRxiv, medRxiv, and Social Science Research Network First Look) and coronavirus resource centres of *The Lancet*, *JAMA*, and *N Engl J Med* (appendix pp 3–5). We did not limit our search by language. We initially could not obtain three full texts for evaluation, but we obtained them through interlibrary loan or contacting a study author. We did not restrict our search to any quantitative cutoff for distance.

Data collection

We screened titles and abstracts, reviewed full texts, extracted data, and assessed risk of bias by two authors and independently, using standardised prepiloted forms (Covidence; Veritas Health Innovation, Melbourne, VIC, Australia), and we cross-checked screening results using artificial intelligence (Evidence Prime, Hamilton, ON, Canada). We resolved disagreements by consensus. We extracted data for study identifier, study design, setting, population characteristics, intervention and comparator characteristics, quantitative outcomes, source of funding

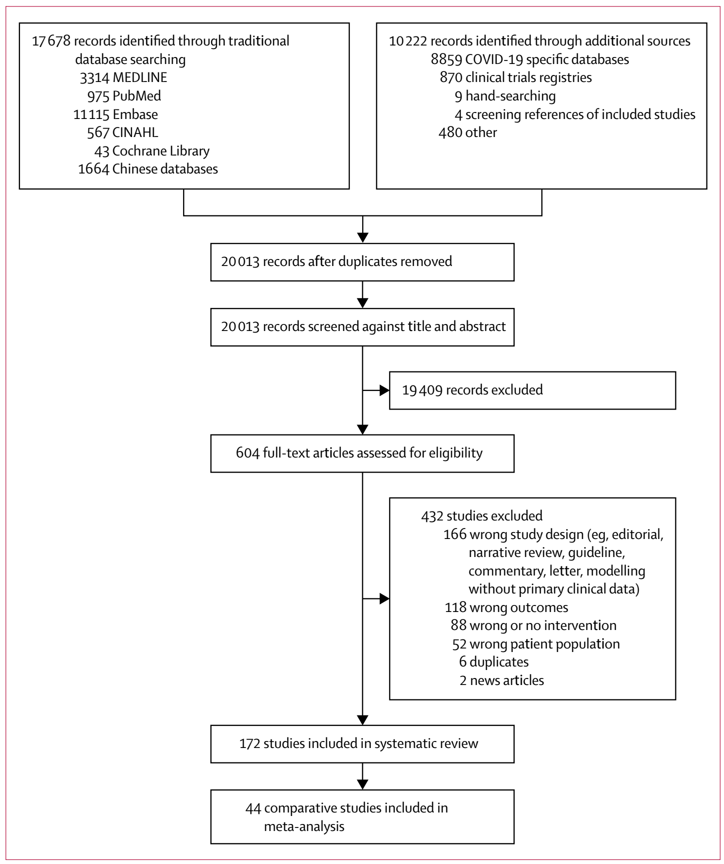

Figure 1: **Study selection**

	Population size (n)	Country	Setting	Disease caused by virus	Case definition (WHO)	Adjusted estimates	Risk of bias*
Alraddadi et al (2016)[34]	283	Saudi Arabia	Health care	MERS	Confirmed	Yes	********
Arwady et al (2016)[35]	79	Saudi Arabia	Non-health care (household and family contacts)	MERS	Confirmed	No	******
Bai et al (2020)[36]	118	China	Health care	COVID-19	Confirmed	No	*****
Burke et al (2020)[37]	338	USA	Health care and non-health care (including household and community)	COVID-19	Confirmed	No	****
Caputo et al (2006)[38]	33	Canada	Health care	SARS	Confirmed	No	*****
Chen et al (2009)[39]	758	China	Health care	SARS	Confirmed	Yes	*******
Cheng et al (2020)[40]	226	China	Non-health care (household and family contacts)	COVID-19	Confirmed	No	******
Ha et al (2004)[42]	117	Vietnam	Health care	SARS	Confirmed	No	**
Hall et al (2014)[43]	48	Saudi Arabia	Health care	MERS	Confirmed	No	***
Heinzerling et al (2020)[44]	37	USA	Health care	COVID-19	Confirmed	No	****
Ho et al (2004)[45]	372	Taiwan	Health care	SARS	Confirmed	No	********
Ki et al (2019)[47]	446	South Korea	Health care	MERS	Confirmed	No	******
Kim et al (2016)[48]	9	South Korea	Health care	MERS	Confirmed	No	*****
Kim et al (2016)[49]	1169	South Korea	Health care	MERS	Confirmed	No	******
Lau et al (2004)[50]	2270	China	Non-health care (households)	SARS	Probable	Yes	******
Liu et al (2009)[51]	477	China	Health care	SARS	Confirmed	Yes	*****
Liu et al (2020)[52]	20	China	Non-health care (close contacts)	COVID-19	Confirmed	No	*******
Loeb et al (2004)[53]	43	Canada	Health care	SARS	Confirmed	No	**
Ma et al (2004)[54]	426	China	Health care	SARS	Confirmed	Yes	*********
Nishiura et al (2005)[55]	115	Vietnam	Health care	SARS	Confirmed	Yes	********
Nishiyama et al (2008)[56]	146	Vietnam	Health care	SARS	Confirmed	Yes	******
Olsen et al (2003)[57]	304	China	Non-health care (airplane)	SARS	Confirmed	No	******
Park et al (2004)[58]	110	USA	Health care	SARS	Confirmed	No	**********
Park et al (2016)[59]	80	South Korea	Health care	MERS	Confirmed and probable	No	***
Peck et al (2004)[60]	26	USA	Health care	SARS	Confirmed	No	*********
Pei et al (2006)[61]	443	China	Health care	SARS	Confirmed	No	********
Rea et al (2007)[62]	8662	Canada	Non-health care (community contacts)	SARS	Probable	No	****
Reuss et al (2014)[63]	81	Germany	Health care	MERS	Confirmed	No	*****
Reynolds et al (2006)[64]	153	Vietnam	Health care	SARS	Confirmed	No	***
Ryu et al (2019)[65]	34	South Korea	Health care	MERS	Confirmed	No	******
Scales et al (2003)[66]	69	Canada	Health care	SARS	Probable	No	**
Seto et al (2003)[67]	254	China	Health care	SARS	Confirmed	Yes	********
Teleman et al (2004)[68]	86	Singapore	Health care	SARS	Confirmed	Yes	********
Tuan et al (2007)[69]	212	Vietnam	Non-health care (household and community contacts)	SARS	Confirmed	Yes	******
Van Kerkhove et al (2019)[46]	828	Saudi Arabia	Non-health care (dormitory)	MERS	Confirmed	Yes	********
Wang et al (2020)[41]	493	China	Health care	COVID-19	Confirmed	Yes	****

(Table 1 continues on next page)

	n	Country	Setting	Disease caused by virus	Case definition (WHO)	Adjusted estimates	Risk of bias*
(Continued from previous page)							
Wang et al (2020)[70]	5442	China	Health care	COVID-19	Confirmed	No	*****
Wiboonchutikul et al (2016)[71]	38	Thailand	Health care	MERS	Confirmed	No	*****
Wilder-Smith et al (2005)[72]	80	Singapore	Health care	SARS	Confirmed	No	********
Wong et al (2004)[73]	66	China	Health care	SARS	Confirmed	No	*****
Wu et al (2004)[74]	375	China	Non-health care (community)	SARS	Confirmed	Yes	********
Yin et al (2004)[75]	257	China	Health care	SARS	Confirmed	Yes	******
Yu et al (2005)[76]	74	China	Health care	SARS	Confirmed	No	*******
Yu et al (2007)[77]	124 wards	China	Health care	SARS	Confirmed	Yes	*******

Across studies, mean age was 30–60 years. SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. *The Newcastle-Ottawa Scale was used for the risk of bias assessment, with more stars equalling lower risk.

Table 1: **Characteristics of included comparative studies**

and reported conflicts of interests, ethics approval, study limitations, and other important comments.

Outcomes

Outcomes of interest were risk of transmission (ie, WHO-defined confirmed or probable COVID-19, SARS, or MERS) to people in health-care or non-health-care settings by those infected; hospitalisation; intensive care unit admission; death; time to recovery; adverse effects of interventions; and contextual factors such as acceptability, feasibility, effect on equity, and resource considerations related to the interventions of interest. However, data were only available to analyse intervention effects for transmission and contextual factors. Consistent with WHO, studies generally defined confirmed cases with laboratory confirmation (with or without symptoms) and probable cases with clinical evidence of the respective infection (ie, suspected to be infected) but for whom confirmatory testing either had not yet been done for any reason or was inconclusive.

Data analysis

Our search did not identify any randomised trials of COVID-19, SARS, or MERS. We did a meta-analysis of associations by pooling risk ratios (RRs) or adjusted odds ratios (aORs) depending on availability of these data from observational studies, using DerSimonian and Laird random-effects models. We adjusted for variables including age, sex, and severity of source case; these variables were not the same across studies. Because between-study heterogeneity can be misleadingly large when quantified by I^2 during meta-analysis of observational studies,[21,22] we used GRADE guidance to assess between-study heterogeneity.[21] Throughout, we present RRs as unadjusted estimates and aORs as adjusted estimates.

