NOVA SCOTIA
Health and Wellness
Office of the Deputy Minister

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September 9, 2021

Shelly Hipson
RR3, Shelburne
Nova Scotia B0T1W0

Dear Shelly Hipson:

Re: You are entitled to part of the information you requested – 2021-01108-HEA

The Department of Health and Wellness received your application for access to information under the *Freedom of Information and Protection of Privacy Act* on June 15, 2021.

In your application, you requested a copy of the following records:

> *All scientific data, correspondence and studies that justify/support the government's actions (1) to lock down and restrict the freedom of movement of Nova Scotians and (2) the wearing of face masks - reduce the spread of Covid-19 held by staff within any program, branch, or office in the department that has been working on the development and implementation of COVID-19 government restrictions as outlined above. (Date Range for Record Search: From 3/1/2020 To 6/3/2021)*

You are entitled to part of the records requested. However, we have removed some of the information from this record according to subsection 5(2) of the *Act*. The severed information is exempt from disclosure under the Act for the following reasons:

1. Section 14: Advice to public body or minister

   Section 14(1) The head of a public body may refuse to disclose to an applicant information that would reveal advice, recommendations or draft regulations developed by or for a public body or a minister.

2. Section 16: Information that would reveal information that is subject to solicitor-client privilege according to Section 16:

   Section 16 The head of a public body may refuse to disclose to an applicant information that is subject to solicitor-client privilege.

3. Section 20: Information that would be an unreasonable invasion of the privacy of individuals mentioned in the records

   Section 20 (1) The head of a public body shall refuse to disclose personal information to an applicant if the disclosure would be an unreasonable invasion of a third party's personal privacy

We are refusing access to a portion of the records for the following reason pursuant to subsection 4(2) of the Act:

Section 4(2)(a): Published Material

The Act does not apply to the following kinds of information in the custody or control of a public body:

- published information, material available for purchase and material that is a matter of public record.

The remainder of the records are enclosed.

Nova Scotia's Covid - 19 response actions have been based on national and international guidance from the Public Health Agency of Canada (PHAC) and the World Health Organization (WHO). As the leading agencies for pandemic response nationally and internationally, both PHAC and WHO are continuously reviewing the evolving scientific evidence regarding COVID-19 and the effectiveness of various measures. These reviews are used to form their guidance, position statements, and other documents all of which are in the public domain.

The Government of Canada's resources, including COVID-19 guidance documents, are available at https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19.html.

The WHO's resources, including COVID-19 technical guidance, are available at https://www.who.int/emergencies/diseases/novel-coronavirus-2019.

The Department of Health and Wellness Public Health Branch continues to be in ongoing contact with PHAC and WHO as evidence has evolved throughout the pandemic. This includes as a participant in federal/provincial/territorial conversations, including committees and networks. This has enabled recommendations on public health measures to be informed by the most up to date evidence.

You have the right to ask for a review of this decision by the Information Access and Privacy Commissioner (formerly the Review Officer). You have 60 days from the date of this letter to exercise this right. If you wish to ask for a review, you may do so on Form 7, a copy of which is attached. Send the completed form to the Information Access and Privacy Commissioner, P.O. Box 181, Halifax, Nova Scotia B3J 2M4.

Please be advised that a de-identified copy of this disclosure letter and the attached response to your FOIPOP application will be made public after 14 days. The package will be posted online at https://openinformation.novascotia.ca/. The letter will not include your name, address or any other personal information that you have supplied while making your application under FOIPOP.

Please contact Tim Gregory at 902-424-3773 or by e-mail at timothy.gregory@novascotia.ca, if you need further assistance regarding this application.

Sincerely,

Craig Beaton
Associate Deputy Minister

Attachment

From: Office of the Chief Medical Officer of Health
To: Strang, Robert; Watson-Creed, Gaynor; Sommers, Ryan; Kempkens, Daniela; Cram, Jennifer; Jackman, Jessica F; Sarbu, Claudia; Earle, Lynda inc#478781 kg; Hmidan, Cara-Leah; Piek, Krista; Burghgraef, Paula; Jackman, Jessica F; MacNeil, Cheryl
Cc: Dean, Kelly E; O"Toole, Gary; Best, Angela; Hebb, Catherine W; Arseneau, Marc; DeSantis, Marcia; Broesch, James; Holmes, Elaine; Cole, Teri J; Passerini, Linda; Ryan, Colleen F; Boland, Melissa L; Billard, Bev A; Nichols, Michaela; Dohoo, Carolyn; Wuite, Sara; Shaver, Ali
Subject: OCMOH Position Statement - COVID-19 and the Use of Non-Medical Masks in the Community – May 8, 2020
Date: May 13, 2020 3:01:29 PM
Attachments: OCMOH Position Statement - NMM 20200508.pdf

Good afternoon,

The OCMOH Position Statement, *COVID-19 and the Use of Non-Medical Masks in the Community* dated May 8, 2020, has been approved for circulation to Public Health. This document has been posted on the *Information for Professionals - Emerging Issues* section of the CDPC website which may be found here: https://novascotia.ca/dhw/cdpc/coronavirus-documents.asp

This document outlines:

- recommendations and considerations for the use of a non-medical mask in the prevention of community transmission of COVID-19
- safe and appropriate practices when wearing a non-medical mask

Please distribute this information to individuals/teams within Public Health as needed.

The website also has information for the general public: https://novascotia.ca/coronavirus/staying-healthy/#masks

NOVEL CORONAVIRUS (COVID-19)

novascotia.ca/coronavirus

NOVA SCOTIA

Office of the Chief Medical Officer of Health
Position Statement: COVID-19 and the Use of Non-Medical Masks in the Community
May 8, 2020

Position

The Office of the Chief Medical Officer of Health (OCMOH) recognizes that there are many questions about the use of non-medical masks (NMMs) to prevent the community transmission of COVID-19.

The use of NMMs in the community needs to be considered along with other core personal public health measures for the prevention of COVID-19. These are:

- staying informed, being prepared and following public health advice
- proper hand hygiene and respiratory etiquette
- physical distancing of 2 metres (6 feet) from others outside of your household
- avoidance of touching one's face, mouth, nose or eyes
- increased cleaning of common, high touch surfaces (e.g. counter tops, doorknobs, taps) in one's personal environment (home, personal workspace) with a disinfecting cleaning product
- staying at home when symptomatic or ill
- staying at home as much as possible if at high risk of severe illness
- reducing personal non-essential travel

The OCMOH **recommends** that individuals in the community wear a NMM if they have respiratory symptoms (cough, sneezing), and, will be in close contact with others or when going out to access medical care or other essential health services.

Given the evidence of transmission of the virus that causes COVID-19 by asymptomatic or mildly symptomatic people, **consideration should be given** to the use of a NMM by anyone in situations when exposure to crowded public spaces is unavoidable and consistent physical distancing is not possible (i.e. public transportation, stores and shopping areas and group living situations). If used widely and correctly and on a risk basis, NMMs can reduce viral transmission. The safe and appropriate use[1] of a NMM is an additional public health practice that can be taken to protect others.

NMMs should[1]:

- allow for easy breathing
- fit securely to the head with ties or ear loops
- maintain their shape after washing and drying

- be changed as soon as possible if damp or dirty
- be comfortable and not require frequent adjustment
- be made of at least 2 layers of tightly woven material fabric (such as cotton or linen)
- be large enough to completely and comfortably cover the nose and mouth without gaping

NMMs should not[1]:
- be shared with others
- impair vision or interfere with tasks
- be placed on children under the age of 2 years
- be made of plastic or other non-breathable materials
- be secured with tape or other inappropriate materials
- be made exclusively of materials that easily fall apart, such as tissues
- be placed on anyone unable to remove them without assistance or anyone who has trouble breathing

The OCMOH continues to monitor evidence on the use of NMMs and local spread of COVID-19. As evidence and understanding of community transmission evolves, the recommendations and guidance in this position statement may change.

Background

The use of masks for the general public has been reviewed as a possible consideration among various COVID-19 pandemic mitigation strategies. The Public Health Agency of Canada has provided advice that Canadians can use NMMs along with physical distancing, hand hygiene, and other measures to limit the transmission of COVID-19[1]. The World Health Organization revised guidance[2] on the use of masks in the context of COVID-19, emphasizing conservation of medical masks for healthcare workers, the importance of other infection prevention measures, and providing a framework[3] for decision makers when considering public masking.

Globally, medical masks are in short supply and their use should be reserved for health care workers. The use of NMMs in the community setting has not been well evaluated. There is no definitive research demonstrating that wearing a NMM in the community protects the person wearing it. However, the use of a NMM is potentially beneficial in preventing an infected person from transmitting virus by limiting spread of respiratory droplets. This may be particularly valuable in settings outside of the person's household. Wearing a NMM is not a substitute for physical distancing, hand washing and other core personal public health measures.

References

1. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks/about-non-medical-masks-face-coverings.html

2. https://www.who.int/publications-detail/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak

3. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-on-covid-19-and-masks

Boland, Melissa L

From: Boland, Melissa L
Sent: May 19, 2020 2:50 PM
To: Preeper, Andrew R
Subject: RE: NMM website language
Attachments: Mask update May 19_AP_MB.docx

Ok, 14(1)

Thanks,
Melissa

From: Preeper, Andrew R <Andrew.Preeper@novascotia.ca>
Sent: May 19, 2020 2:44 PM
To: Boland, Melissa L <Melissa.Boland@novascotia.ca>
Subject: RE: NMM website language

14(1)

From: Boland, Melissa L
Sent: May 19, 2020 2:20 PM
To: Preeper, Andrew R <Andrew.Preeper@novascotia.ca>
Subject: RE: NMM website language

Hi Andrew-

14(1)

Thanks,
Melissa

From: Preeper, Andrew R <Andrew.Preeper@novascotia.ca>
Sent: May 19, 2020 2:03 PM
To: Boland, Melissa L <Melissa.Boland@novascotia.ca>
Subject: RE: NMM website language

See attached. Are you ok with this? 14(1)
14(1)

From: Boland, Melissa L
Sent: May 19, 2020 9:22 AM

To: Preeper, Andrew R <Andrew.Preeper@novascotia.ca>
Subject: NMM website language

Hi Andrew-

Based on PHAC's new recommendation with the caveat that PH officials will make their own recommendations based on epi and rates of transmission, below is what I am proposing. 14(1)

14(1)

Thanks,

Melissa

14(1)

From: Doyle-Bedwell, George H
To: Stevens, Catherine L; alkesh.patel@medportal.ca; Armstrong, Brooke J; Billard, Bev A; Boland, Melissa L; Bourke, Kevin; Broesch, James; Cole, Teri J; Comeau, Jeannette; Cram, Jennifer; Davis, Heather; Davis, Ian; Dean, Kelly E; Earle, Lynda inc#478781 kg; Fairbairn, Heather J; Fuller, Adrian M; Hatchette, Todd; Holmes, Elaine; Howlett, Todd; Jackman, Jessica F; Kempkens, Daniela; Lamb, Alyson; MacDonald, Tammy; McNeil, Shelly; O''Toole, Gary; Passerini, Linda; Preeper, Andrew R; Rankin, Carole E; Ryan, Colleen F; Sarbu, Claudia; Strang, Robert; Watson-Creed, Gaynor; White, Noma; Wilson, Rod; Wong-Petrie, Karen; Barro, Kimberlee X; Boutilier, Andy P; Sommers, Ryan
Cc: Doyle-Bedwell, George H
Subject: RE: OCMOH IMT Meeting
Date: June 3, 2020 1:31:39 PM
Attachments: Chu, Schünemann et al (Jun 1 2020) - Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19.pdf
MacIntyre & Wang (Jun 1 2020) - Lancet Comment - Physical distancing, face masks, and eye protection to prevention of COVID-19.pdf

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Dear All:

Here are some reviews of the Lancet article for your review.