We used the Newcastle-Ottawa scale to rate risk of bias for comparative non-randomised studies corresponding to every study's design (cohort or case-control).[23,24] We planned to use the Cochrane Risk of Bias tool 2.0 for randomised trials,[25] but our search did not identify any eligible randomised trials. We synthesised data in both narrative and tabular formats. We graded the certainty of evidence using the GRADE approach. We used the GRADEpro app to rate evidence and present it in GRADE evidence profiles and summary of findings tables[26,27] using standardised terms.[28,29]

For more on the **GRADEpro app** see https://www.gradepro.org

We analysed data for subgroup effects by virus type, intervention (different distances or face mask types), and setting (health care *vs* non-health care). Among the studies assessing physical distancing measures to prevent viral transmission, the intervention varied (eg, direct physical contact [0 m], 1 m, or 2 m). We, therefore, analysed the effect of distance on the size of the associations by random-effects univariate meta-regressions, using restricted maximum likelihood, and we present mean effects and 95% CIs. We calculated tests for interaction using a minimum of 10 000 Monte Carlo random permutations to avoid spurious findings.[30] We formally assessed the credibility of potential effect-modifiers using GRADE guidance.[21] We did two sensitivity analyses to test the robustness of our findings. First, we used Bayesian meta-analyses to reinterpret the included studies considering priors derived from the effect point estimate and variance from a meta-analysis of ten randomised trials evaluating face mask use versus no face mask use to prevent influenza-like illness in health-care workers.[31] Second, we used Bayesian meta-analyses to reinterpret the efficacy of N95 respirators versus medical masks on preventing influenza-like illness after seasonal viral (mostly influenza) infection.[13] For these sensitivity analyses, we used hybrid Metropolis-Hastings and Gibbs sampling, a 10 000 sample burn-in, 40 000 Markov chain Monte Carlo samples, and we tested non-informative and sceptical priors (eg, four time variance)[32,33] to inform

	Country	Respirator (0=no)	Distance (m)	Events, further distance (n/N)	Events, shorter distance (n/N)	RR (95% CI)	% weight (random)
MERS							
Van Kerkhove et al (2019)[46]	Saudi Arabia	0	0	8/774	11/54	0·05 (0·02–0·12)	5·5
Arwady et al (2016)[35]	Saudi Arabia	0	1	1/10	8/20	0·25 (0·04–1·73)	2·6
Ki et al (2019)[47]	South Korea	1	2	2/29	4/42	0·72 (0·14–3·70)	3·2
Park et al (2016)[59]	South Korea	0	2	0/3	5/25	0·59 (0·04–8·77)	1·6
Hall et al (2014)[43]	Saudi Arabia	1	1	0/5	0/43	(Not calculable)	0
Wiboonchutikul et al (2019)[71]	Thailand	1	1	0/16	0/22	(Not calculable)	0
Reuss et al (2014)[63]	Germany	1	2	0/12	0/69	(Not calculable)	0
Ryu et al (2019)[65]	South Korea	1	2	0/7	0/27	(Not calculable)	0
Random, subtotal (I^2=75%)				**11/856**	**28/302**	**0·23 (0·04–1·20)**	**12·9**
SARS							
Scales et al (2003)[66]	Canada	0	0	1/12	6/19	0·35 (0·05–2·57)	2·6
Ma et al (2004)[54]	China	1	0*	4/149	43/294	0·18 (0·07–0·50)	5·0
Nishiyama et al (2008)[56]	Vietnam	0	0	1/12	26/73	0·23 (0·03–1·57)	2·7
Tuan et al (2007)[69]	Vietnam	0	0	3/123	6/57	0·23 (0·06–0·89)	3·9
Rea et al (2007)[62]	Canada	0	1	18/3493	41/647	0·08 (0·05–0·14)	6·6
Chen et al (2009)[39]	China	0	1*	28/314	63/445	0·63 (0·41–0·96)	6·9
Lau et al (2004)[50]	China	0	1	39/965	136/1124	0·33 (0·24–0·47)	7·1
Liu et al (2009)[51]	China	0	0	14/133	39/341	0·92 (0·52–1·64)	6·5
Pei et al (2006)[61]	China	0	1	8/61	139/382	0·36 (0·19–0·70)	6·2
Wong et al (2004)[73]	China	0	1	0/4	3/3	0·11 (0·01–1·63)	1·7
Teleman et al (2004)[68]	Singapore	1	1	4/9	32/77	1·07 (0·49–2·33)	5·8
Reynolds et al (2006)[64]	Vietnam	0	1	5/38	17/29	0·22 (0·09–0·54)	5·5
Olsen et al (2003)[57]	China	0	1·5	9/84	11/35	0·34 (0·16–0·75)	5·8
Wong et al (2004)[73]	China	0	2	0/4	4/8	0·20 (0·01–3·00)	1·6
Loeb et al (2004)[53]	Canada	1	2*	0/11	8/40	0·20 (0·01–3·24)	1·6
Yu et al (2005)[76]	China	1	2	17/54	13/20	0·48 (0·29–0·81)	6·6
Peck et al (2004)[60]	USA	1	1	0/3	0/38	(Not calculable)	0
Random, subtotal (I^2=75%)				**151/5469**	**587/3632**	**0·35 (0·23–0·52)**	**76·1**
COVID-19							
Bai et al (2020)[36]	China	1	0	0/76	12/42	0·02 (0·001–0·37)	1·5
Burke et al (2020)[37]	USA	0	0	0/13	2/2	0·04 (0·003–0·68)	1·6
Liu et al (2020)[52]	China	0	1	0/17	2/3	0·04 (0·003–0·76)	1·5
Cheng et al (2020)[40]	Taiwan	0	1*	5/47	7/36	0·55 (0·19–1·58)	4·8
Heinzerling et al (2020)[44]	USA	0	1·8	0/4	3/33	0·97 (0·06–16·14)	1·5
Burke et al (2020)[37]	USA	1	0	0/50	0/76	(Not calculable)	0
Burke et al (2020)[37]	USA	0	2	0/41	0/37	(Not calculable)	0
Random, subtotal (I^2=59%)				**5/248**	**26/229**	**0·15 (0·03–0·73)**	**10·9**
Unadjusted estimates, overall (I^2=73%)				**167/6573**	**641/4163**	**0·30 (0·20–0·44)**	**100·0**
Adjusted estimates, overall (1 MERS, 8 SARS)						**aOR 0·18 (0·09–0·38)**	
						aRR 0·20 (0·10–0·41)	

Interaction by type of virus p=0·49

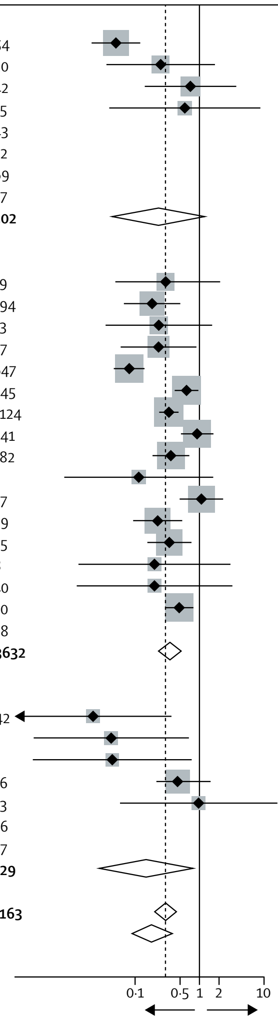

Figure 2: **Forest plot showing the association of COVID-19, SARS, or MERS exposure proximity with infection**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative risk. *Estimated values; sensitivity analyses excluding these values did not meaningfully alter findings.

mean estimates of effect, 95% credibility intervals (CrIs), and posterior distributions. We used non-informative hyperpriors to estimate statistical heterogeneity. Model convergence was confirmed in all cases with good mixing in visual inspection of trace plots, autocorrelation plots, histograms, and kernel density estimates in all scenarios. Parameters were blocked, leading to acceptance of approximately 50% and efficiency greater than 1% in all cases (typically about 40%). We did analyses using Stata version 14.3.

Role of the funding source

The funder contributed to defining the scope of the review but otherwise had no role in study design and data collection. Data were interpreted and the report drafted and submitted without funder input, but according to contractual agreement, the funder provided review at the time of final publication. The corresponding author had full access to all data in the study and had final responsibility for the decision to submit for publication.

	Studies and participants	Relative effect (95% CI)	Anticipated absolute effect (95% CI), eg, chance of viral infection or transmission		Difference (95% CI)	Certainty*	What happens (standardised GRADE terminology)[29]
			Comparison group	Intervention group			
Physical distance ≥1 m *vs* <1 m	Nine adjusted studies (n=7782); 29 unadjusted studies (n=10 736)	aOR 0·18 (0·09 to 0·38); unadjusted RR 0·30 (95% CI 0·20 to 0·44)	Shorter distance, 12·8%	Further distance, 2·6% (1·3 to 5·3)	–10·2% (–11·5 to –7·5)	Moderate†	A physical distance of more than 1 m probably results in a large reduction in virus infection; for every 1 m further away in distancing, the relative effect might increase 2·02 times
Face mask *vs* no face mask	Ten adjusted studies (n=2647); 29 unadjusted studies (n=10 170)	aOR 0·15 (0·07 to 0·34); unadjusted RR 0·34 (95% CI 0·26 to 0·45)	No face mask, 17·4%	Face mask, 3·1% (1·5 to 6·7)	–14·3% (–15·9 to –10·7)	Low‡	Medical or surgical face masks might result in a large reduction in virus infection; N95 respirators might be associated with a larger reduction in risk compared with surgical or similar masks§
Eye protection (faceshield, goggles) *vs* no eye protection	13 unadjusted studies (n=3713)	Unadjusted RR 0·34 (0·22 to 0·52)¶	No eye protection, 16·0%	Eye protection, 5·5% (3·6 to 8·5)	–10·6% (–12·5 to –7·7)	Low‖	Eye protection might result in a large reduction in virus infection

Table based on GRADE approach.[26–29] Population comprised people possibly exposed to individuals infected with SARS-CoV-2, SARS-CoV, or MERS-CoV. Setting was any health-care or non-health-care setting. Outcomes were infection (laboratory-confirmed or probable) and contextual factors. Risk (95% CI) in intervention group is based on assumed risk in comparison group and relative effect (95% CI) of the intervention. All studies were non-randomised and evaluated using the Newcastle-Ottawa Scale; some studies had a higher risk of bias than did others but no important difference was noted in sensitivity analyses excluding studies at higher risk of bias; we did not further rate down for risk of bias. Although there was a high I^2 value (which can be exaggerated in non-randomised studies)[31] and no overlapping CIs, point estimates generally exceeded the thresholds for large effects and we did not rate down for inconsistency. We did not rate down for indirectness for the association between distance and infection because SARS-CoV-2, SARS-CoV, and MERS-CoV all belong to the same family and have each caused epidemics with sufficient similarity; there was also no convincing statistical evidence of effect-modification across viruses; some studies also used bundled interventions but the studies include only those that provide adjusted estimates. aOR=adjusted odds ratio. RR=relative risk. SARS-CoV-2=severe acute respiratory syndrome coronavirus 2. SARS-CoV=severe acute respiratory syndrome coronavirus. MERS-CoV=Middle East respiratory syndrome coronavirus. *GRADE category of evidence; high certainty (we are very confident that the true effect lies close to that of the estimate of the effect); moderate certainty (we are moderately confident in the effect estimate; the true effect is probably close to the estimate, but it is possibly substantially different); low certainty (our confidence in the effect estimate is limited; the true effect could be substantially different from the estimate of the effect); very low certainty (we have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of effect). †The effect is very large considering the thresholds set by GRADE, particularly at plausible levels of baseline risk, which also mitigated concerns about risk of bias; data also suggest a dose–response gradient, with associations increasing from smaller distances to 2 m and beyond, by meta-regression; we did not rate up for this domain alone but it further supports the decision to rate up in combination with the large effects. ‡The effect was very large, and the certainty of evidence could be rated up, but we made a conservative decision not to because of some inconsistency and risk of bias; hence, although the effect is qualitatively highly certain, the precise quantitative effect is low certainty. §In a subgroup analysis comparing N95 respirators with surgical or similar masks (eg, 12–16-layer cotton), the association was more pronounced in the N95 group (aOR 0·04, 95% CI 0·004–0·30) compared with other masks (0·33, 0·17–0·61; $p_{interaction}$=0·090); there was also support for effect-modification by formal analysis of subgroup credibility. ¶Two studies[54,75] provided adjusted estimates with n=295 in the eye protection group and n=406 in the group not wearing eye protection; results were similar to the unadjusted estimate (aOR 0·22, 95% CI 0·12–0·39). ‖The effect is large considering the thresholds set by GRADE assuming that ORs translate into similar magnitudes of RR estimates; this mitigates concerns about risk of bias, but we conservatively decided not to rate up for large or very large effects.

Table 2: **GRADE summary of findings**

Results

We identified 172 studies for our systematic review from 16 countries across six continents (figure 1; appendix pp 6–14, 41–47). Studies were all observational in nature; no randomised trials were identified of any interventions that directly addressed the included study populations. Of the 172 studies, 66 focused on how far a virus can travel by comparing the association of different distances on virus transmission to people (appendix pp 42–44). Of these 66 studies, five were mechanistic, assessing viral RNA, virions, or both cultured from the environment of an infected patient (appendix p 45).

44 studies were comparative[34–77] and fulfilled criteria for our meta-analysis (n=25 697; figure 1; table 1). We used these studies rather than case series and qualitative studies (appendix pp 41–47) to inform estimates of effect. 30 studies[34,37,41–45,47–51,53–56,58–61,64–70,72,74,75] focused on the association between use of various types of face masks and respirators by health-care workers, patients, or both with virus transmission. 13 studies[34,37–39,47,49,51,54,58,60,61,65,75] addressed the association of eye protection with virus transmission.

Some direct evidence was available for COVID-19 (64 studies, of which seven were comparative in design),[36,37,40,41,44,52,70] but most studies reported on SARS (n=55) or MERS (n=25; appendix pp 6–12). Of the 44 comparative studies, 40 included WHO-defined confirmed cases, one included both confirmed and probable cases, and the remaining three studies included probable cases. There was no effect-modification by case-definition (distance $p_{interaction}$=0·41; mask $p_{interaction}$=0·46; all cases for eye protection were confirmed). Most studies reported on bundled interventions, including different components of PPE and distancing, which was usually addressed by statistical adjustment. The included studies all occurred during recurrent or novel outbreak settings of COVID-19, SARS, or MERS.

Risk of bias was generally low-to-moderate after considering the observational designs (table 1), but both within studies and across studies the overall findings were similar between adjusted and unadjusted estimates. We did not detect strong evidence of publication bias in the body of evidence for any intervention (appendix pp 15–18). As we did not use case series data to inform estimates of effect of each intervention, we did not systematically rate risk of bias of these data. Therefore, we report further only those studies with comparative data.

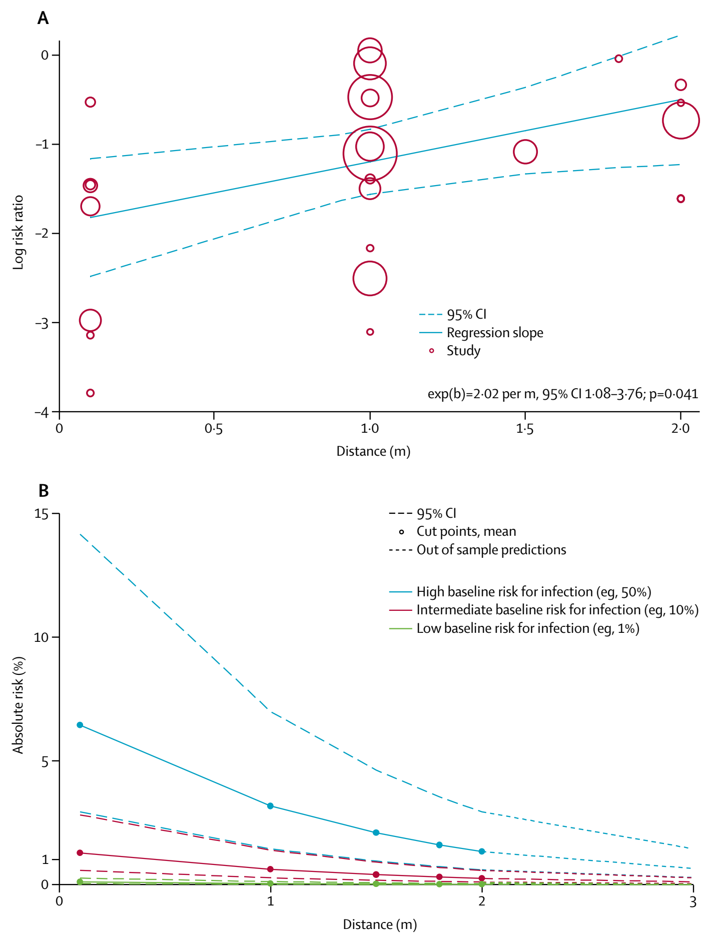

***Figure 3:* Change in relative risk with increasing distance and absolute risk with increasing distance**
Meta-regression of change in relative risk with increasing distance from an infected individual (A). Absolute risk of transmission from an individual infected with SARS-CoV-2, SARS-CoV, or MERS-CoV with varying baseline risk and increasing distance (B). SARS-CoV-2=severe acute respiratory syndrome coronavirus 2. SARS-CoV=severe acute respiratory syndrome coronavirus. MERS-CoV=Middle East respiratory syndrome coronavirus.

Across 29 unadjusted and nine adjusted studies,[35–37,39,40,43,44,46,47,50–54,56,57,59–66,68,69,71,73,76] a strong association was found of proximity of the exposed individual with the risk of infection (unadjusted n=10 736, RR 0·30, 95% CI 0·20 to 0·44; adjusted n=7782, aOR 0·18, 95% CI 0·09 to 0·38; absolute risk [AR] 12·8% with shorter distance *vs* 2·6% with further distance, risk difference [RD] –10·2%, 95% CI –11·5 to –7·5; moderate certainty; figure 2; table 2; appendix p 16). Although there were six studies on COVID-19, the association was seen irrespective of causative virus ($p_{interaction}$=0·49), health-care setting versus non-health-care setting ($p_{interaction}$=0·14), and by type of face mask ($p_{interaction}$=0·95; appendix pp 17, 19). However, different studies used different distances for the intervention. By meta-regression, the strength of association was larger with increasing distance (2·02 change in RR per m, 95% CI 1·08 to 3·76; $p_{interaction}$=0·041; moderate credibility subgroup effect; figure 3A; table 2). AR values with increasing distance given different degrees of baseline risk are shown in figure 3B, with potential values at 3 m also shown.