Thank you
Take Care
George

From: Doyle-Bedwell, George H <George.Doyle-Bedwell@novascotia.ca>
Sent: June 3, 2020 12:56 PM
To: Stevens, Catherine L <Catherine.L.Stevens@novascotia.ca>; alkesh.patel@medportal.ca; Armstrong, Brooke J <Brooke.Armstrong@novascotia.ca>; Billard, Bev A <Bev.Billard@novascotia.ca>; Boland, Melissa L <Melissa.Boland@novascotia.ca>; Bourke, Kevin <Kevin.Bourke@nshealth.ca>; Broesch, James <James.Broesch@nshealth.ca>; Cole, Teri J <Teri.Cole@novascotia.ca>; Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; 20(1) @gmail.com>; Davis, Ian <Ian.Davis@nshealth.ca>; Dean, Kelly E <Kelly.Dean@novascotia.ca>; Earle, Lynda inc#478781 kg <Lynda.Earle@nshealth.ca>; Fairbairn, Heather J <Heather.Fairbairn@novascotia.ca>; Fuller, Adrian M <Adrian.Fuller@novascotia.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Howlett, Todd <Todd.Howlett@nshealth.ca>; Jackman, Jessica F <JessicaF.Jackman@nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Lamb, Alyson <Alyson.Lamb@iwk.nshealth.ca>; MacDonald, Tammy <Tammy.MacDonald@nshealth.ca>; McNeil, Shelly <Shelly.McNeil@nshealth.ca>; O'Toole, Gary <Gary.OToole@nshealth.ca>; Passerini, Linda <Linda.Passerini@novascotia.ca>; Preeper, Andrew R <Andrew.Preeper@novascotia.ca>; Rankin, Carole E <Carole.Rankin@novascotia.ca>; Ryan, Colleen F <Colleen.Ryan@novascotia.ca>; Sarbu, Claudia <Claudia.Sarbu@nshealth.ca>; Strang, Robert <Robert.Strang@novascotia.ca>; Watson-Creed, Gaynor <Gaynor.Watson-Creed@novascotia.ca>; White, Noma <NomaR.White@nshealth.ca>; 20(1) @gmail.com>; Wong-Petrie, Karen <Karen.Wong-Petrie@novascotia.ca>; Barro, Kimberlee X <Kimberlee.Barro@novascotia.ca>; Boutilier, Andy P <Andy.Boutilier@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>
Cc: Doyle-Bedwell, George H <George.Doyle-Bedwell@novascotia.ca>
Subject: RE: OCMOH IMT Meeting

Dear All:

Here is the Lancet article we discussed on today's OCMOH IMT call. Thank you, Dr. Watson-Creed, for sending it!

Enjoy

Take Care
George

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.

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June 1, 2020
https://doi.org/10.1016/S0140-6736(20)31142-9

See Online/Comment
https://doi.org/10.1016/S0140-6736(20)31183-1

*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

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

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

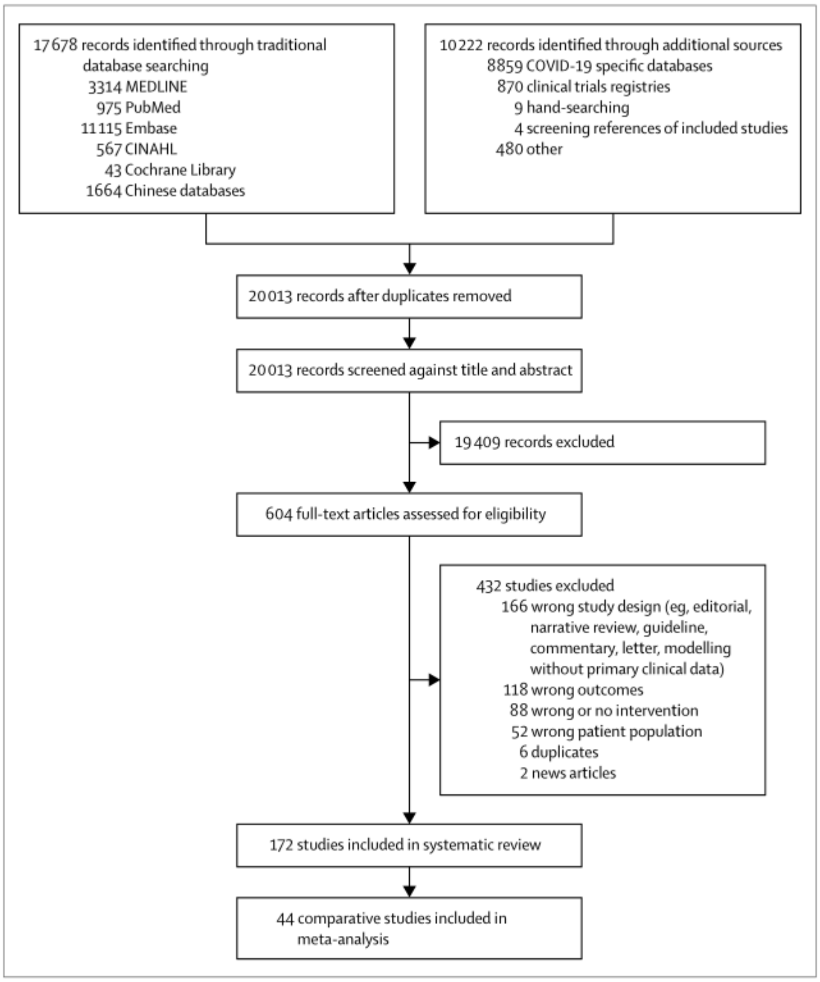

Figure 1: **Study selection**

	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)

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	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

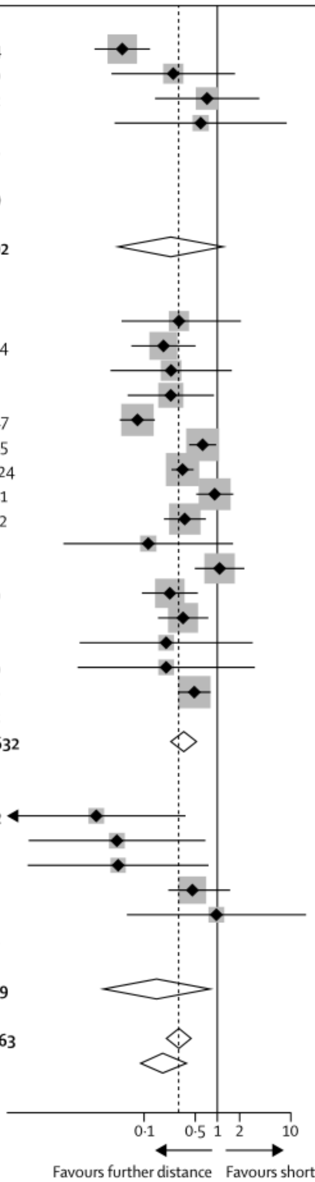

Figure 2: **Forest plot showing the association of COVID-19, SARS, or MERS exposure proximity with infection**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative risk. *Estimated values; sensitivity analyses 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)[21] 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.

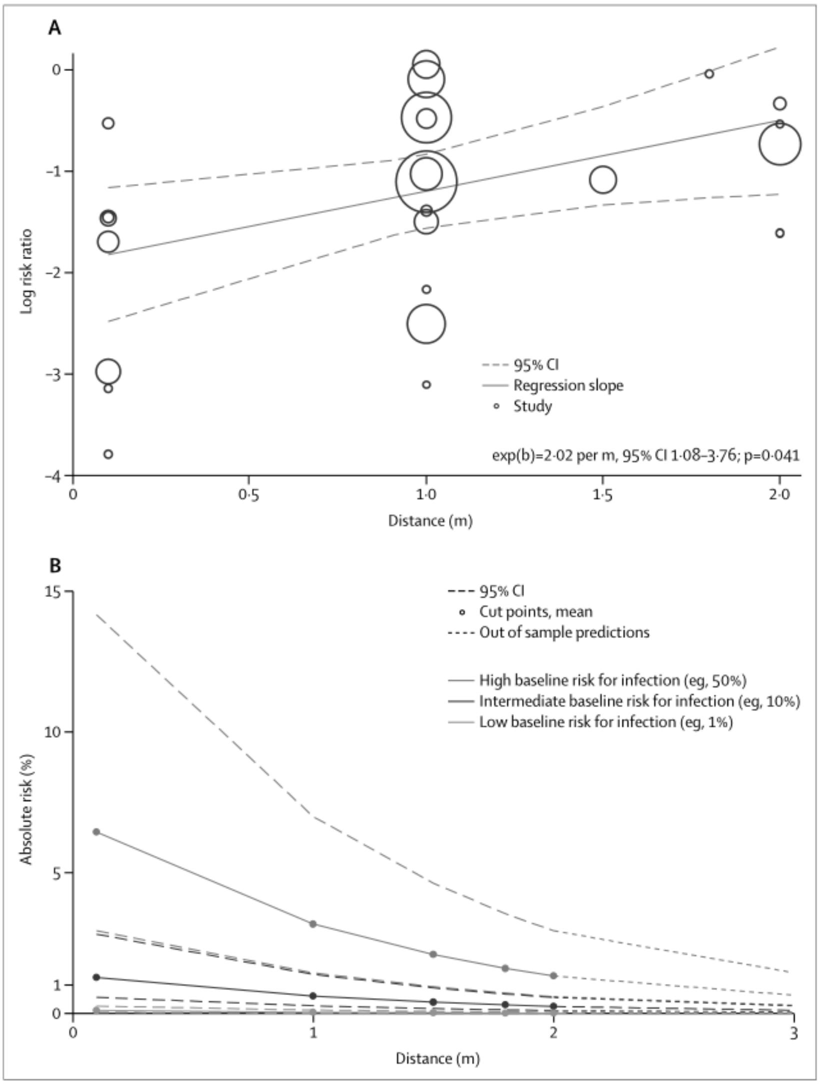

***Figure 3:* Change in relative risk with increasing distance and absolute risk with increasing distance**
Meta-regression of change in relative risk with increasing distance from an infected individual (A). Absolute risk of transmission from an individual infected with SARS-CoV-2, SARS-CoV, or MERS-CoV 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

Study	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

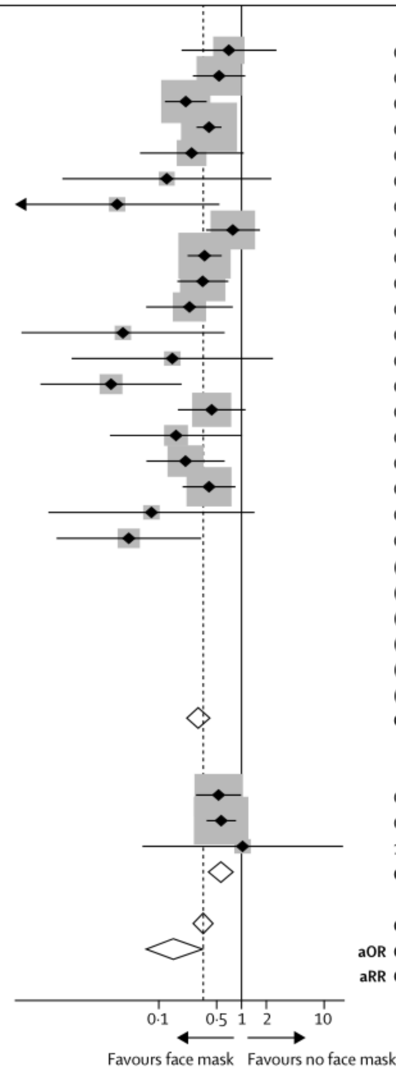

***Figure 4:* Forest plot showing unadjusted estimates for the association of face mask use with viral infection causing COVID-19, SARS, or MERS**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative risk.

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.

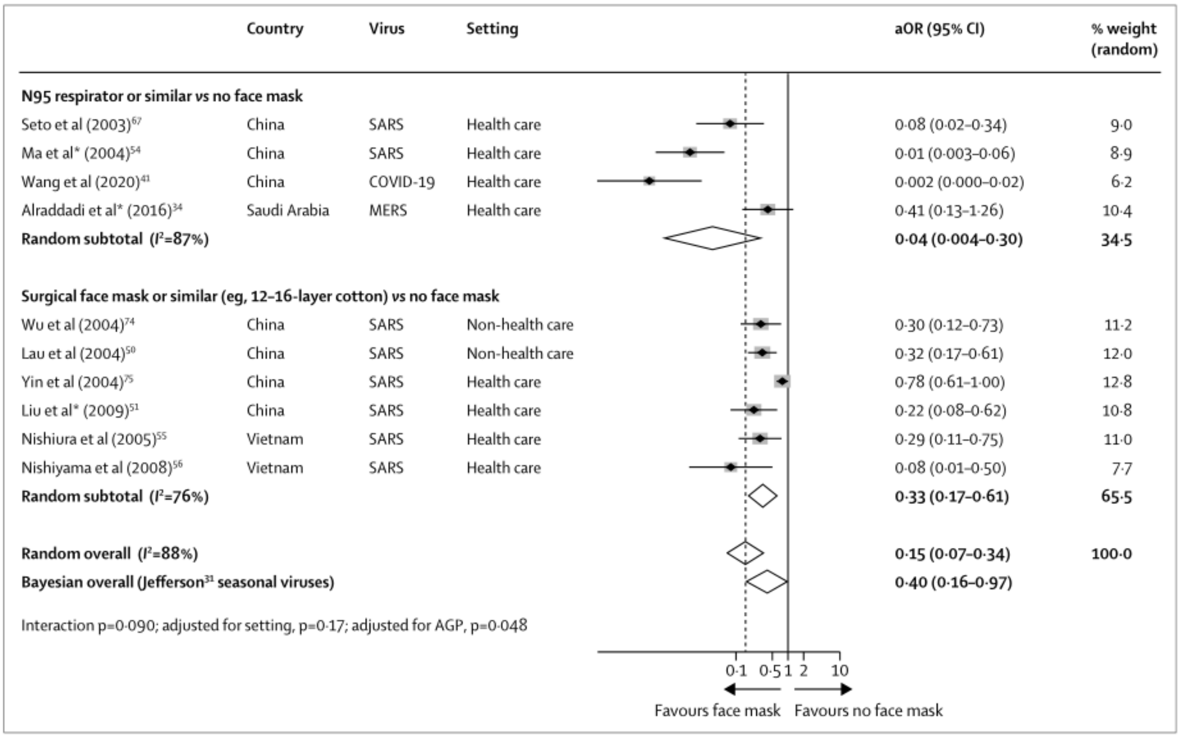

Figure 5: **Forest plot showing adjusted estimates for the association of face mask use with viral infection causing COVID-19, SARS, or MERS**
SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. AGP=aerosol-generating procedures. *Studies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

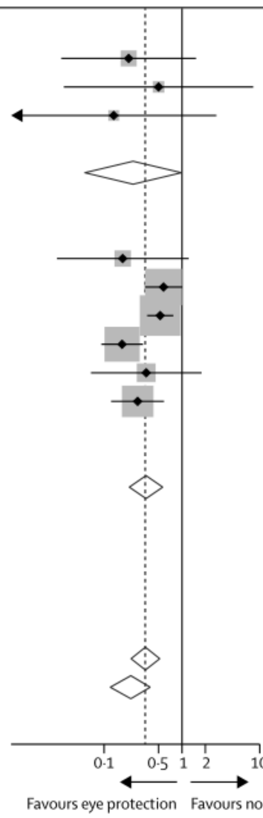

***Figure 6*: Forest plot showing the association of eye protection with risk of COVID-19, SARS, or MERS transmission**
Forest plot shows unadjusted estimates. SARS=severe acute respiratory syndrome. MERS=Middle East respiratory syndrome. RR=relative risk. aOR=adjusted odds ratio. aRR=adjusted relative 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 face mask use between settings. The credibility of effect-modification across settings was, therefore, low. Wearing face masks was also acceptable and feasible. Policy makers at all levels should, therefore, strive to address equity implications for groups with currently limited access to face masks and eye protection. One concern is that face mask use en masse could divert supplies from people at highest risk for infection.[10] Health-care workers are increasingly being asked to ration and reuse PPE,[82,83] leading to calls for government-directed repurposing of manufacturing capacity to overcome mask shortages[84] and finding solutions for mask use by the general public.[84] In this respect, some of the masks studied in our review were reusable 12–16-layer cotton or gauze masks.[51,54,61,75] At the moment, although there is consensus that SARS-CoV-2 mainly spreads through large droplets and contact, debate continues about the role of aerosol,[2–8,85,86] but our meta-analysis provides evidence (albeit of low certainty) that respirators might have a stronger protective effect than surgical masks. Biological plausibility would be supported by data for aerosolised SARS-CoV-2[5–8] and preclinical data showing seasonal coronavirus RNA detection in fine aerosols during tidal breathing,[87] albeit, RNA detection does not necessarily imply replication and infection-competent virus. Nevertheless, our findings suggest it plausible that even in the absence of aerosolisation, respirators might be simply more effective than masks at preventing infection. At present, there is no data to support viable virus in the air outside of aerosol generating procedures from available hospital studies. Other factors such as super-spreading events, the subtype of health-care setting (eg, emergency room, intensive care unit, medical wards, dialysis centre), if aerosolising procedures are done, and environmental factors such as ventilation, might all affect the degree of protection afforded by personal protection strategies, but we did not identify robust data to inform these aspects.

Strengths of our review include adherence to full systematic review methods, which included artificial intelligence-supported dual screening of titles and abstracts, full-text evaluation, assessment of risk of bias, and no limitation by language. We included patients infected with SARS-CoV-2, SARS-CoV, or MERS-CoV and searched relevant data up to May 3, 2020. We followed the GRADE approach[16] to rate the certainty of evidence. Finally, we identified and appraise a large body of published work from China, from which much evidence emerged before the pandemic spread to other global regions.

The primary limitation of our study is that all studies were non-randomised, not always fully adjusted, and might suffer from recall and measurement bias (eg, direct contact in some studies might not be measuring near distance). However, unadjusted, adjusted, frequentist, and Bayesian meta-analyses all supported the main findings, and large or very large effects were recorded. Nevertheless, we are cautious not to be overly certain in the precise quantitative estimates of effects, although the qualitative effect and direction is probably of high certainty. Many studies did not provide information on precise distances, and direct contact was equated to 0 m distance; none of the eligible studies quantitatively evaluated whether distances of more than 2 m were more effective, although our meta-regression provides potential predictions for estimates of risk. Few studies assessed the effect of interventions in non-health-care settings, and they primarily evaluated mask use in households or contacts of cases, although beneficial associations were seen across settings. Furthermore, most evidence was from studies that reported on SARS and MERS (n=6674 patients with COVID-19, of 25 697 total), but data from these previous epidemics provide the most direct information for COVID-19 currently. We did not specifically assess the effect of duration of exposure on risk for transmission, although whether or not this variable was judged a risk factor considerably varied across studies, from any duration to a minimum of 1 h. Because of inconsistent reporting, information is limited about whether aerosol-generating procedures were in place in studies using respirators, and whether masks worn by infected patients might alter the effectiveness of each intervention, although the stronger association with N95 or similar respirators over other masks persisted when adjusting for studies reporting aerosol-generating medical procedures. These factors might account for some of the residual statistical heterogeneity seen for some outcomes, albeit I^2 is commonly inflated in meta-analyses of observational data,[21,22] and nevertheless the effects seen were large and probably clinically important in all adjusted studies.

Our comprehensive systematic review provides the best available information on three simple and common interventions to combat the immediate threat of COVID-19, while new evidence on pharmacological treatments, vaccines, and other personal protective strategies is being generated. Physical distancing of at least 1 m is strongly associated with protection, but distances of up to 2 m might be more effective. Although direct evidence is limited, the optimum use of face masks, in particular N95 or similar respirators in health-care settings and 12–16-layer cotton or surgical masks in the community, could depend on contextual factors; action is needed at all levels to address the paucity of better evidence. Eye protection might provide additional benefits. Globally collaborative and well conducted studies, including randomised trials, of different personal protective strategies are needed regardless of the challenges, but this systematic appraisal of currently best available evidence could be considered to inform interim guidance.

Contributors

DKC, EAA, SD, KS, SY, and HJS designed the study. SY, SD, KS, and HJS coordinated the study. SY and LH designed and ran the literature search. All authors acquired data, screened records, extracted data, and assessed risk of bias. DKC did statistical analyses. DKC and HJS wrote the report. All authors provided critical conceptual input, analysed and interpreted data, and critically revised the report.

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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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Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Chu DK, Akl EA, Duda S, et al. 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. *Lancet* 2020; published online June 1. https://doi.org/10.1016/S0140-6736(20)31142-9.

Supplementary material

Physical distancing, face masks, and eye protection to prevent person-person SARS-CoV2 and COVID-19 transmission: A systematic review and meta-analysis

The COVID-19 Systematic Urgent Review Group Effort (SURGE) Study Group

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Contents:

Appendix 1. Search strategies for the different databases ran on March 26, 2020. Preprint and coronavirus searches were run daily until May 3, 2020.

We developed the search strategy with the assistance of an information specialist experienced with systematic reviews (LH). Two information specialists (Ms. Neera Bhatnagar and Ms. Aida Farha) peer reviewed the search strategy. Other members of the team, particularly the content experts provided feedback to the search strategy. The strategies combined medical subject headings (MeSH) and keywords for the two following concepts: COVID-19 and personal protection by any of physical distancing, masks, or eye protection. PubMed search terms were informed by the Biomedical Information of the Dutch Library Association specialists curated search blocks at https://blocks.bmi-online.nl/catalog/397.

Medline (OVID)

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to March 26, 2020

1 (pneumonia/ or pneumonia, viral/ or exp Viruses/) and (exp Disease Outbreaks/ or exp Epidemiology/ or Epidemiology.fs.) (104129)

2 coronaviridae/ or exp coronavirus/ or exp Coronavirus Infections/ or exp Betacoronavirus/ (15998)

3 (Betacoronavirus or Beta-coronavirus or Coronavirus* or COVID).mp. (14380)

4 1 or 2 or 3 (121096)

5 limit 4 to ez="20191101-20200325" (1524)

6 (("2019" adj (novel or new) adj corona*) or ("2019" adj (CoV or nCoV)) or (coronavirus adj (disease adj "2019")) or COVID19 or COVID-19 or ((Novel or New) adj Corona*) or SARS2 or SARS-CoV-2 or (SARS adj2 (coronaviridae or coronavirus)) or ((sars or Coronavirus) adj "2") or nCov or 2019ncov).mp. (4983)

7 5 or 6 (5522)

8 (Mask? or facemask? or face-mask? or ppe or (body adj substance* adj isolati*) or bsi or (infect* adj prevent* adj control*) or ipc or N95 or ffp or ffp1 or ffp3 or ffp2 or (filter* adj face adj piece) or ((face or respiratory or eye) adj2 (shield or equipment? or protect* or cover*)) or ((airborne or air-borne or droplet*) adj precau*) or N99 or N97 or respirator? or goggle? or ((patient? or person* or individual?) adj1 isolat*) or distanc* or space or spacing or separation or (aerosol adj generat* adj procedur*) or ((safety or protective) adj (supply or supplies or device* or equipment? or material* or measure* or gear?)) or (safely adj1 equipped) or meter? or metre? or foot or feet or (non-pharm* adj intervention*) or ((physical or person*) adj (intervention* or barrier? or protect*)) or transmission* or contamination? or shedding? or fomite? or gap? or ((head or face) adj cover?) or (protective adj clothing?)).mp. or masks/ or protective devices/ or personal protective equipment/ or respiratory protective devices/ or Eye Protective Devices/ (2489045)

9 7 and 8 (3314)

PubMed

Search Query

#7 Search ((((#4 OR #5))) AND (((mask[tw] OR masks[tw] OR facemask[tw] OR facemasks[tw] OR face-mask[tw] OR face-masks[tw] OR PPE[tw] OR body substance isolation*[tw] OR bsi[tw] OR infection prevention control*[tw] OR ipc[tw] OR N95[tw] OR ffp[tw] OR ffp1[tw] OR ffp3[tw] OR ffp2[tw] OR N97[tw] OR N99[tw] OR physical barrier*[tw] OR physical intervention*[tw] OR physical protection*[tw] OR personal protection*[tw] OR person protection*[tw] OR transmission[tw] OR transmissions[tw] OR contamination[tw] OR contaminations[tw] OR shedding[tw] OR fomite[tw] OR gap[tw] OR gaps[tw] OR non-pharm intervention*[tw] OR non-pharmaceutical intervention*[tw] OR distancing[tw] OR space [tw] OR distances[tw] OR spacing[tw] OR separation[tw] OR respirator[tw] OR respirators[tw] OR aerosol-generating procedure*[tw] OR patient isolation*[tw] OR patient isolator*[tw] OR person isolation[tw] OR person isolator*[tw] OR individual isolation[tw] OR individual isolator*[tw] OR filtering face piece[tw] OR filtering face piece*[tw] OR [tw] OR face protection*[tw] OR face shield*[tw] OR face protective device*[tw] OR face protective gear*[tw] OR eye protection*[tw] OR eye shield*[tw] OR eye protective device*[tw] OR eye protective gear*[tw] OR airborne precaution*[tw] OR droplet precautions*[tw] OR safety supply*[tw] OR safety supplies*[tw] OR safety device*[tw] OR safety equipment*[tw] OR safety measure*[tw] OR safety gear*[tw] OR protective supply*[tw] OR protective supplies*[tw] OR protective device*[tw] OR protective equipment*[tw] OR protective measure*[tw] OR protective gear*[tw] OR person isolation[tw] OR personal isolation[tw] OR individual isolation[tw] OR respirator[tw] OR respirators[tw] OR respiratory protection*[tw] OR respiratory protective device*[tw] OR respiratory protective supply*[tw] OR respiratory protective supplies*[tw] OR respiratory protective equipment*[tw] OR respiratory protective gear*[tw] OR safely equipped*[tw] OR meter[tw] OR metre[tw] OR foot[tw] OR feet[tw] OR meters[tw] OR metres[tw] OR head cover*[tw] OR face cover*[tw] OR eye cover*[tw] OR goggle*[tw] OR protective clothing*[tw])) OR (((("Masks"[Mesh:NoExp]) OR "Protective Devices"[Mesh]) OR "Personal Protective Equipment"[Mesh:NoExp]) OR "Respiratory Protective Devices"[Mesh:NoExp] OR "Eye Protective Devices"[Mesh:NoExp])))

#6 Search ((#4 OR #5))

#5 Search (((2019-novel-corona* OR 2019-new-corona* OR novel-corona* OR new-corona* OR 2019-Cov OR 2019-nCov OR nCov OR coronavirus disease-2019 OR SARS2 OR SARS-2 OR SARS-CoV-2 OR sars cORona* OR CORonavirus-2 OR 2019ncov)))

#4 Search ((((#1 OR #2 OR #3) AND 2019/11:2020/03 [crdt])))