Across 29 unadjusted studies and ten adjusted studies,[34,37,41–45,47–51,53–56,58–61,64–70,72,74,75] the use of both N95 or similar respirators or face masks (eg, disposable surgical masks or similar reusable 12–16-layer cotton masks) by those exposed to infected individuals was associated with a large reduction in risk of infection (unadjusted n=10 170, RR 0·34, 95% CI 0·26 to 0·45; adjusted studies n=2647, aOR 0·15, 95% CI 0·07 to 0·34; AR 3·1% with face mask *vs* 17·4% with no face mask, RD –14·3%, 95% CI –15·9 to –10·7; low certainty; figure 4; table 2; appendix pp 16, 18) with stronger associations in health-care settings (RR 0·30, 95% CI 0·22 to 0·41) compared with non-health-care settings (RR 0·56, 95% CI 0·40 to 0·79; $p_{interaction}$=0·049; low-to-moderate credibility for subgroup effect; figure 4; appendix p 19). When differential N95 or similar respirator use, which was more frequent in health-care settings than in non-health-care settings, was adjusted for the possibility that face masks were less effective in non-health-care settings, the subgroup effect was slightly less credible ($p_{interaction}$=0·11, adjusted for differential respirator use; figure 4). Indeed, the association with protection from infection was more pronounced with N95 or similar respirators (aOR 0·04, 95% CI 0·004 to 0·30) compared with other masks (aOR 0·33, 95% CI 0·17 to 0·61; $p_{interaction}$=0·090; moderate credibility subgroup effect; figure 5). The interaction was also seen when additionally adjusting for three studies that clearly reported aerosol-generating procedures ($p_{interaction}$=0·048; figure 5). Supportive evidence for this interaction was also seen in within-study comparisons (eg, N95 had a stronger protective association compared with surgical masks or 12–16-layer cotton masks); both N95 and surgical masks also had a stronger association with protection versus single-layer masks.[38,39,51,53,54,61,66,67,75]

We did a sensitivity analysis to test the robustness of our findings and to integrate all available information on face mask treatment effects for protection from COVID-19. We reconsidered our findings using random-effects Bayesian meta-analysis. Although non-informative priors showed similar results to frequentist approaches (aOR 0·16, 95% CrI 0·04–0·40), even using informative priors from the most recent meta-analysis on the effectiveness of masks versus no masks to prevent influenza-like illness (RR 0·93, 95% CI 0·83–1·05)[31] yielded a significant association with protection from COVID-19 (aOR 0·40, 95% CrI 0·16–0·97; posterior probability for RR <1, 98%). Minimally informing (25% influence with or without four-fold smaller mean effect size) the most recent and rigorous meta-analysis of the effectiveness of N95

	Country	Respirator (0=no)	Infection	Events, face mask (n/N)	Events, no face mask (n/N)	RR (95% CI)	% weight (random)
Health-care setting							
Scales et al (2003)[66]	Canada	0	SARS	3/16	4/15	0·70 (0·19–2·63)	3·2
Liu et al (2009)[51]	China	0	SARS	8/123	43/354	0·54 (0·26–1·11)	6·7
Pei et al (2006)[61]	China	0	SARS	11/98	61/115	0·21 (0·12–0·38)	7·9
Yin et al (2004)[75]	China	0	SARS	46/202	31/55	0·40 (0·29–0·57)	10·3
Park et al (2016)[59]	South Korea	0	MERS	3/24	2/4	0·25 (0·06–1·06)	2·8
Kim et al (2016)[48]	South Korea	0	MERS	0/7	1/2	0·13 (0·01–2·30)	0·8
Heinzerling et al (2020)[44]	USA	0	COVID-19	0/31	3/6	0·03 (0·002–0·54)	0·9
Nishiura et al (2005)[55]	Vietnam	0	SARS	8/43	17/72	0·79 (0·37–1·67)	6·5
Nishiyama et al (2008)[56]	Vietnam	0	SARS	17/61	14/18	0·36 (0·22–0·58)	9·0
Reynolds et al (2006)[64]	Vietnam	0	SARS	8/42	14/25	0·34 (0·17–0·69)	6·7
Loeb et al (2004)[53]	Canada	1	SARS	3/23	5/9	0·23 (0·07–0·78)	3·6
Wang et al (2020)[41]	China	1	COVID-19	0/278	10/215	0·04 (0·002–0·63)	0·9
Seto et al (2003)[67]	China	1	SARS	0/51	13/203	0·15 (0·01–2·40)	0·9
Wang et al (2020)[70]	China	1	COVID-19	1/1286	119/4036	0·03 (0·004–0·19)	1·7
Alraddadi et al (2016)[34]	Saudi Arabia	1	MERS	6/116	12/101	0·44 (0·17–1·12)	5·0
Ho et al (2004)[45]	Singapore	1	SARS	2/62	2/10	0·16 (0·03–1·02)	1·9
Teleman et al (2004)[68]	Singapore	1	SARS	3/26	33/60	0·21 (0·07–0·62)	4·2
Wilder-Smith et al (2005)[72]	Singapore	1	SARS	6/27	39/71	0·40 (0·19–0·84)	6·5
Ki et al (2019)[47]	South Korea	1	MERS	0/218	6/230	0·08 (0·005–1·43)	0·8
Kim et al (2016)[49]	South Korea	1	MERS	1/444	16/308	0·04 (0·01–0·33)	1·6
Hall et al (2014)[43]	Saudi Arabia	1	MERS	0/42	0/6	(Not calculable)	0
Ryu et al (2019)[65]	South Korea	1	MERS	0/24	0/10	(Not calculable)	0
Park et al (2004)[58]	USA	1	SARS	0/60	0/45	(Not calculable)	0
Peck et al (2004)[60]	USA	1	SARS	0/13	0/19	(Not calculable)	0
Burke et al (2020)[37]	USA	1	COVID-19	0/64	0/13	(Not calculable)	0
Ha et al (2004)[42]	Vietnam	1	SARS	0/61	0/1	(Not calculable)	0
Random subtotal (I^2=50%)				**126/3442**	**445/6003**	**0·30 (0·22–0·41)**	**81·9**
Non-health-care setting							
Lau et al (2004)[50]	China	0	SARS	12/89	25/98	0·53 (0·28–0·99)	7·5
Wu et al (2004)[74]	China	0	SARS	25/146	69/229	0·57 (0·38–0·85)	9·7
Tuan et al (2007)[69]	Vietnam	0	SARS	0/9	7/154	1·03 (0·06–16·83)	0·9
Random subtotal (I^2=0%)				**37/244**	**101/481**	**0·56 (0·40–0·79)**	**18·1**
Unadjusted estimates, overall (I^2=48%)				**163/3686**	**546/6484**	**0·34 (0·26–0·45)**	**100·0**
Adjusted estimates, overall (1 COVID-19, 1 MERS, 8 SARS)						**aOR 0·15 (0·07–0·34)**	
						aRR 0·18 (0·08–0·38)	

Interaction by setting, p=0·049; adjusted for N95 and distance, p=0·11

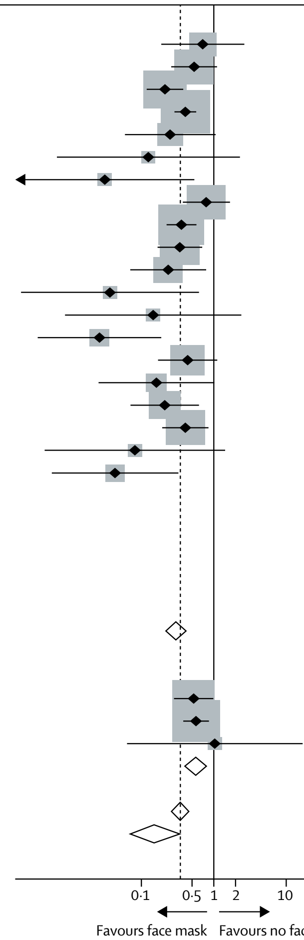

Figure 4: **Forest plot showing unadjusted estimates for the association of face mask use with viral infection causing COVID-19, SARS, or MERS**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative risk.

respirators versus medical masks in randomised trials (OR 0·76, 95% CI 0·54–1·06)[13] with the effect-modification seen in this meta-analysis on COVID-19 (ratio of aORs 0·14, 95% CI 0·02–1·05) continued to support a stronger association of protection from COVID-19, SARS, or MERS with N95 or similar respirators versus other face masks (posterior probability for RR <1, 100% and 95%, respectively).

In 13 unadjusted studies and two adjusted studies,[34,37–39,47,49,51,54,58,60,61,65,75] eye protection was associated with lower risk of infection (unadjusted n=3713, RR 0·34, 95% CI 0·22 to 0·52; AR 5·5% with eye protection *vs* 16·0% with no eye protection, RD –10·6%, 95% CI –12·5 to –7·7; adjusted n=701, aOR 0·22, 95% CI 0·12 to 0·39; low certainty; figure 6; table 2; appendix pp 16–17).