#3 Search (((BetacORonavirus[tw] OR Beta-cORonavirus[tw] OR corona[tw] OR corona'[tw] OR corona's[tw] OR OR coronaviral[tw] OR coronavirdae[tw] OR coronavirida[tw] OR coronaviridae[tw] OR coronaviridea[tw] OR coronaviridiae[tw] OR coronavirinae[tw] OR coronavirion[tw] OR coronavirions[tw] OR coronavirologists[tw] OR coronavirology[tw] OR coronaviroses[tw] OR coronavirous[tw] OR coronavirues[tw] OR coronavirus[tw] OR coronavirus'[tw] OR coronavirus's[tw] OR

coronaviruscpe[tw] OR coronaviruse[tw] OR coronaviruses[tw] OR coronaviruses'[tw] OR coronaviruslike[tw] OR coronaviser[tw] OR coronaviurs[tw] OR coronaviuses[tw] OR coronavrius[tw] OR coronavvirus[tw] OR COVID[tw])))
#2 Search ((((pneumonia[Mesh:noexp] OR pneumonia, viral[Mesh:noexp] OR Viruses[Mesh]) and ("Disease Outbreaks"[Mesh] OR Epidemiology[Mesh] OR Epidemiology [Mesh subject heading]))))
#1 Search (((cORonaviridae[Mesh:noexp] OR cORonavirus[Mesh] OR "Coronavirus Infections"[Mesh] OR BetacORonavirus[Mesh])))

EMBASE

No. **Query**
#18 #7 AND #17
#17 #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16
#16 'mask'/de OR 'protective equipment'/de OR 'respiratory protection'/de OR 'eye mask'/de
#15 meter$:ti,ab,kw OR metre$:ti,ab,kw OR foot:ti,ab,kw OR feet:ti,ab,kw OR (('non pharm*' NEXT/0 intervention*):ti,ab,kw) OR (((physical OR person*) NEXT/0 (intervention* OR barrier$ OR protect*)):ti,ab,kw) OR transmission*:ti,ab,kw OR contamination$:ti,ab,kw OR shedding$:ti,ab,kw OR fomite$:ti,ab,kw OR gap$:ti,ab,kw
#14 ((filter* NEXT/0 face NEXT/0 piece):ti,ab,kw) OR (((face OR respiratory OR eye) NEAR/2 (shield OR equipment$ OR protect* OR cover$)):ti,ab,kw)
#13 ((safety OR protective) NEXT/0 (supply OR supplies OR device* OR equipment? OR material* OR measure* OR gear$)) AND ti,ab,kw OR ((safely NEAR/1 equipped):ti,ab,kw)
#12 distanc*:ti,ab,kw OR space:ti,ab,kw OR spacing:ti,ab,kw OR separation:ti,ab,kw OR ((aerosol NEXT/0 generat* NEXT/0 procedur*):ti,ab,kw)
#11 (((airborne OR 'air borne' OR droplet$) NEXT/0 precau*):ti,ab,kw) OR n99:ti,ab,kw OR n97:ti,ab,kw OR goggle$:ti,ab,kw OR respirator$:ti,ab,kw OR (((patient$ OR person* OR individual$) NEXT/0 isolat*):ti,ab,kw)
#10 ((filter* NEXT/0 face NEXT/0 piece):ti,ab,kw) OR (((face OR respiratory) NEAR/2 (shield OR equipment$ OR protect*)):ti,ab,kw)
#9 'ppe':ti,ab,kw OR ((body NEXT/0 substance$ NEXT/0 isolati*):ti,ab,kw) OR bsi:ti,ab,kw OR ((infect* NEXT/0 prevent* NEXT/0 control*):ti,ab,kw) OR ipc:ti,ab,kw OR n95:ti,ab,kw OR ffp:ti,ab,kw OR ffp1:ti,ab,kw OR ffp3:ti,ab,kw OR ffp2:ti,ab,kw
#8 mask$:ti,ab,kw OR facemask$:ti,ab,kw OR 'face mask':ti,ab,kw
#7 #5 OR #6
#6 ((2019 NEXT/0 novel):ti,ab,kw) OR ((2019 NEXT/0 cov):ti,ab,kw) OR ((coronavirus NEXT/0 disease NEXT/0 2019):ti,ab,kw) OR covid19:ti,ab,kw OR 'covid 19':ti,ab,kw OR (((novel OR new) NEXT/0 corona*):ti,ab,kw) OR sars2:ti,ab,kw OR 'sars cov 2':ti,ab,kw OR ((sars NEAR/2 coronaviridae):ti,ab,kw) OR coronavirus:ti,ab,kw OR sars:ti,ab,kw OR ((coronavirus NEXT/0 '2'):ti,ab,kw) OR ncov:ti,ab,kw OR 2019ncov:ti,ab,kw
#5 #4 AND [1-11-2019]/sd
#4 #1 OR #2 OR #3
#3 betacoronavirus:ti,ab,kw OR 'beta coronavirus':ti,ab,kw OR coronavirus*:ti,ab,kw OR covid:ti,ab,kw
#2 'coronaviridae'/exp OR 'coronavirus infection'/exp OR 'betacoronavirus'/exp
#1 ('pneumonia'/de OR 'virus pneumonia'/de OR 'virus'/exp) AND ('epidemic'/exp OR 'epidemiology'/exp OR epidemiology:lnk)

CINAHL (OVID)

Cochrane Library

ID	**Search**	**Hits**
#1	MeSH descriptor: [Pneumonia, Viral] this term only	51
#2	MeSH descriptor: [Pneumonia] this term only	1976
#3	MeSH descriptor: [Viruses] explode all trees	8746
#4	#1 OR #2 OR #3	10734
#5	MeSH descriptor: [Disease Outbreaks] explode all trees	262
#6	MeSH descriptor: [Epidemiology] explode all trees	37
#7	(Epidemiology):ti,ab,kw	48587
#8	#5 OR #6 OR #7	48682
#9	#4 AND #8	1315
#10	MeSH descriptor: [Coronaviridae] this term only	0
#11	MeSH descriptor: [Coronavirus] explode all trees	11
#12	MeSH descriptor: [Coronavirus Infections] explode all trees	12
#13	MeSH descriptor: [Betacoronavirus] explode all trees	10
#14	(Betacoronavirus or Beta-coronavirus or Coronavirus* or COVID):ti,ab,kw	98
#15	#9 OR #10 OR #11 OR #12 OR #13 OR #14 with Cochrane Library publication date Between Nov 2019 and Mar 2020	44
#16	((2019 NEXT (novel or new) NEXT corona*)):ti,ab,kw	8

#17 (("2019" NEXT (CoV or nCoV)) or (coronavirus NEXT (disease NEXT "2019")) or COVID19 or COVID-19 or ((Novel or New) NEXT Corona*) or SARS2 or SARS-CoV-2 or (SARS NEAR/2 (coronaviridae or coronavirus)) or ((sars or Coronavirus) NEXT "2") or nCov or 2019ncov):ti,ab,kw 118
#18 #15 OR #16 OR #17 145
#19 MeSH descriptor: [Masks] this term only 475
#20 MeSH descriptor: [Protective Devices] this term only 207
#21 MeSH descriptor: [Personal Protective Equipment] this term only 19
#22 MeSH descriptor: [Respiratory Protective Devices] this term only 66
#23 MeSH descriptor: [Eye Protective Devices] this term only 65
#24 (Mask? OR facemask? OR face-mask? OR ppe OR (body NEAR substance* NEAR isolati*) OR bsi OR (infect* NEAR prevent* NEAR control*) OR ipc OR N95 OR ffp OR ffp1 OR ffp3 OR ffp2 OR (filter* NEAR face NEAR piece) OR ((face OR respiratORy OR eye) NEXT/2 (shield OR equipment? OR protect* OR cover*)) OR ((airbORne OR air-bORne OR droplet*) NEAR precau*) OR N99 OR N97 OR respiratOR? OR goggle? OR ((patient? OR person* OR individual?) NEXT/1 isolat*) OR distanc* OR space OR spacing OR separation OR (aerosol NEAR generat* NEAR procedur*) OR ((safety OR protective) NEAR (supply OR supplies OR device* OR equipment? OR material* OR measure* OR gear?)) OR (safely NEAR/1 equipped) OR meter? OR metre? OR foot OR feet OR (non-pharm* NEAR intervention*) OR ((physical OR person*) NEAR (intervention* OR barrier? OR protect*)) OR transmission* OR contamination? OR shedding? OR fomite? OR gap? OR ((head or face) NEXT cover?) OR (protective NEXT clothing?)):ti,ab,kw 161945
#25 #19 OR #20 OR #21 OR #22 OR #23 OR #24 161945
#26 #18 AND #25 43

China National Knowledge Infrastructure (CNK)I 中国知网--topic words searching in Chinese
新型冠状病毒性肺炎，新冠肺炎，新型冠状病毒，冠状病毒感染，冠状病毒肺炎，冠状病毒，COVID-19

Science Chinese Biomedical Literature Database (SinoMed)—field searching in Chinese
("2019冠状病毒"[常用字段:智能] OR "新型冠状病毒"[常用字段:智能] OR "新冠肺炎"[常用字段:智能] OR "2019-nCoV"[常用字段:智能] OR "SARS-CoV-2"[常用字段:智能] OR "Novel coronavirus"[常用字段:智能] OR "nCoV"[常用字段:智能] OR "Emerging Coronaviruses"[常用字段:智能] OR "new coronavirus"[常用字段:智能] OR "COVID-19"[常用字段:智能] OR "coronavirus"[常用字段:智能] AND ("Wuhan"[常用字段] OR "Hubei"[常用字段] OR "China"[常用字段])) AND 2019-2020[日期]

Appendix 2. Characteristics of included studies

Study ID[Reference]	Study Design	Country	Setting	Virus
Alameer 2015(1)	Non-comparative	Saudi Arabia	Healthcare setting	MERS
Alanazi 2018(2)	Non-comparative	Saudi Arabia	Healthcare setting	MERS
Alfaraj 2018(3)	Comparative NRS	Saudi Arabia	Non-healthcare setting	MERS
Alraddadi 2016(4)	Comparative NRS	Saudi Arabia	Healthcare setting	MERS
Al-Tawfiq 2019(5)	Qualitative	Saudi Arabia	Healthcare setting	MERS
Assiri 2013(6)	Non-comparative	Saudi Arabia	Healthcare setting	MERS
Bai 2020(7)	Non-comparative	China	Non-healthcare setting	COVID-19
Bai 2020(8)	Comparative	China	Healthcare setting	COVID-19
Barratt 2019(9)	Qualitative	Australia	Healthcare setting	Other
Baseer 2016(10)	Qualitative	Saudi Arabia	Healthcare setting	MERS
Booth 2005(11)	Mechanistic	Canada	Healthcare setting	SARS
Cai 2020(12)	Contextual factors - qualitative or quantiative	China	Non-healthcare setting	COVID-19
Cao 2020(13)	Non-comparative	China	Non-healthcare setting	COVID-19
Caputo 2006(14)	Comparative NRS	Canada	Healthcare setting	SARS
Chau 2010(15)	Qualitative	China	Healthcare setting	Other
Chen 2004(16)	Non-comparative	Taiwan	Healthcare setting	SARS
Chen 2009(17)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Chen 2020(18)	Contextual factors - qualitative or quantiative	China	Non-healthcare setting	COVID-19
Chen 2020(19)	Non-comparative	China	Non-healthcare setting	COVID-19
Chen 2020(20)	Comparative NRS	China	Non-healthcare setting	COVID-19
Chen 2020(21)	Non-comparative	China	Healthcare setting	COVID-19
Cheng 2020(22)	Non-comparative - mechanistic	China	Healthcare setting	COVID-19
Chia 2005(23)	Qualitative	Singapore	Healthcare setting	SARS
Christian 2004(24)	Non-comparative - Case series	Canada	Healthcare setting	SARS
Chughtai 2015(25)	Qualitative	Vietnam	Healthcare setting	Other

Study ID[Reference]	Study Design	Country	Setting	Virus
Chughtai 2020(26)	Qualitative	Australia	Healthcare setting	Other
Cui 2020(27)	Comparative NRS	China	Non-healthcare setting	COVID-19
Du 2020(28)	Comparative NRS	China	Non-healthcare setting	COVID-19
El Bushra 2016(29)	Non-comparative - Case series	Saudi Arabia	Healthcare setting	MERS
Fan 2020(30)	Comparative NRS - Cohort	China	Healthcare setting	COVID-19
Feng 2020(31)	Non-comparative	China	Non-healthcare setting	COVID-19
Fix 2019(32)	Qualitative	United States of America	Healthcare setting	SARS
Gan 2020(33)	Comparative NRS	China	Non-healthcare setting	COVID-19
Goh 2019(34)	Qualitative	Singapore	Healthcare setting	NA
Gomersall 2006(35)	Non-comparative - Cohort (but all received the intervention)	China	Healthcare setting	SARS
Ha 2004(36)	Comparative NRS - Cohort	Vietnam	Healthcare setting	SARS
Hall 2014(37)	Comparative NRS - Cohort	Saudi Arabia	Healthcare setting	MERS
Hines 2019(38)	Qualitative	United States of America	Healthcare setting	Other
Ho 2003(39)	Non-comparative - Case series	China	Healthcare setting	SARS
Ho 2004(40)	Comparative NRS - Cohort	Singapore	Healthcare setting	SARS
Ho 2012(41)	Qualitative	China	Healthcare setting	Other
Honarbakhsh 2018(42)	Qualitative	Iran	Healthcare setting	Other
Huang 2011(43)	Qualitative	Taiwan	Healthcare setting	Respiratory infectious diseases
Hunter 2016(44)	Non-comparative - Case series	United Arabic Emirates	Healthcare setting	MERS
Huynh 2020(45)	Contextual factors - qualitative or quantitative	Vietnam	Non-healthcare setting	COVID-19
Jia 2020(46)	Non-comparative	China	Healthcare setting	COVID-19
Jiang 2020(47)	Qualitative	China	Healthcare setting	COVID-19
Kang 2018(48)	Qualitative	South Korea	Healthcare setting	MERS
Kao 2004(49)	Qualitative	China	Healthcare setting	SARS
Khalid 2016(50)	Qualitative	Saudi Arabia	Healthcare setting	MERS
Khoo 2005(51)	Qualitative	China	Healthcare setting	SARS