Across 24 studies in health-care and non-health-care settings during the current pandemic of COVID-19, previous epidemics of SARS and MERS, or in general use, looking at contextual factors to consider in recommendations, most stakeholders found physical distancing and use of face masks and eye protection acceptable, feasible, and reassuring (appendix pp 20–22). However, challenges included frequent discomfort, high resource use linked with potentially decreased equity, less clear communication, and perceived reduced empathy of care providers by those they were caring for.

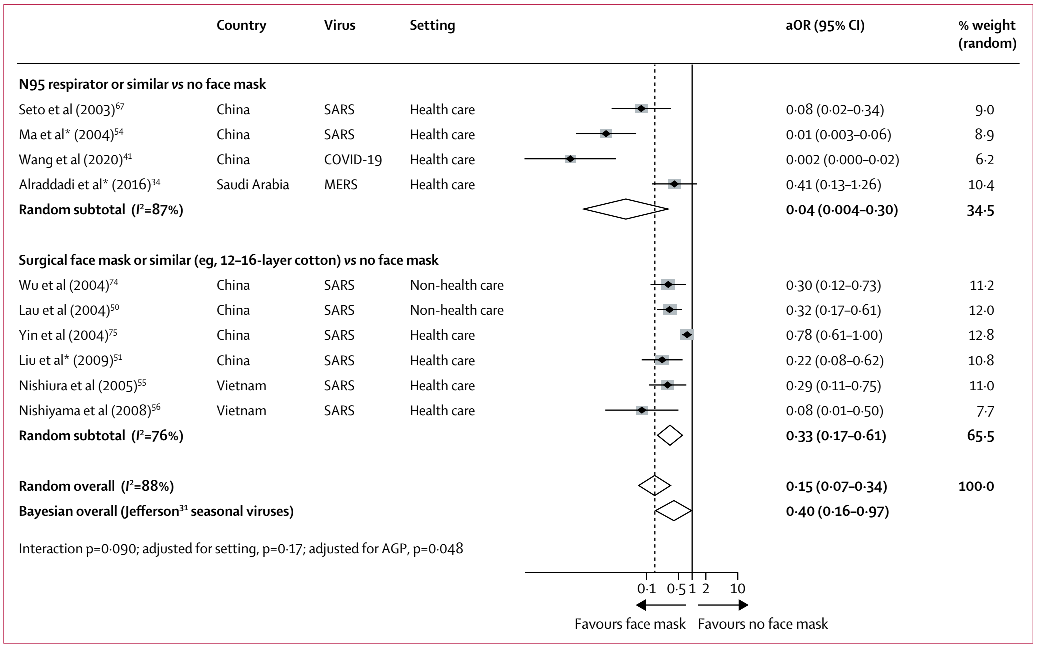

Figure 5: **Forest plot showing adjusted estimates for the association of face mask use with viral infection causing COVID-19, SARS, or MERS**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. AGP=aerosol-generating procedures. *Studies clearly reporting AGP.

Discussion

The findings of this systematic review of 172 studies (44 comparative studies; n=25 697 patients) on COVID-19, SARS, and MERS provide the best available evidence that current policies of at least 1 m physical distancing are associated with a large reduction in infection, and distances of 2 m might be more effective. These data also suggest that wearing face masks protects people (both health-care workers and the general public) against infection by these coronaviruses, and that eye protection could confer additional benefit. However, none of these interventions afforded complete protection from infection, and their optimum role might need risk assessment and several contextual considerations. No randomised trials were identified for these interventions in COVID-19, SARS, or MERS.

Previous reviews are limited in that they either have not provided any evidence from COVID-19 or did not use direct evidence from other related emerging epidemic betacoronaviruses (eg, SARS and MERS) to inform the effects of interventions to curtail the current COVID-19 pandemic.[13,19,31,78] Previous data from randomised trials are mainly for common respiratory viruses such as seasonal influenza, with a systematic review concluding low certainty of evidence for extrapolating these findings to COVID-19.[13] Further, previous syntheses of available randomised controlled trials have not accounted for cluster effects in analyses, leading to substantial imprecision in treatment effect estimates. In between-study and within-study comparisons, we noted a larger effect of N95 or similar respirators compared with other masks. This finding is inconsistent with conclusions of a review of four randomised trials,[13] in which low certainty of evidence for no larger effect was suggested. However, in that review, the CIs were wide so a meaningful protective effect could not be excluded. We harmonised these findings with Bayesian approaches, using indirect data from randomised trials to inform posterior estimates. Despite this step, our findings continued to support the ideas not only that masks in general are associated with a large reduction in risk of infection from SARS-CoV-2, SARS-CoV, and MERS-CoV but also that N95 or similar respirators might be associated with a larger degree of protection from viral infection than disposable medical masks or reusable multilayer (12–16-layer) cotton masks. Nevertheless, in view of the limitations of these data, we did not rate the certainty of effect as high.[21] Our findings accord with those of a cluster randomised trial showing a potential benefit of continuous N95 respirator use over medical masks against seasonal viral infections.[79] Further high-quality research, including randomised trials of the optimum physical distance and the effectiveness of different types of masks in the general population and for health-care workers' protection, is urgently needed. Two trials are registered to better inform the optimum use of face masks for COVID-19 (NCT04296643 [n=576] and

	Country	Respirator (0=no)	Events, eye protection (n/N)	Events, no eye protection (n/N)	RR (95% CI)	% weight (random)
MERS						
Alraddadi et al (2016)[34]	Saudi Arabia	1	1/47	17/165	0·21 (0·03–1·51)	4·0
Ki et al (2019)[47]	South Korea	1	0/9	6/64	0·50 (0·03–8·21)	2·2
Kim et al (2016)[49]	South Korea	1	0/443	2/294	0·13 (0·01–2·76)	1·8
Ryu et al (2019)[65]	South Korea	1	0/24	0/10	(Not calculable)	0
Random subtotal (I^2=0%)			**1/523**	**25/533**	**0·24 (0·06–0·99)**	**8·0**
SARS						
Chen et al (2009)[39]	China	0	1/45	90/703	0·17 (0·02–1·22)	4·2
Liu et al (2009)[51]	China	0	17/221	34/256	0·58 (0·33–1·01)	21·2
Pei et al (2006)[61]	China	0	24/120	123/323	0·53 (0·36–0·77)	26·0
Yin et al (2004)[75]	China	0	10/120	67/137	0·17 (0·09–0·32)	19·4
Caputo et al (2006)[38]	Canada	1	2/46	4/32	0·35 (0·07–1·79)	5·6
Ma et al (2004)[54]	China	1	7/175	40/269	0·27 (0·12–0·59)	15·6
Park et al (2004)[58]	USA	1	0/30	0/72	(Not calculable)	0
Peck et al (2004)[60]	USA	1	0/13	0/19	(Not calculable)	0
Random subtotal (I^2=62%)			**61/770**	**358/1811**	**0·34 (0·21–0·56)**	**92·0**
COVID-19						
Burke et al (2020)[37]	USA	1	0/42	0/34	(Not calculable)	0
Random subtotal			**0/42**	**0/34**	**(Not calculable)**	**0**
Random overall (I^2=43%)			**62/1335**	**383/2378**	**0·34 (0·22–0·52)**	**100·0**
Adjusted estimates, overall (2 studies, Yin[75] and Ma[54])					**aOR 0·22 (0·12–0·39)**	
					aRR 0·25 (0·14–0·43)	
Interaction by virus, p=0·75						

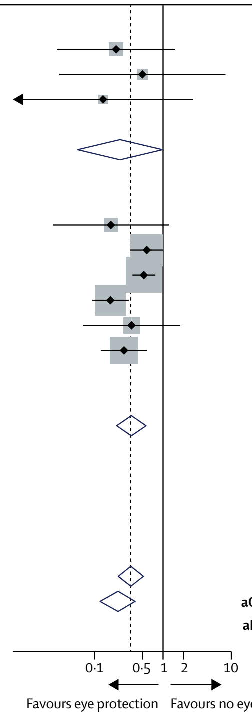

***Figure 6*: Forest plot showing the association of eye protection with risk of COVID-19, SARS, or MERS transmission**
Forest plot shows unadjusted estimates. SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative risk.

NCT04337541 [n=6000]). Until such data are available, our findings represent the current best estimates to inform face mask use to reduce infection from COVID-19. We recognise that there are strong, perhaps opposing, sentiments about policy making during outbreaks. In one viewpoint, the 2007 SARS Commission report stated:

> "...recognize, as an aspect of health worker safety, the precautionary principle that reasonable action to reduce risk, such as the use of a fitted N95 respirator, need not await scientific certainty".[80]

> "...if we do not learn from SARS and we do not make the government fix the problems that remain, we will pay a terrible price in the next pandemic".[81]

A counter viewpoint is that the scientific uncertainty and contextual considerations require a more nuanced approach. Although challenging, policy makers must carefully consider these two viewpoints along with our findings.

We found evidence of moderate certainty that current policies of at least 1 m physical distancing are probably associated with a large reduction in infection, and that distances of 2 m might be more effective, as implemented in some countries. We also provide estimates for 3 m. The main benefit of physical distancing measures is to prevent onward transmission and, thereby, reduce the adverse outcomes of SARS-CoV-2 infection. Hence, the results of our current review support the implementation of a policy of physical distancing of at least 1 m and, if feasible, 2 m or more. Our findings also provide robust estimates to inform models and contact tracing used to plan and strategise for pandemic response efforts at multiple levels.

The use of face masks was protective for both health-care workers and people in the community exposed to infection, with both the frequentist and Bayesian analyses lending support to face mask use irrespective of setting. Our unadjusted analyses might, at first impression, suggest use of face masks in the community setting to be less effective than in the health-care setting, but after accounting for differential N95 respirator use between health-care and non-health-care settings, we did not detect any striking differences in effectiveness of

COVID-19 Systematic Urgent Review Group Effort (SURGE) study authors

Argentina—German Hospital of Buenos Aires (Ariel Izcovich); Canada—Cochrane Consumer Executive (Maureen Smith); McMaster University (Mark Loeb, Anisa Hajizadeh, Carlos A Cuello-Garcia, Gian Paolo Morgano, Leila Harrison, Tejan Baldeh, Karla Solo, Tamara Lotfi, Antonio Bognanni, Rosa Stalteri, Thomas Piggott, Yuan Zhang, Stephanie Duda, Derek K Chu, Holger J Schünemann); Southlake Regional Health Centre (Jeffrey Chan); University of British Columbia (David James Harris); Chile—Pontificia Universidad Católica de Chile (Ignacio Neumann); China—Beijing University of Chinese Medicine, Dongzhimen Hospital (Guang Chen); Guangzhou University of Chinese Medicine, The Fourth Clinical Medical College (Chen Chen); China Academy of Chinese Medical Sciences (Hong Zhao); Germany—Finn Schünemann; Italy—Azienda USL–IRCCS di Reggio Emilia (Paolo Giorgi Rossi); Universita Vita-Salute San Raffaele, Milan, Italy (Giovanna Elsa Ute Muti Schünemann); Lebanon—American University of Beirut (Layal Hneiny, Amena El-Harakeh, Fatimah Chamseddine, Joanne Khabsa, Nesrine Rizk, Rayane El-Khoury, Zahra Saad, Sally Yaacoub, Elie A Akl); Rafik Hariri University Hospital (Pierre AbiHanna); Poland—Evidence Prime, Krakow (Anna Bak, Ewa Borowiack); UK—The London School of Hygiene & Tropical Medicine (Marge Reinap); University of Hull (Assem Khamis).

Declaration of interests

ML is an investigator of an ongoing clinical trial on medical masks versus N95 respirators for COVID-19 (NCT04296643). All other authors declare no competing interests.

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References

1 Worldometer. COVID-19 coronavirus pandemic. 2020. https://www.worldometers.info/coronavirus/ (accessed May 28, 2020).

2 Guo ZD, Wang ZY, Zhang SF, et al. Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in hospital wards, Wuhan, China, 2020. *Emerg Infect Dis* 2020; published online April 10. DOI:10.3201/eid2607.200885.

3 Chia PY, Coleman KK, Tan YK, et al. Detection of air and surface contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in hospital rooms of infected patients. *medRxiv* 2020; published online April 9. DOI:10.1101/2020.03.29.20046557 (preprint).

4 Santarpia JL, Rivera DN, Herrera V, et al. Transmission potential of SARS-CoV-2 in viral shedding observed at the University of Nebraska Medical Center. *medRxiv* 2020; published online March 26. DOI:10.1101/2020.03.23.20039446 (preprint).

5 Cheng V, Wong S-C, Chen J, et al. Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARS-CoV-2 in Hong Kong. *Infect Control Hosp Epidemiol* 2020; **41:** 493–98.

6 Wong SCY, Kwong RT-S, Wu TC, et al. Risk of nosocomial transmission of coronavirus disease 2019: an experience in a general ward setting in Hong Kong. *J Hosp Infect* 2020; **105:** 119–27.

7 Faridi S, Niazi S, Sadeghi K, et al. A field indoor air measurement of SARS-CoV-2 in the patient rooms of the largest hospital in Iran. *Sci Total Environ* 2020; **725:** 138401.

8 Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA* 2020; **323:** 1610–12.

9 Qualls N, Levitt A, Kanade N, et al. Community mitigation guidelines to prevent pandemic influenza: United States, 2017. *MMWR Recomm Rep* 2017; **66:** 1–34.

10 Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. *Lancet Respir Med* 2020; **8:** 434–36.

11 MacIntyre R, Chughtai A, Tham CD, Seale H. COVID-19: should cloth masks be used by healthcare workers as a last resort? April 9, 2020. https://blogs.bmj.com/bmj/2020/04/09/covid-19-should-cloth-masks-be-used-by-healthcare-workers-as-a-last-resort/ (accessed May 12, 2020).

12 Loeb M, Dafoe N, Mahony J, et al. Surgical mask *vs* N95 respirator for preventing influenza among health care workers: a randomized trial. *JAMA* 2009; **302:** 1865–71.

13 Bartoszko JJ, Farooqi MAM, Alhazzani W, Loeb M. Medical masks vs N95 respirators for preventing COVID-19 in healthcare workers: a systematic review and meta-analysis of randomized trials. *Influenza Other Respir Viruses* 2020; published online April 4. DOI:10.1111/irv.12745.

14 Schünemann HJ, Moja L. Reviews: rapid! Rapid! Rapid! . . . and systematic. *Syst Rev* 2015; **4:** 4.

15 Cochrane Training. Cochrane handbook for systematic reviews of interventions, version 6. 2019. https://training.cochrane.org/handbook/current (accessed May 12, 2020).

16 Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008; **336:** 924–26.

17 Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Clin Epidemiol* 2009; **62:** 1006–12.

18 Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *JAMA* 2000; **283:** 2008–12.

19 Jefferson T, Del Mar CB, Dooley L, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. *Cochrane Database Syst Rev* 2011; **7:** CD006207.

20 Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of masks and respirators against respiratory infections in healthcare workers: a systematic review and meta-analysis. *Clin Infect Dis* 2017; **65:** 1934–42.

21 Guyatt GH, Oxman AD, Kunz R, et al. GRADE guidelines, 7: rating the quality of evidence—inconsistency. *J Clin Epidemiol* 2011; **64:** 1294–302.

22 Iorio A, Spencer FA, Falavigna M, et al. Use of GRADE for assessment of evidence about prognosis: rating confidence in estimates of event rates in broad categories of patients. *BMJ* 2015; **350:** h870.

23 Moskalewicz A, Oremus M. No clear choice between Newcastle-Ottawa Scale and Appraisal Tool for Cross-Sectional Studies to assess methodological quality in cross-sectional studies of health-related quality of life and breast cancer. *J Clin Epidemiol* 2020; **120:** 94–103.

24 Wells GA, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. 2019. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp (accessed May 12, 2020).

25 Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366:** l4898.

26 Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines, 1: introduction—GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol* 2011; **64:** 383–94.

27 Guyatt GH, Thorlund K, Oxman AD, et al. GRADE guidelines, 13: preparing summary of findings tables and evidence profiles—continuous outcomes. *J Clin Epidemiol* 2013; **66:** 173–83.

28 Santesso N, Carrasco-Labra A, Langendam M, et al. Improving GRADE evidence tables part 3: detailed guidance for explanatory footnotes supports creating and understanding GRADE certainty in the evidence judgments. *J Clin Epidemiol* 2016; **74:** 28–39.

29 Santesso N, Glenton C, Dahm P, et al. GRADE guidelines, 26: informative statements to communicate the findings of systematic reviews of interventions. *J Clin Epidemiol* 2020; **119:** 126–35.