Study ID[Reference]	Study Design	Country	Setting	Virus
Ki 2019(52)	Comparative NRS - Cohort	South Korea	Healthcare setting	MERS
Kim 2016(53)	Comparative NRS - Cohort	South Korea	Healthcare setting	MERS
Kinlay 2015(54)	Qualitative	United States of America	Healthcare setting	NA
Knapp 2008(55)	Qualitative	United States of America	Healthcare setting	Other
Lau 2003(56)	Qualitative	China	Non-healthcare setting	SARS
Lau 2004(57)	Comparative NRS - Cohort	China	Non-healthcare setting	SARS
Lau 2007(58)	Qualitative	China	Non-healthcare setting	Other
Li 2020(59)	Comparative NRS	China	Non-healthcare setting	COVID-19
Li 2020(60)	Non-comparative	China	Non-healthcare setting	COVID-19
Li 2020(61)	Non-comparative	China	Healthcare setting	COVID-19
Li 2020(62)	Comparative NRS	China	Non-healthcare setting	COVID-19
Li 2020(63)	Non-comparative	China	Non-healthcare setting	COVID-19
Li 2020(64)	Contextual factors - qualitative or quantiative	China	Non-healthcare setting	COVID-19
Lim 2004(65)	Qualitative	Singapore	Non-healthcare setting	SARS
Lin 2020(66)	Non-comparative	China	Non-healthcare setting	COVID-19
Liu 2009(67)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Liu 2020(68)	Non-comparative	China	Non-healthcare setting	COVID-19
Liu 2020(69)	Non-comparative	China	Non-healthcare setting	COVID-19
Liu 2020(70)	Non-comparative	China	Non-healthcare setting	COVID-19
Liu 2020(71)	Comparative NRS	China	Non-healthcare setting	COVID-19
Liu 2020(72)	Comparative NRS	China	Non-healthcare setting	COVID-19
Liu 2020(73)	Comparative NRS	China	Non-healthcare setting	COVID-19
Loeb 2004(74)	Comparative NRS - Cohort	Canada	Healthcare setting	SARS
Loh 2004(75)	Qualitative	Malaysia	Healthcare setting	SARS
Lu 2003(76)	Non-comparative	China	Healthcare setting	SARS
Luo 2020(77)	Non-comparative	China	Non-healthcare setting	COVID-19
Ma 2004(78)	Comparative NRS	China	Healthcare setting	SARS

Study ID[Reference]	Study Design	Country	Setting	Virus
Ma 2020(79)	Comparative NRS	China	Healthcare setting	COVID-19
MacIntyre 2015(80)	RCT	Vietnam	Healthcare setting	Other
Maclntyre 2016(81)	RCT	China	Healthcare setting	Respiratory infectious diseases
Marchand-Senecal 2020(82)	Non-comparative - Case series	Canada	Healthcare setting	COVID-19
Maroldi 2017(83)	Qualitative	Brazil		Other
Matthews Pillemer 2015(84)	Qualitative	United States of America, China, Taiwan and Singapore	Non-healthcare setting	SARS
Moore 2005(85)	Qualitative	Canada	Healthcare setting	SARS
Mukerji 2017(86)	Qualitative	China	Healthcare setting	Respiratory infection (Clinical respiratory illness [CRI])
Nichol 2008(87)	Qualitative	Canada	Healthcare setting	SARS
Nichol 2013(88)	Qualitative	Canada	Healthcare setting	Occupational transmission
Nishiura 2005(89)	Comparative NRS - Cohort	Vietnam	Healthcare setting	SARS
Nishiyama 2008(90)	Comparative NRS	Vietnam	Healthcare setting	SARS
Ofner-Agostini 2006(91)	Non-comparative - Case series	Canada	Healthcare setting	SARS
Olsen 2003(92)	Comparative NRS - Cohort	China	Non-healthcare setting	SARS
Ong 2020(93)	Mechanistic	Singapore	Healthcare setting	SARS
Ou 2020(94)	Comparative NRS	China	Non-healthcare setting	COVID-19
Park 2004(95)	Comparative NRS - Cohort	United States of America	Healthcare setting	SARS
Park 2015(96)	Non-comparative - Case series	South Korea	Healthcare setting	MERS
Park 2016(97)	Comparative NRS - Cohort	South Korea	Healthcare setting	MERS
Park 2020(98)	Non-comparative	South Korea	Healthcare setting	MERS
Parker 2006(99)	Qualitative	Canada	Healthcare setting	SARS
Peck 2004(100)	Comparative NRS - Cohort	United States of America	Healthcare setting	SARS
Pei 2006(101)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Qi 2020(102)	Contextual factors - qualitative or quantiative	China	Healthcare setting	COVID-19
Qian 2020(103)	Comparative NRS	China	Non-healthcare setting	COVID-19

Study ID[Reference]	Study Design	Country	Setting	Virus
Qian 2020(104)	Non-comparative	China	Healthcare setting	COVID-19
Qiu 2020(105)	Non-comparative	China	Non-healthcare setting	COVID-19
Rabaan 2017(106)	Qualitative	Saudi Arabia	Healthcare setting	MERS
Radonovich 2019(107)	Qualitative	United States of America	NR	Viral respiratory infections
Rea 2007(108)	Comparative NRS - Cohort	Canada	Non-healthcare setting	SARS
Reuss 2014(109)	Comparative NRS	Germany	Healthcare setting	MERS
Reynolds 2006(110)	Comparative NRS - Cohort	Vietnam	Healthcare setting	SARS
Rozenbojm 2015(111)	Qualitative	Canada	Healthcare setting	Other
Ryu 2019(112)	Comparative NRS - Cohort (but none infected)	South Korea	Healthcare setting	MERS
Scales 2003(113)	Comparative NRS	Canada	Healthcare setting	SARS
Seto 2003(114)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Shen 2020(115)	Comparative NRS	China	Healthcare setting	COVID-19
Shigayeva 2007(116)	Qualitative	Canada	Healthcare setting	SARS
Siu 2016(117)	Qualitative	China	Healthcare setting	SARS
Sun 2020(118)	Non-comparative	China	Non-healthcare setting	COVID-19
Tan 2006(119)	Qualitative	Singapore	Healthcare setting	SARS
Tang 2004(120)	Qualitative	Hong Kong		SARS
Tang 2005(121)	Qualitative	Singapore	Healthcare setting	SARS
Teleman 2004(122)	Comparative NRS - Cohort	Singapore	Healthcare setting	SARS
Tian 2020(123)	Non-comparative	China	Healthcare setting	COVID-19
Timen 2010(124)	Qualitative	Netherlands	Healthcare setting	NA
Tuan 2007(125)	Comparative NRS - Cohort	Vietnam	Non-healthcare setting	SARS
Turnberg W 2008(126)	Qualitative	Washington	Healthcare setting	None
Twu 2003(127)	Non-comparative - Case series	Taiwan	Healthcare setting	SARS
Varia 2003(128)	Non-comparative - Case series	Canada	Healthcare setting	SARS
Visentin 2009(129)	Qualitative	Canada	Healthcare setting	SARS
Wang 2015(130)	RCT - Cluster RCT	Saudi Arabia	Non-healthcare setting	MERS and other respiratory viruses

Study ID[Reference]	Study Design	Country	Setting	Virus
Wang 2020(131)	Comparative NRS	China	Non-healthcare setting	COVID-19
Wang 2020(132)	Non-comparative	China	Non-healthcare setting	COVID-19
Wang 2020(133)	Comparative NRS	China	Non-healthcare setting	COVID-19
Wang 2020(134)	Contextual factors - qualitative or quantiative	China	Healthcare setting	COVID-19
Wiboonchutikul 2016(135)	Comparative NRS	Thailand	Healthcare setting	MERS
Wilder-Smith 2005(136)	Comparative NRS - Cohort	Singapore	Healthcare setting	SARS
Wizner 2016(137)	Qualitative	United States of America	Healthcare setting	SARS
Wong 2004(138)	Qualitative	China	NR	SARS
Wong 2005(139)	Qualitative	China	NR	SARS
Wong 2013(140)	Qualitative – RCT + EtD	China	NR	Other
Wu 2004(141)	Comparative NRS	China	Healthcare setting	SARS
Wu 2020(142)	Non-comparative	China	Non-healthcare setting	COVID-19
Wu 2020(143)	Qualitative	China	Healthcare setting	COVID-19
Wu 2020(144)	Non-comparative - Case series	China	Healthcare setting	COVID-19
Xiang 2020(145)	Non-comparative	China	Non-healthcare setting	COVID-19
Xiao 2020(146)	Non-comparative	China	Non-healthcare setting	COVID-19
Xie 2020(147)	Non-comparative - Case series	China	NR	COVID-19
Yang 2011(148)	Non-comparative + EtD	China	NR	Respiratory infection (Clinical respiratory illness [CRI])
Yang 2020(149)	Comparative NRS	China	Non-healthcare setting	COVID-19
Yang 2020(150)	Non-comparative	China	Healthcare setting	COVID-19
Yin 2004(151)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Yu 2005(152)	Comparative NRS - Cohort	China	Healthcare setting	SARS
Yu 2007(153)	Comparative NRS - Cohort (cluster, not by patient)	China	Healthcare setting	SARS
Yu 2020(154)	Non-comparative	China	Non-healthcare setting	COVID-19
Yue 2020(155)	Non-comparative	China	Healthcare setting	COVID-19

Study ID[Reference]	Study Design	Country	Setting	Virus
Zeng 2020(156)	Comparative NRS	China	Non-healthcare setting	COVID-19
Zhang 2020(157)	Comparative NRS	China	Non-healthcare setting	COVID-19
Zhang 2020(158)	Non-comparative	China	Non-healthcare setting	COVID-19
Zhang 2020(159)	Non-comparative	China	Non-healthcare setting	COVID-19
Zhao 2020(160)	Comparative NRS	China	Healthcare setting	COVID-19
Zhou 2020(161)	Non-comparative	China	Healthcare setting	COVID-19
Zhou 2020(162)	Non-comparative	China	Non-healthcare setting	COVID-19
Zhu 2020(163)	Contextual factors - qualitative or quantiative	China	Non-healthcare setting	COVID-19
Zhuang 2020(164)	Non-comparative	China	Non-healthcare setting	COVID-19

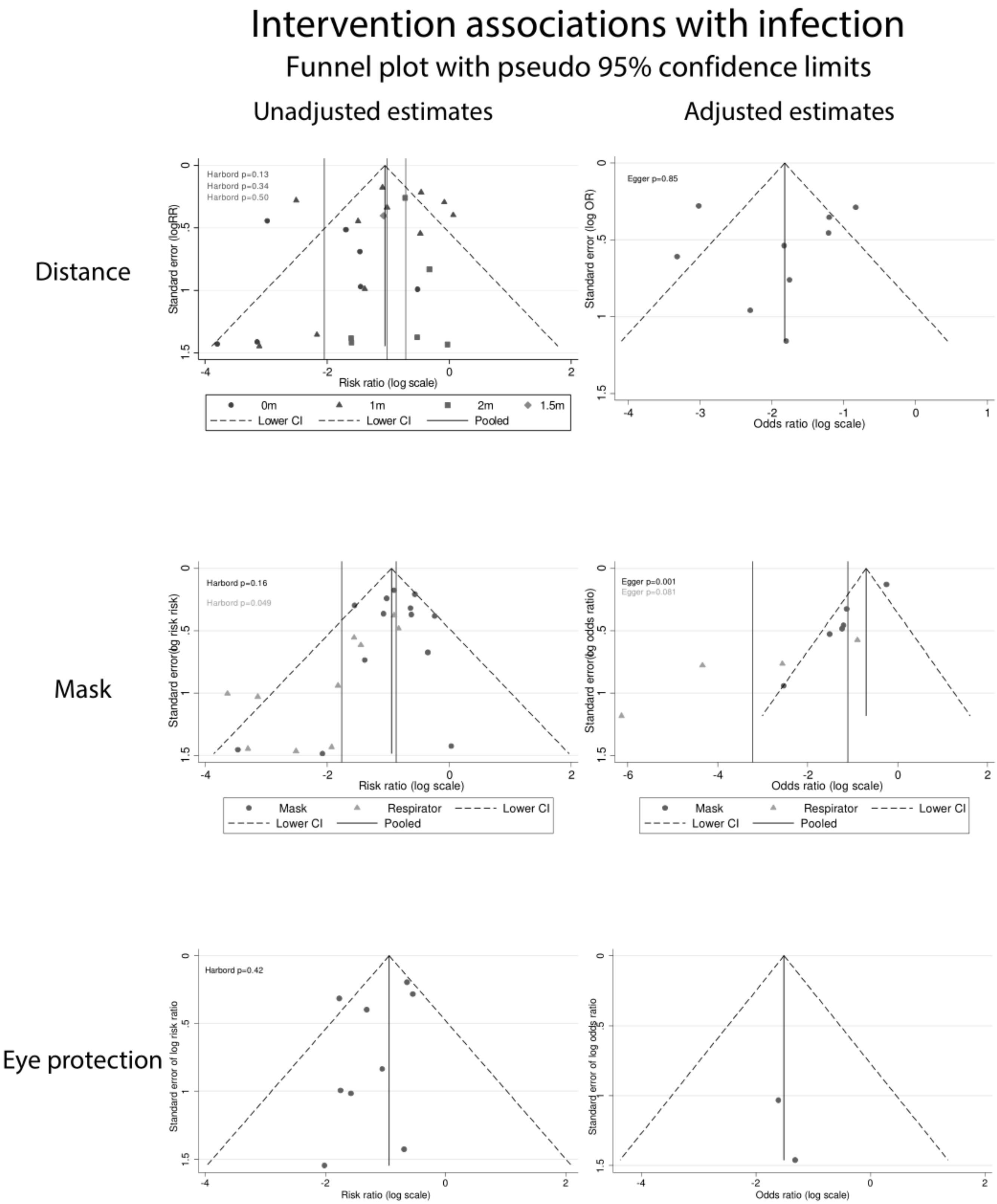
Appendix 3. Newcastle-Ottawa for non-randomized studies, for the outcome of disease transmission

Study	Selection*	Comparability	Outcome/Exposure	Overall Rating (more stars = lower risk of bias)	Disease
Alraddadi 2016	★★★	★★	★★★	★★★★★★★★	MERS
Arwady 2016	★★★	-	★★★	★★★★★★	MERS
Bai 2020	★★	-	★★★	★★★★★	COVID-19
Burke 2020	★★★	-	★	★★★★	COVID-19
Caputo 2006	★★	-	★★★	★★★★★	SARS
Chen 2009	★★★★	★★	★	★★★★★★★	SARS
Cheng 2020	★★★	-	★★	★★★★★	COVID-19
Fan 2020	★★	-	★★	★★★★	COVID-19
Ha 2004	★★	-	-	★★	SARS
Hall 2014	★★★	-	-	★★★	MERS
Heinzerling 2020	★★	-	★★	★★★★	COVID-19
Ho 2004	★★★	★★	★★★	★★★★★★★★	SARS
Ki 2019	★★	★★	★★★	★★★★★★	MERS
Kim 2016	★★★★	-	★★	★★★★★★	MERS
Kim 2016	★★★★	-	★★	★★★★★★	MERS
Lau 2004	★★★	★★	★★	★★★★★★★	SARS
Liu 2009	★★★	★	★	★★★★★	SARS
Liu ZQ 2020	★★★★	-	★★★	★★★★★★★	COVID-19
Loeb 2004	★★	-	-	★★	SARS
Ma 2004	★★★★	★★	★★★	★★★★★★★★★	SARS
Nishiura 2005	★★★	★★	★★★	★★★★★★★★	SARS
Nishiyama 2008	★★	★★	★★	★★★★★★	SARS
Olsen 2003	★★★	-	★★★	★★★★★★	SARS
Park 2004	★★★★	★★	★★★★	★★★★★★★★★★	SARS

Park 2016	★★	-	★	★★★	MERS
Peck 2004	★★★★	★★	★★★	★★★★★★★★★	SARS
Pei 2006	★★★	★★	★★★	★★★★★★★★	SARS
Rea 2007	★★	-	★★	★★★★	SARS
Reuss 2014	★★★	-	★★	★★★★★	MERS
Reynolds 2006	★★	-	★	★★★	SARS
Ryu 2019	★★★	★	★★★	★★★★★★★	MERS
Scales 2003	★★	-	-	★★	SARS
Seto 2003	★★★★	★★	★★	★★★★★★★★	SARS
Teleman 2004	★★★★	★★	★★	★★★★★★★★	SARS
Tuan 2007	★★	★★	★★	★★★★★★	SARS
Wang QP 2020	★★★	-	★★	★★★★★	COVID-19
Wiboonchutikul 2016	★★	-	★★★	★★★★★	MERS
Wilder-Smith 2005	★★★	★★	★★★	★★★★★★★★	SARS
Wong TW 2004	★★★	-	★★	★★★★★	SARS
Wu 2004	★★★★	★★	★★	★★★★★★★★	SARS
Wu 2020	★★	-	★★	★★★★	COVID-19
Yin 2004	★★★★	★★	-	★★★★★★	SARS
Yu 2005	★★★	★	★★★	★★★★★★★	SARS
Yu 2007	★★★	★★	★★	★★★★★★★	SARS

[*]For each category, A single dash (-) indicates no stars, and therefore high risk of bias.

Appendix 4. Funnel plots



Appendix 5. Evidence Profiles

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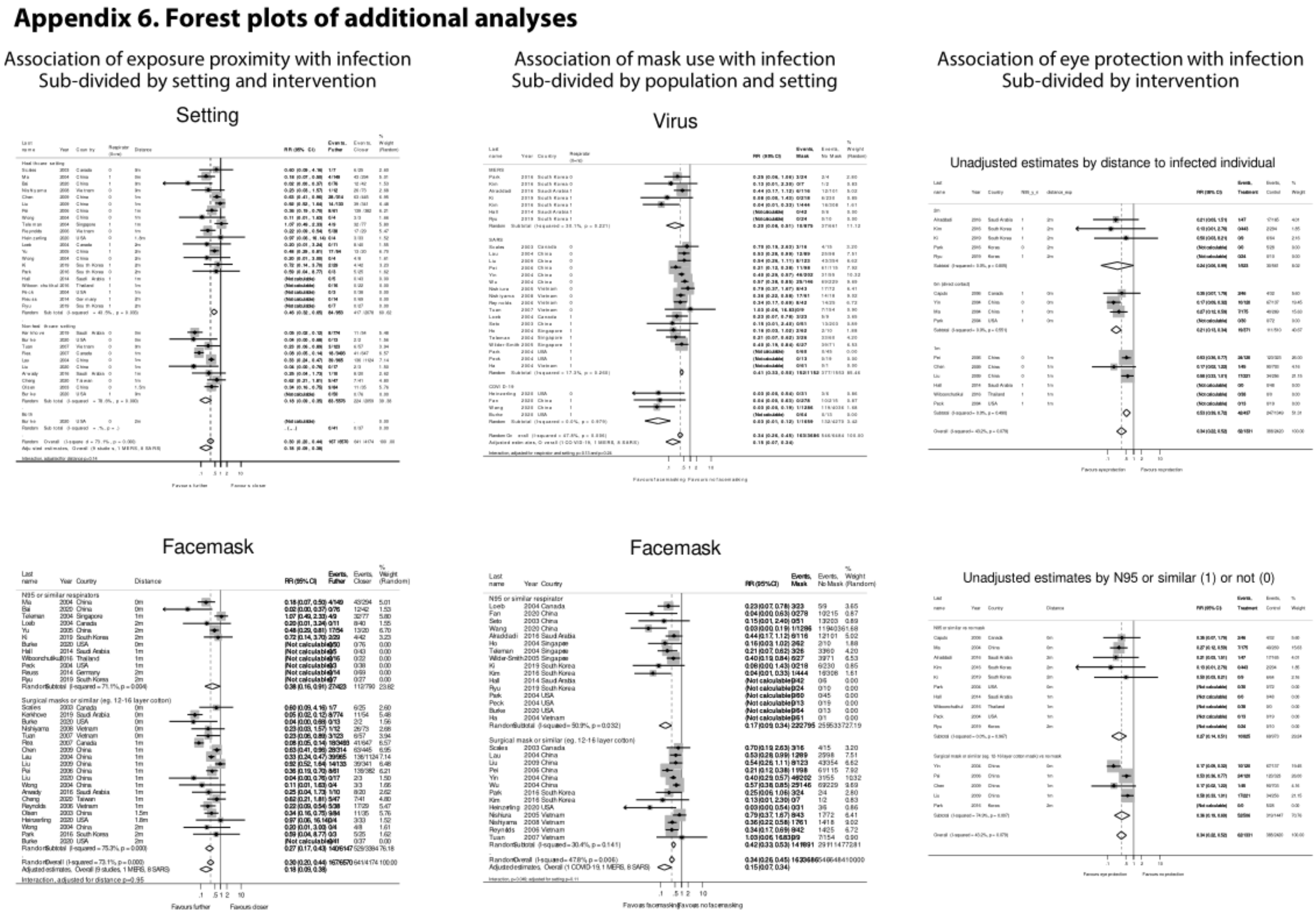
Question: Should physical distancing of more than one meter compared to one meter or less, masks versus no masks, and/or eye protection versus no eye protection be used to prevent disease transmission to people exposed to patients infected or suspected to be with COVID-19?
Setting: Any (Healthcare and non-healthcare)
Bibliography: Chu et al. prepared for publication

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Intervention	Control	Relative (95% CI)	Absolute (95% CI)		
Infection with COVID-19 (follow up: range 10 days to more days; assessed with: COVID-19, SARS, MERS infection)												
9	observational studies A physical distance of more than one meter vs less than one meter	not serious [a]	not serious [b]	not serious [c,d]	not serious	strong association [e,f]	97/5065 (1.9%) [g]	347/2717 (12.8%)	**aOR 0.18** (0.09 to 0.38)	**102 fewer per 1,000** (from 115 fewer to 75 fewer)	⨁⨁⨁◯ MODERATE	CRITICAL
10	observational studies Masks vs no masks	not serious i	not serious [h]	not serious [j]	not serious	none [k]	145/1066 (13.6%)	197/1134 (17.4%)	**aOR 0.15** (0.07 to 0.34)	**143 fewer per 1,000** (from 159 fewer to 107 fewer)	⨁⨁◯◯ LOW	CRITICAL
13	observational studies Eye protection (face shield, goggles)	not serious n	not serious [m]	not serious [o]	not serious	none [p]	62/1335 (4.6%)	388/2378 (16.3%)	**RR 0.34** (0.22 to 0.52) [l]	**108 fewer per 1,000** (from 127 fewer to 78 fewer)	⨁⨁◯◯ LOW	CRITICAL

CI: Confidence interval; **OR:** Odds ratio

a. All studies were non-randomized and evaluated using the Newcastle-Ottawa Scale. Some studies had higher risk of bias than others but there was no important difference in the sensitivity analyses excluding studies at higher risk of bias. We did not further rate down for risk of bias.
b. Although there was a high I2 value and lack of overlapping confidence intervals, all point estimates of the studies exceeded the thresholds for large effects and we did not rate down for inconsistency.
c. We did not rate down for indirectness for the association between distance and infection because the SARS and COVID-19 viruses 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
d. Some studies included the use of masks, but subgroup analysis did not reveal important differences. Some studies also used bundled interventions and the effect of distances could not be evaluated in isolation but the studies shown here include only those that provide adjusted estimates. We did not rate down for intervention indirectness.
e. The effect is large considering the thresholds set by GRADE assuming that the odds ratios translate into similar magnitudes of relative risk estimates. This also mitigated concerns about risk of bias.
f. The data suggest a dose-response gradient with associations increasing from smaller distances to 2 meters and beyond. This was also suggested by a meta-regression. We did not rate up for this domain alone but in combination with the large effects.
g. One of the studies, did report the raw data but only the adjusted estimates.
h. Although there was a high I2 value, all point estimates of the studies were relatively large and the confidence intervals were overlapping and we did not rate down for inconsistency.
i. All studies were non-randomized and evaluated using the Newcastle-Ottawa Scale. Some studies had higher risk of bias than others but there was no important difference in the sensitivity analyses excluding studies at higher risk of bias. We did not further rate down for risk of bias.
j. We did not rate down for indirectness for the association between eye protection and infection because the SARS and COVID-19 belong to the same family and are considered sufficiently similar. Some studies also used bundled interventions and the effect of distances could not be evaluated in isolation but the studies shown here include only those that provide adjusted estimates. We did not rate down for intervention indirectness.
k. The effect is large considering the thresholds set by GRADE assuming that the odds ratio translate into similar magnitudes of relative risk estimates. This mitigate concerns about risk of bias but all studies were unadjusted and risk of bias still too high to rate up for large effects.
l. Two of these studies (Ma 2004 and Yin 2004) provided adjusted estimates with a total of 295 in the goggles group and 107 in the group not wearing goggles. The results were similar to the unadjusted estimate (OR 0.22, 95% CI 0.12 - 0.39).
m. Although there was a high I2 value, all point estimates of the studies were relatively large and the confidence intervals were overlapping and we did not rate down for inconsistency.
n. All studies were non-randomized and evaluated using the Newcastle-Ottawa Scale. Some studies had higher risk of bias than others but there was no important difference in the sensitivity analyses excluding studies at higher risk of bias. We did not further rate down for risk of bias.
o. We did not rate down for indirectness for the association between eye protection and infection because the SARS and COVID-19 belong to the same family and are considered sufficiently similar. Some studies also used bundled interventions and the effect of distances could not be evaluated in isolation but the studies shown here include only those that provide adjusted estimates. We did not rate down for intervention indirectness.
p. The effect is large considering the thresholds set by GRADE assuming that the odds ratio translate into similar magnitudes of relative risk estimates. This mitigate concerns about risk of bias but all studies were unadjusted and risk of bias still too high to rate up for large effects.