30 Higgins JP, Thompson SG. Controlling the risk of spurious findings from meta-regression. *Stat Med* 2004; **23:** 1663–82.
31 Jefferson T, Jones M, Al Ansari LA, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses, part 1: face masks, eye protection and person distancing—systematic review and meta-analysis. *medRxiv* 2020; published online April 7. DOI:10.1101/2020.03.30.20047217 (preprint).
32 Sutton AJ, Abrams KR. Bayesian methods in meta-analysis and evidence synthesis. *Stat Methods Med Res* 2001; **10:** 277–303.
33 Goligher EC, Tomlinson G, Hajage D, et al. Extracorporeal membrane oxygenation for severe acute respiratory distress syndrome and posterior probability of mortality benefit in a post hoc Bayesian analysis of a randomized clinical trial. *JAMA* 2018; **320:** 2251–59.
34 Alraddadi BM, Al-Salmi HS, Jacobs-Slifka K, et al. Risk factors for Middle East respiratory syndrome coronavirus infection among healthcare personnel. *Emerg Infect Dis* 2016; **22:** 1915–20.
35 Arwady MA, Alraddadi B, Basler C, et al. Middle East respiratory syndrome coronavirus transmission in extended family, Saudi Arabia, 2014. *Emerg Infect Dis* 2016; **22:** 1395–402.
36 Bai Y, Wang X, Huang Q, et al. SARS-CoV-2 infection in health care workers: a retrospective analysis and a model study. *medRxiv* 2020; published online April 1. DOI:10.1101/2020.03.29.20047159 (preprint).
37 Burke RM, Balter S, Barnes E, et al. Enhanced contact investigations for nine early travel-related cases of SARS-CoV-2 in the United States. *medRxiv* 2020; published online May 3. DOI:10.1101/2020.04.27.20081901 (preprint).
38 Caputo KM, Byrick R, Chapman MG, Orser BJ, Orser BA. Intubation of SARS patients: infection and perspectives of healthcare workers. *Can J Anaesth* 2006; **53:** 122–29.
39 Chen WQ, Ling WH, Lu CY, et al. Which preventive measures might protect health care workers from SARS? *BMC Public Health* 2009; **9:** 81.
40 Cheng H-Y, Jian S-W, Liu D-P, Ng T-C, Huang W-T, Lin H-H. High transmissibility of COVID-19 near symptom onset. *medRxiv* 2020; published online March 19. DOI:10.1101/2020.03.18.20034561 (preprint).
41 Wang X, Pan Z, Cheng Z. Association between 2019-nCoV transmission and N95 respirator use. *J Hosp Infect* 2020; **105:** 104–05.
42 Ha LD, Bloom SA, Hien NQ, et al. Lack of SARS transmission among public hospital workers, Vietnam. *Emerg Infect Dis* 2004; **10:** 265–68.
43 Hall AJ, Tokars JI, Badreddine SA, et al. Health care worker contact with MERS patient, Saudi Arabia. *Emerg Infect Dis* 2014; **20:** 2148–51.
44 Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient: Solano County, California, February 2020. *MMWR Morb Mortal Wkly Rep* 2020; **69:** 472–76.
45 Ho KY, Singh KS, Habib AG, et al. Mild illness associated with severe acute respiratory syndrome coronavirus infection: lessons from a prospective seroepidemiologic study of health-care workers in a teaching hospital in Singapore. *J Infect Dis* 2004; **189:** 642–47.
46 Van Kerkhove MD, Alaswad S, Assiri A, et al. Transmissibility of MERS-CoV infection in closed setting, Riyadh, Saudi Arabia, 2015. *Emerg Infect Dis J* 2019; **25:** 1802–09.
47 Ki HK, Han SK, Son JS, Park SO. Risk of transmission via medical employees and importance of routine infection-prevention policy in a nosocomial outbreak of Middle East respiratory syndrome (MERS): a descriptive analysis from a tertiary care hospital in South Korea. *BMC Pulm Med* 2019; **19:** 190.
48 Kim T, Jung J, Kim SM, et al. Transmission among healthcare worker contacts with a Middle East respiratory syndrome patient in a single Korean centre. *Clin Microbiol Infect* 2016; **22:** e11–13.
49 Kim CJ, Choi WS, Jung Y, et al. Surveillance of the Middle East respiratory syndrome (MERS) coronavirus (CoV) infection in healthcare workers after contact with confirmed MERS patients: incidence and risk factors of MERS-CoV seropositivity. *Clin Microbiol Infect* 2016; **22:** 880–86.
50 Lau JTF, Lau M, Kim JH, Tsui HY, Tsang T, Wong TW. Probable secondary infections in households of SARS patients in Hong Kong. *Emerg Infect Dis* 2004; **10:** 235–43.
51 Liu W, Tang F, Fang LQ, et al. Risk factors for SARS infection among hospital healthcare workers in Beijing: a case control study. *Trop Med Int Health* 2009; **14** (suppl 1): 52–59.
52 Liu ZQ, Ye Y, Zhang H, Guohong X, Yang J, Wang JL. Analysis of the spatio-temporal characteristics and transmission path of COVID-19 cluster cases in Zhuhai. *Trop Geogr* 2020; published online March 12. DOI:10.13284/j.cnki.rddl.003228.
53 Loeb M, McGeer A, Henry B, et al. SARS among critical care nurses, Toronto. *Emerg Infect Dis* 2004; **10:** 251–55.
54 Ma HJ, Wang HW, Fang LQ, et al. A case-control study on the risk factors of severe acute respiratory syndromes among health care workers. *Zhonghua Liu Xing Bing Xue Za Zhi* 2004; **25:** 741–44 (in Chinese).
55 Nishiura H, Kuratsuji T, Quy T, et al. Rapid awareness and transmission of severe acute respiratory syndrome in Hanoi French Hospital, Vietnam. *Am J Trop Med Hyg* 2005; **73:** 17–25.
56 Nishiyama A, Wakasugi N, Kirikae T, et al. Risk factors for SARS infection within hospitals in Hanoi, Vietnam. *Jpn J Infect Dis* 2008; **61:** 388–90.
57 Olsen SJ, Chang HL, Cheung TY, et al. Transmission of the severe acute respiratory syndrome on aircraft. *N Engl J Med* 2003; **349:** 2416–22.
58 Park BJ, Peck AJ, Kuehnert MJ, et al. Lack of SARS transmission among healthcare workers, United States. *Emerg Infect Dis* 2004; **10:** 244–48.
59 Park JY, Kim BJ, Chung KH, Hwang YI. Factors associated with transmission of Middle East respiratory syndrome among Korean healthcare workers: infection control via extended healthcare contact management in a secondary outbreak hospital. *Respirology* 2016; **21** (suppl 3): 89 (abstr APSR6-0642).
60 Peck AJ, Newbern EC, Feikin DR, et al. Lack of SARS transmission and U.S. SARS case-patient. *Emerg Infect Dis* 2004; **10:** 217–24.
61 Pei LY, Gao ZC, Yang Z, et al. Investigation of the influencing factors on severe acute respiratory syndrome among health care workers. *Beijing Da Xue Xue Bao Yi Xue Ban* 2006; **38:** 271–75.
62 Rea E, Laflèche J, Stalker S, et al. Duration and distance of exposure are important predictors of transmission among community contacts of Ontario SARS cases. *Epidemiol Infect* 2007; **135:** 914–21.
63 Reuss A, Litterst A, Drosten C, et al. Contact investigation for imported case of Middle East respiratory syndrome, Germany. *Emerg Infect Dis* 2014; **20:** 620–25.
64 Reynolds MG, Anh BH, Thu VH, et al. Factors associated with nosocomial SARS-CoV transmission among healthcare workers in Hanoi, Vietnam, 2003. *BMC Public Health* 2006; **6:** 207.
65 Ryu B, Cho SI, Oh MD, et al. Seroprevalence of Middle East respiratory syndrome coronavirus (MERS-CoV) in public health workers responding to a MERS outbreak in Seoul, Republic of Korea, in 2015. *Western Pac Surveill Response J* 2019; **10:** 46–48.
66 Scales DC, Green K, Chan AK, et al. Illness in intensive care staff after brief exposure to severe acute respiratory syndrome. *Emerg Infect Dis* 2003; **9:** 1205–10.
67 Seto WH, Tsang D, Yung RWH, et al. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). *Lancet* 2003; **361:** 1519–20.
68 Teleman MD, Boudville IC, Heng BH, Zhu D, Leo YS. Factors associated with transmission of severe acute respiratory syndrome among health-care workers in Singapore. *Epidemiol Infect* 2004; **132:** 797–803.
69 Tuan PA, Horby P, Dinh PN, et al. SARS transmission in Vietnam outside of the health-care setting. *Epidemiol Infect* 2007; **135:** 392–401.
70 Wang Q, Huang X, Bai Y, et al. Epidemiological characteristics of COVID-19 in medical staff members of neurosurgery departments in Hubei province: a multicentre descriptive study. *medRxiv* 2020; published online April 24. DOI:10.1101/2020.04.20.20064899 (preprint).
71 Wiboonchutikul S, Manosuthi W, Likanonsakul S, et al. Lack of transmission among healthcare workers in contact with a case of Middle East respiratory syndrome coronavirus infection in Thailand. *Antimicrob Resist Infect Control* 2016; **5:** 21.
72 Wilder-Smith A, Teleman MD, Heng BH, Earnest A, Ling AE, Leo YS. Asymptomatic SARS coronavirus infection among healthcare workers, Singapore. *Emerg Infect Dis* 2005; **11:** 1142–45.
73 Wong TW, Lee CK, Tam W, et al. Cluster of SARS among medical students exposed to single patient, Hong Kong. *Emerg Infect Dis* 2004; **10:** 269–76.