Appendix 6. Forest plots of additional analyses



Appendix 7. Sensitivity analyses, and Bayesian Meta-analyses

	Distancing		Masks		Eye protection	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Sensitivity analyses						
Bayesian Influenza RCTs (mean=0.93, SD of logRR=0.57)			0.54 (95%CrI 0.43-0.82)	0.40 (95%CrI 0.16-0.97)		
Exclude Preprints	0.32 (0.21-0.48)	0.15 (0.07-0.31)	0.38 (0.31-0.48)	0.21 (0.10-0.43)	0.34 (0.22-0.52)	0.22 (0.12-0.39)
Fixed effect model	0.34 (0.29-0.40)	0.16 (0.12-0.22)	0.32 (0.27-0.38)	0.16 (0.12-0.22)	0.36 (0.28-0.46)	0.22 (0.12-0.39)
Hartung-Knapp-Sidik-Jonkman random effects model	0.30 (0.20-0.44)	0.15 (0.08-0.30)	0.34 (0.25-0.47)	0.15 (0.08-0.30)	0.34 (0.22-0.51)	0.22 (0.04-1.27)

Bayesian meta-analysis if MacIntyre 2013(165) cluster RCT used as likelihood function (OR 0.50 [95%CI 0.34-0.74]), posterior probability for OR<1 of N95 masks being more protective versus medical masks = 98.4%.

Pooled unadjusted odds ratios were similar to risk ratios:
Distancing: OR 0.22 (0.14- 0.35)
Masks: OR 0.22 (0.15- 0.32)
Eye protection: OR 0.26 (0.16-0.45)

Exclusion of Seto from adjusted estimates, because about 54% of its population used N95 masks, did not change the findings: aOR 0.03 (0.001-0.56)

The pooled aORs for studies with the various types of facemasks were:
N95 or similar respirators: 0.04 (0.004-0.30)

versus

Surgical masks: 0.20 (0.06-0.63)
12-16 multilayer cotton masks: 0.33 (0.10-1.03)
Surgical masks or multilayer cotton masks: 0.31 (0.16-0.53)
Test for interaction of surgical versus multilayer cotton masks, $p_{interaction} = 0.91$

Appendix 8. Credibility assessment of potential effect modifiers (modified from GRADE inconsistency guidelines to include 'other considerations')

Outcome	COVID-19, SARS, MERS viral transmission		
Potential effect modifier **Criteria**	Distance dose-response	N95 or similar versus surgical mask or similar (eg. 12-16 layer cotton)	Healthcare versus non-healthcare settings for mask use
Is the subgroup variable a characteristic specified at baseline (in contrast with after randomization)?	Yes	Yes	Yes
Is the subgroup difference suggested by comparisons within rather than between studies?	No	Yes, the included studies report a potential hierarchy of least protective being no mask, paper mask, disposable or 12-16 layer reusable cotton mask, then N95 or similar respirator	No
Does statistical analysis suggest that chance is an unlikely explanation for the subgroup difference?	Possibly, mean > 1 with wide CIs expected from few studies at each cut point, p=0.041	Yes, p=0.033 Bayesian analyses also support this with posterior probability of RR<1 being >95%.	Possibly, p=0.049 in univariate meta-regression, and when controlling for differential N95 use between settings, still low at p=0.11
Did the hypothesis precede rather than follow the analysis, and include a hypothesized direction that was subsequently confirmed?	Yes	Yes	Yes
Was the subgroup hypothesis one of a small number tested?	Yes	Yes	Yes
Is the subgroup difference consistent across studies and across important outcomes?	Consistent with findings with other interventions presented here	Yes across studies	No
Does external evidence (biological or sociological rationale) support the hypothesized subgroup difference?	Yes, it would be expected that the further away one is from a person with infection that transmits by droplets, that the further distances lead to decreased risk of infection.	The increased filtration capacity of respirators would be expected to have enhanced protection against viral droplets, or smaller versions of such droplets or aerosols.	Possibly, some hypothesize that mask use in non-healthcare settings can lead to self-inoculation virus through mechanisms such as improper use or touching the mask with contaminated hands, but there is no definitive evidence with hard outcomes that community-based mask interventions are ineffective or harmful.
Absence of other considerations that would decrease confidence of true effect-modification?	Imprecision. Association primarily based on unadjusted data, albeit estimates of unadjusted and adjusted data were similar.	Although influenza is very different from pandemic COVID-19, SARS, MERS, it provides very indirect and limited RCT data suggesting no difference, albeit the Bayesian analyses here attempt to account for that.	Imprecision, particularly few community-focused studies
Criteria fulfilled, out of 8 (not an absolute cutoff)	**5**	**6-7**	**3-4**
Overall credibility of subgroup analysis	**MODERATE**	**MODERATE-HIGH**	**LOW-MODERATE**

Low credibility, likely spurious; Moderate credibility, plausible, possibly even likely, but some important doubt remains; High credibility, Likely convincing.

Appendix 9. Summary of contextual factor data

Resource use

Two qualitative and two cross-sectional studies reported on data related to the cost and resource use in the management of SARS (51, 65), MERS (5) and coronavirus (83). The four studies were conducted in Hong Kong, Brazil, Singapore and Saudi Arabia. Khoo et al. (2005) reported the cost of 3M powered air-purifying respirators (PAPR) to be US$860 and Stryker PARP US$580 as compared to N95 (US$0.70) (51). In another study, health workers perceived the management of SARS as a burden which costs hundreds of millions; with direct operating expenditure (e.g., medical supplies, personal protective equipment, and screening) costing US$110 million(65). Malordi et al. (2017) highlighted the consequences of the lack of resources which include inadequate training on measures to prevent disease transmission(83). Al-Tawfiq et al. (2019) highlighted a monthly added cost of $16,400 for infection control items, such as hand sanitizers, soap, surgical masks, and N95 respirators during MERS outbreak in one hospital in Saudi Arabia (5). A survey of health workers in a hospital (doctors, nurses and respiratory therapists, n=51) showed that the majority of health workers (84%) preferred using PAPR over N-95 respirators when treating suspected SARS patients despite its high cost (51).

Acceptability

Six qualitative studies conducted in China and one cross-sectional study conducted in Vietnam reported on the acceptability of physical distancing and/or wearing masks as preventive measures for COVID-19.

Acceptability by visitors of suspected or confirmed COVID-19 cases

Wang et al. (2020) carried out an online survey to investigate the protective behaviors of visitors accompanying hospitalized patients during COVID-19 pandemic (134). 208 questionnaires were collected, and the survey showed that 85% of visitors accompanying suspected COVID-19 cases wear masks while present in the hospital.

Acceptability by the public

Four qualitative studies presented information on the willingness of residents in China to wear masks in public places and to avoid crowds (18, 64, 102, 166). The four studies used online questionnaires to survey members of the public and the samples were respectively, n=1,138 (64), n=917 (166), n=3,083 (102), and n=4,016 (18). Across the four studies, most of the participants reflected high willingness to wear masks in public places (95%, 99%, 97%, 94% respectively). In terms of social gatherings, the majority of the participants across three of the studies favored avoiding crowded areas (91%, 96%, 97% respectively) (18, 64, 102).

Another survey conducted in Vietnam (n=345) found that the risk perception of COVID-19 threat significantly increased the likelihood of wearing medical masks ($p<0.01$). The increased likelihood of wearing masks was also shown to increase with age (45).

Acceptability by college students

A survey to assess the knowledge and protective behaviors among college students (n=22,302 online questionnaires) in China during COVID-19 pandemic(12), found that 99% of students were willing to avoid close contact with others (less than 1 meter), 95% considered avoiding crowded places as an important way to control the epidemic, and 99% reported wearing a mask in public places for week prior to being surveyed.

Acceptability by healthcare workers

A cross-sectional survey (56) performed in the context of the SARS epidemic in Hong Kong, assessed various precautionary measures from the viewpoint of 1,397 residents. Most of the respondents believed that SARS could be transmitted via direct body contact with patients (84%) and via respiratory droplets (97%). The perceived risk of transmission increased during the escalating phase of the epidemic (52%) and declined during a later stage (36%).

During the first phase of the epidemic, respondents reported a significant increase in the application of preventive measures such as avoiding going outside and avoiding crows, which dropped at a later stage. Those who perceived avoiding crowded places as an effective preventive measure (OR: 31.564, 95% CI: 15.610 -63.824) were likely to avoid crowded places. In terms of the acceptability of wearing masks, most of the respondents (95%) regarded this action as a 'civic responsibility' and reflected commitment to wearing masks in public places. Those who perceived wearing a mask as an efficacious means of prevention (OR: 7.151, 95% CI: 4.245-12.045) were more likely than others to wear a mask (56).

Five studies conducted on health professionals (including medical staff and nurses) in primary health care and hospital settings showed that an increase in the perceptions and awareness of risk of transmission of SARS was associated with better adherence to preventive measures including wearing masks and eye protection (32, 75, 83, 88, 116).

A cross-sectional quantitative survey of dental health professionals (n=406) working in dental facilities in Saudi Arabia showed good practices related to making patients with MERS infection wear masks during transport (84%). However, knowledge was relatively limited (56.4%) about the need to wear a mask within a 90 cm distance from a patient under droplet precaution care (10). Another cross-sectional survey of health workers (N=10,236) was conducted about the appropriateness of using PAPR and N95 respirators in public hospitals and polyclinics during the SARS outbreak in Singapore (23). Among doctors (n=873), nurses (n=4,404), and clerical staff (n=921), 99.5%, 99% and 97% respectively viewed N95 respirator to be an adequate protection against SARS.

A cross-sectional study (two surveys) was conducted to assess the use of personal protective equipment among medical students during and after the SARS outbreak in a teaching hospital in Hong Kong and study its impact on their personal hygiene practice when they contacted patients (139). Prior to the SARS outbreak, none of the students wore masks during history taking and physical examination. In the 2004 survey, 86.1% and 93.8% of students wore masks during history taking and physical examination, respectively.

Another study (secondary data analysis) conducted in Saudi Arabia evaluating the use of masks before and during MERS showed an increase in the use of both, surgical masks (from 2,947.4 to 10,283.9 per 1,000 patient-days) and N-95 respirators (from 22 to 232 per 1,000 patient-days) ($p < .0000001$) (5).

Feasibility

In this section, we summarized barriers and facilitators to the implementation and sustainability of using masks based on findings from the included studies. Among barriers, we identified:

Barriers to the use of protective masks

A study showed that N-95 respirators was perceived by health workers as uncomfortable during the SARS outbreak (48). N95 respirators often developed cracks in the chin area for small-jawed female health professionals and the overlapping parts of different PPE items were ill-fitted (e.g., gaps between goggles and N95 respirator) (48).

Family physicians (n=7) in Singapore stressed on the physical discomfort during prolonged use of the N-95 mask (e.g., breathing difficulty, headache, development of allergic facial rash around the mask) in a qualitative study employing interviews about factors that influence the use of PPE during the SARS outbreak (119) . In this study, family physicians in Singapore also showed that the use of the N-95 mask led to difficulty in communication with patients who had adverse reaction (i.e., worries and concern as PPE was a sign that the physician could have been exposed to SARS) (119). In addition, Khoo et al. (2005) showed that PAPR made most of the health workers (64%) feel that they looked frightening to their patients when using it (51).

Another qualitative study used 15 focus group discussions to examine the perceptions of health workers (n=105) in Canada regarding factors associated with self-protective behavior during the SARS outbreak (85). This study identified mask fitting and uncomfortable PPE to be among the barriers to effective use of PPE.

Absence of a monitoring system

Moore et al. (2005) showed that barriers to the use of protective wear included deficiencies in the tracking system to monitor the development, delivery and evaluation of training in infection control (85).

Lack of adherence to available guidance

In a qualitative study among health professionals (n=26) in the Netherlands about barriers to implementing infection prevention and control guidelines during crises, respondents highlighted the below as potential reasons for the lack of adherence to guidelines during outbreaks such as SARS (124):

- lack of imperative or precise wording
- lack of easily identifiable instructions specific to each profession
- lack of concrete performance targets
- lack of timely and adequate guidance on personal protective equipment and other safety measures

Other barriers that were described in the included studies were the shortage of PPE and cost due to bulk purchase (119), lack of consistent policies for quarantining individuals, reuse of masks, and deficiencies in decision regarding the assignment of patients to negative pressure rooms (85).