74 Wu J, Xu F, Zhou W, et al. Risk factors for SARS among persons without known contact with SARS patients, Beijing, China. *Emerg Infect Dis* 2004; **10:** 210–16.
75 Yin WW, Gao LD, Lin WS, et al. Effectiveness of personal protective measures in prevention of nosocomial transmission of severe acute respiratory syndrome. *Zhonghua Liu Xing Bing Xue Za Zhi* 2004; **25:** 18–22.
76 Yu ITS, Wong TW, Chiu YL, Lee N, Li Y. Temporal-spatial analysis of severe acute respiratory syndrome among hospital inpatients. *Clin Infect Dis* 2005; **40:** 1237–43.
77 Yu IT, Xie ZH, Tsoi KK, et al. Why did outbreaks of severe acute respiratory syndrome occur in some hospital wards but not in others? *Clin Infect Dis* 2007; **44:** 1017–25.
78 Verbeek JH, Rajamaki B, Ijaz S, et al. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. *Cochrane Database Syst Rev* 2019; **7:** CD011621.
79 MacIntyre CR, Wang Q, Seale H, et al. A randomized clinical trial of three options for N95 respirators and medical masks in health workers. *Am J Respir Crit Care Med* 2013; **187:** 960–66.
80 Campbell A. Chapter eight: it's not about the mask: SARS Commission final report, volume 3. December, 2006. http://www.archives.gov.on.ca/en/e_records/sars/report/v3-pdf/Vol3Chp8.pdf (accessed May 12, 2020).
81 Webster P. Ontario issues final SARS Commission report. *Lancet* 2007; **369:** 264.
82 Rimmer A. COVID-19: experts question guidance to reuse PPE. *BMJ* 2020; **369:** m1577.
83 Mackenzie D. Reuse of N95 masks. *Engineering* 2020; published online April 13. DOI:10.1016/j.eng.2020.04.003.
84 Greenhalgh T, Schmid MB, Czypionka T, Bassler D, Gruer L. Face masks for the public during the covid-19 crisis. *BMJ* 2020; **369**: m1435.
85 Bahl P, Doolan C, de Silva C, Chughtai AA, Bourouiba L, MacIntyre CR. Airborne or droplet precautions for health workers treating coronavirus disease 2019? *J Infect Dis* 2020; published online April 16. DOI:10.1093/infdis/jiaa189.
86 Schünemann HJ, Khabsa J, Solo K, et al. Ventilation techniques and risk for transmission of coronavirus disease, including COVID-19: a living systematic review of multiple streams of evidence. *Ann Intern Med* 2020; published online May 22. DOI:10.7326/M20-2306.
87 Leung NHL, Chu DKW, Shiu EYC, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nat Med* 2020; **26:** 676–80.

The Wall Street Journal: What We Know About Face Shields and Coronavirus

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What We Know About Face Shields and Coronavirus

Here's how shields offer protection from Covid-19 and how that differs from what face masks offer

Caroline Osman wears a protective face shield as customers arrive on the first day of business since the coronavirus lockdown at W.J. French and Son, a shoe store in Southampton, England on June 15.

PHOTO: ADRIAN DENNIS/AGENCE FRANCE-PRESSE/GETTY IMAGES

By Alina Dizik
June 16, 2020 11:38 am ET

With face shields a growing part of hospital protocol, some infectious disease doctors are calling for greater adoption outside the medical setting. Unlike masks that protect the nose and mouth, face shields may also keep the virus from entering through the eyes. We asked experts for advice:

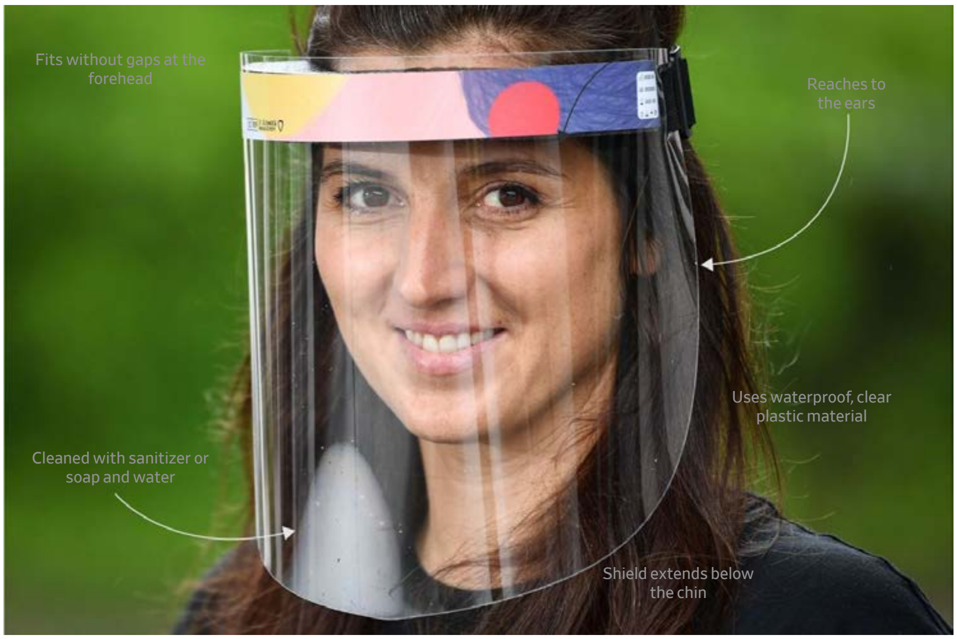
How do face shields offer protection from coronavirus?

The new coronavirus spreads mostly through droplets expelled from an infected person coughing, sneezing or talking. Face shields cover the eyes, mouth and nose—the areas of potential infection. “If someone coughs and it catches your eyes, you are going to get the infection,” says Daniel McQuillen, vice president of the Infectious Diseases Society of America and an infectious disease physician at Beth Israel Lahey Health in Boston.

Face shields block droplets, which are larger particles that drop to the floor due to gravity, but not aerosols, smaller particles that may linger in the air when exhaled during a dental procedure or intubation. “The general way that this virus spread is by droplets, despite the scary pictures you see of aerosols and things hanging in the air,” Dr. McQuillen says.

Covering Your Bases

A well-fitting face shield can be a good option for additional coverage.



Sources: Dr. Michael Edmond; Dr. Daniel McQuillen
Photo: Philipp Guelland/Shutterstock

What are the benefits of wearing a face shield?

The shield covers more of the face than a mask, so infected droplets are less likely to land anywhere near your eyes, mouth or nose.

A meta-analysis that looked at nearly 26,000 patients affected by Covid-19 and similar conditions that was published in the Lancet this month found “eye protection might result in a large reduction in virus infection” and provides additional benefit to mask wearers. In health-care settings, eye protection reduced risk compared with no eye protection in 13 studies, but more evidence is needed, says co-author Derek Chu of McMaster University in Hamilton, Ontario.

And in countries including China and South Korea “PPE is starting to shift from masks to shields,” says Luis Ostrosky, professor of infectious diseases at UTHealth’s McGovern Medical School in Houston.

What scientists don’t yet know is what portion of infections start in the eyes, or whether face shields are superior to face masks.

Shields can be easier to wear for prolonged periods, especially for those with breathing problems. You may also be less likely to touch your face while wearing a shield or fidget with the shield itself, says Michael Edmond, chief quality officer at the University of Iowa

Hospitals & Clinics. "Universal face shielding would help stop the outbreak and let people have less restrictions on what they do," says Dr. Edmond, an infectious disease doctor who co-wrote an opinion piece on the community use of face shields in JAMA this April.

Should you still wear a mask under the face shield?

There's no consensus. Infectious disease experts calling for greater adoption still disagree on whether wearing a face shield alone offers enough protection for yourself or others.

Dr. Edmond says a face shield on its own is enough to wear in most community settings, especially if keeping a social distance. "For general life, I just wear a shield," he says. He also believes face shields alone are just as effective in preventing an infected person from infecting others.

Other experts, including Saad Omer, director of the Yale Institute for Global Health, say that face shields should be used in conjunction with masks until more research is available. "There is no harm in taking extra precautions, especially in a closed setting," he says.

Not all doctors think shields can stop people from receiving or spreading infection, including Aaron Glatt, chairman of the department of medicine at Mount Sinai South Nassau in Oceanside, N.Y. "Droplets can go out the side. It's a risk," he says.

Dr. Glatt, who is also the hospital's chief of infectious diseases, thinks they can help in a hospital setting. He doesn't recommend wearing face shields in the community because he doesn't feel it will reduce risk for the everyday wearer who is already wearing a mask. But he does think it makes sense to pair shields with masks for barbers, dentists and personal trainers who may require more protection.

When do face shields alone make the most sense?

Schools, especially with younger children, may benefit from offering face shields to students and teachers. Dr. Ostrosky says children liable to touch the masks or take them off need an alternative.

Face shields may also work best in settings like restaurants or coffee shops where employees must communicate with people. Masks "are a communication barrier in some settings," Dr. McQuillen says.

Which materials and other specs are best?

Opt for shields with any kind of sturdy, clear, waterproof plastic and those that use foam to fill gaps at the forehead or attach securely to a hat or visor, Dr. Edmond says. "If the coughing person is on the taller side, the droplets may come over," he says. The shield also needs to reach to the ears and just slightly below the chin, he says.

What's the most effective way to clean and take off the shield?

Taking off personal protective equipment is key to preventing infection, Dr. Omer says. He recommends face-shield users disinfect their hands and slip off the shield without touching the clear plastic, especially the inside. Use a disinfectant spray, alcohol wipe or rinse with soap and water before putting it away in a place where it cannot get contaminated.

How can consumers purchase them?

Online retailers like Amazon and office stores like OfficeMax offer face shields for $3 to $15 each. Etsy offers colorful face shields for children.

Some companies, including Midwest Prototyping, that already provide shields to hospitals are also starting to sell to consumers. Additionally, the University of Wisconsin-Madison offers open-source shield design for its Badger Shield, which is being used both in hospitals and nonmedical settings, says Lennon Rodgers, director of the university's Grainger Engineering Design Innovation Lab.

What are the downsides to wearing a face shield?

With masks more popular, many are reluctant to switch or add additional face covering. "It's awkward and puts a barrier between you and others. We've never done that," says Dr. Ostrosky. "To a certain extent it's a big behavioral and appearance change."

SHARE YOUR THOUGHTS

Have you tried a face shield? If so, how does it compare with a mask? Join the conversation below.