Facilitators to the use of protective masks

Most of the health workers perceived both types of PAPR (3M and Stryker) to be easy or relatively easy to use (74% and 91%) with an acceptable level of visual impairment attributable to the PAPR (98% and 95% for the 3M and Stryker PAPR, respectively) (51).

Perceived susceptibility and perceived benefits

A survey about factors influencing the wearing of facemasks for the prevention of SARS among adult Chinese (n=1329) in Hong Kong showed that 61% of respondents reported consistent use of facemasks to prevent SARS and the following predicting factors (120):

- Awareness of the risks and serious consequences associated with SARS: respondents who felt more susceptible to contracting SARS (OR = 2.575; CI = 1.586, 4.181) and those who perceived SARS as having more serious consequences (OR =1.176; CI = 0.909, 1.521) were more likely to wear facemasks.
- Awareness of the benefits of wearing facemasks: respondents who believed greater benefits in wearing facemasks (OR = 1.354; CI = 1.019, 1.800) were more likely to wear facemasks.

Appendix 10. PROSPERO Registration number
Registration number CRD42020177047

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

A rapid systematic review of physical distancing with or without masks and with or without eye protection to prevent COVID-19 transmission between patients with confirmed COVID-19 infection and other people, including health care workers

Holger Schunemann, Derek Chu, Elie Akl, Mark Loeb, Sally Yaacoub, Layal Hneiny, Neera Bhatnagar, Aida Farha, Ray Yuan Zhang, Ariel Izcovich, Ignacio Neumann, Carlos Cuello Garcia, Finn Schünemann, Giovanna Muti-Schünemann, Gian Paolo Morgano, Tamara Lotfi, Thomas Piggott, Ewa Borowiack, Anna Bak, Tejan Baldeh, Rosa Stalteri, Anisa Hajizadeh, Leila Harrison, Hong Zhao, Guang Chen, Antonio Bognanni, Marge Reinap, Paolo Giorgi Rossi

Citation

Holger Schunemann, Derek Chu, Elie Akl, Mark Loeb, Sally Yaacoub, Layal Hneiny, Neera Bhatnagar, Aida Farha, Ray Yuan Zhang, Ariel Izcovich, Ignacio Neumann, Carlos Cuello Garcia, Finn Schünemann, Giovanna Muti-Schünemann, Gian Paolo Morgano, Tamara Lotfi, Thomas Piggott, Ewa Borowiack, Anna Bak, Tejan Baldeh, Rosa Stalteri, Anisa Hajizadeh, Leila Harrison, Hong Zhao, Guang Chen, Antonio Bognanni, Marge Reinap, Paolo Giorgi Rossi. A rapid systematic review of physical distancing with or without masks and with or without eye protection to prevent COVID-19 transmission between patients with confirmed COVID-19 infection and other people, including health care workers. PROSPERO 2020 CRD42020177047 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020177047

Review question

From patients infected with COVID-19, what distance can the COVID-19 virus travel (mechanistic question)? What is the impact on people maintaining at least one meter distance compared to a smaller distance from a patient or suspected patient with COVID-19 on droplet transmission (intervention question)?

Sub-questions:

(1) With or without a mask on the patient;

(2) With or without a mask and with or without eye protection on the non-infected person

Searches

We will search the following electronic databases:

• PubMed, MEDLINE, EMBASE, CINAHL, and the Cochrane Library from 2019 to current date.

We will search the following Chinese electronic databases:

• WHO Chinese database

• CNKI (http://new.oversea.cnki.net/index/)

• China Biomedical Literature Service (http://www.sinomed.ac.cn/login.do)

In addition, we will search the following COVID-19 specific databases from 2019 to current date

• Epistemonikos COVID-19 L·OVE platform (https://app.iloveevidence.com/loves/5e6fdb9669c00e4ac072701d);

• EPPI Centre living systematic map of the evidence (http://eppi.ioe.ac.uk/cms/Projects/DepartmentofHealthandSocialCare/Publishedreviews/COVID-19Livingsystematicmapoftheevidence/tabid/3765/Default.aspx);

• CORD-19 (https://www.kaggle.com/allen-institute-for-ai/CORD-19-research-challenge);

• COVID-19 Research Database maintained by the World Health Organization (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov)

We will conduct a search for ongoing trials using the U.S. National Library of Medicine Register of Clinical Trials (ClinicalTrials.gov) and the WHO International Clinical Trials Registry Platform (ICTRP). We will hand-search the reference lists of the included papers. We will also review the studies included in any identified relevant systematic reviews.

Search strategy combines relevant medical subject headings (MeSH) and keywords, which include “COVID-19”, and “corona virus”. PubMed search terms are informed by https://blocks.bmi-online.nl/catalog/397. The search strategy has been drafted by Ms. Layal Hneiny and is being peer reviewed by two information specialists (Ms. Neera Bhatnagar and Ms. Aida Farha). Finalized search strategies will be available on March 26, 2020 but the final draft can be found in the appendix.

Content experts will search websites of governmental and organizational websites for relevant grey literature documents.

Additional search strategies to identify indirect evidence on SARS and MERS will also be constructed and peer-reviewed by information specialists. This latter search will focus on systematic reviews.

Types of study to be included

No restrictions will be placed on study design. However, evidence will be prioritized by study design as follows: i) randomized controlled trials; ii) non-randomized comparative studies; iii) non-comparative studies (i.e., case reports, case series); iv) qualitative studies. We will exclude single case reports if non-randomized studies comparative studies provide the same certainty of evidence. We will also review modelling studies. For the question addressing how far the virus can travel we will consider mechanistic human studies.

Condition or domain being studied

Infections and infestations, respiratory disorders

Participants/population

Studies focused on patients with confirmed COVID-19 infection [or SARS or MERS] and people in close contact with them, including health care workers, will be eligible for inclusion. Other related populations to consider are:

• individuals with suspected COVID-19 infection who are waiting to be tested (e.g., presenting to a lab, emergency department, or dedicated clinic to get tested), or cannot be tested (because of lack of resources)

• individuals with suspected or confirmed COVID-19 infection (whether symptomatic or not) who are in isolation in non-healthcare settings (e.g., at home, and other dedicated spaces such as stadiums and tents)?

Intervention(s), exposure(s)

At least one meter distance between people and COVID-19 infected patients:

(1) With or without a mask on the patient;

(2) With or without a mask and with or without eye protection on the HCW.

Subgroups:

• Masks include surgical mask and N95 mask among others; Similar names for N95 are:

o FFP2 (Europe EN 149-2001)

o KN95 (China GB2626-2006)

o P2 (Australia/New Zealand AS/NZA 1716:2012) o Korea 1st class (Korea KMOEL - 2017-64)

o DS (Japan JMHLW-Notification 214, 2018)

• Eye protection include visors, shields, and goggles among others

Comparator(s)/control
less than one meter of physical distancing

Main outcome(s)
· Transmission
· Risk of transmission to members of the community (herd immunity)
· Acceptability by different stakeholders (patient, HCW, individuals handling the dead bodies, health authorities) (e.g., possibly as a surrogate for harms if people are not wearing masks or eye protection)
· Unintended harms of distancing (e.g., when providing care) and of using masks or eye protection, stigmatization
· COVID19 infection (confirmed)
· COVID19 probable case
· ICU admission
· Hospitalization
· Death
· (Time to) Recovery

* Measures of effect

relative risks, odds ratios, risk difference, narrative summary

Additional outcome(s)
Droplet transmission (as measured by infection of others and confirmed by serological or microbiological or virolgical testing)

* Measures of effect

narrative

Data extraction (selection and coding)
A single reviewer will extract data using a piloted form and a second reviewer will verify all extracted data. Minimal data will be extracted addressing the following domains: study identifier; study design; setting; population characteristics; intervention and comparator characteristics; outcomes (quantitative if possible); source of funding and reported conflicts of interests; ethical approval; study limitations or other important comments.

Risk of bias (quality) assessment
One reviewer will perform risk of bias assessments and a second reviewer will verify all assessments. We will use the Cochrane risk of bias tool (version 2) for randomized controlled trials, and Newcastle Ottawa scale for non-randomized studies.

Strategy for data synthesis
We will synthesize data in both tabular and narrative formats. We anticipate our outcomes to be dichotomous, such as transmission, and therefore they will be analyzed as pooled risk ratios (RRs), if they are unadjusted estimates. If there are adjusted odds ratios from multivariable regression reported in the studies, then these will be pooled as adjusted odds ratios (aORs). These will be summarized using random effects meta-analysis using the DerSimonian and Laird random effects model, with heterogeneity calculated from the Mantel-Haenszel model. If there are time to event outcomes, shared frailty cox prorportional hazards models will be completed, with validation of the assumption of proportionality. This may necessitate digitization of Kaplan-Meier curves from published studies. All summary measures will be reported with an accompanying 95% confidence interval.

We anticipate that traditional statistical measures of heterogeneity will be less informative than established criteria per GRADE. Because of the poor performance of I^2 to quantify true heterogeneity, then we will accept any magnitude of I^2 for meta-analysis. Nevertheless, we will collect the I^2 statistic, but comment on its limitations in the presentation of final product. We will also accept any number of study for comparative or non comparative meta-analysis. Summary measures will include absolute and relative risks for the outcomes outlined above, displayed using funnel plots and calculated using random effects models. Publication bias will also be assessed visually using funnel plots and Harbord's modification to Egger test, or if adjusted odds ratios are used, then Egger's original test. If necessary, mean and SD will be calculated from medians and IQR or range by the method of Wan (BMC Medical Research Methodology201414:135).

If there are only non-comparative studies, then we will meta-analyze these by proportions (ie. incidence of outcome per report [eg. numerator=events of transmission, denominator=total exposed]. In the presence of sparse data, we will give preference to the logit transformation when completing this, otherwise we will use the Freeman-Tukey double arcsine transformation.

The synthesis of contextual factors (acceptability, etc.) will be narrative.

Subgroup effects will be analysed by meta-regression with tests of interaction by 10, 000 Monte-Carlo permutations to calculate p values to avoid spurious findings.

Sensitivity analyses will include analysis by fixed effect and Knapp-Hartung-Sidik-Jonkman random effects model. We will also employ Bayesian meta-analyses of existing literature on the efficacy of mask use to prevent viral transmission, using as charitable assumptions as plausible that the RCT data represent the true effect estimates. This will include shrinking the effect estimate of the observational data, decreasing its weight (ie. increasing its variance as a prior) or both. We will also employ noninformative priors.

Data analyses will be performed using STATA 14.3. GRADEpro GDT will be used to construct the summary of findings table.

The analyses and reporting of the review will be done according to the PRISMA and MOOSE guidelines. A single reviewer will grade the certainty of the evidence using the GRADE approach and a second reviewer will verify all assessments. If applicable, we will follow published guidance for rating the certainty in evidence in the absence of a single estimate of effect. Evidence will be presented using GRADE Evidence Profiles developed in the GRADEpro (www.gradepro.org) software.

Analysis of subgroups or subsets

Health care workers versus non health care workers, by mask type, with or without goggles or eye protection

Contact details for further information

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Organisational affiliation of the review

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Collaborators

Stephanie Duda. McMaster University
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Type and method of review

Epidemiologic, Meta-analysis, Narrative synthesis, Systematic review

Anticipated or actual start date

25 March 2020

Anticipated completion date

28 April 2020

Funding sources/sponsors

World Health Organization, McMaster University, and American University of Beirut

Conflicts of interest

Language

English

Country

Argentina, Canada, Chile, China, Denmark, Germany, Italy, Lebanon

Stage of review

Review Ongoing

Subject index terms status

Subject indexing assigned by CRD

Subject index terms

COVID-19; Health Personnel; Humans; Infections; Masks; severe acute respiratory syndrome coronavirus 2

Date of registration in PROSPERO

16 April 2020

Date of first submission

28 March 2020

Stage of review at time of this submission

Stage	Started	Completed
Preliminary searches	Yes	No
Piloting of the study selection process	Yes	No
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.

The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions

16 April 2020

Appendix 11. PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4-6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5-7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7-8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7-8

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7-8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7-8
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9, Fig 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9, Table 1, Appendix
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Table 1, Appendix
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-12, Fig 2-4
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10-12, Figs 2-4 Table 2
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Table 2, Appendix
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10-12, Appendix
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	13
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	17
FUNDING			

Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	8

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Appendix 11 continued – MOOSE checklist

Reporting of background should include	Page/Location
Problem definition	3-4
Hypothesis statement	3-4
Description of study outcome(s)	6
Type of exposure or intervention used	5-6
Type of study designs used	5-6
Study population	5-6
Reporting of search strategy should include	
Qualifications of searchers (eg, librarians and investigators)	5-6, Appendix
Search strategy, including time period included in the synthesis and keywords	5-6, Appendix
Effort to include all available studies, including contact with authors	5-6, Appendix
Databases and registries searched	5-6, Appendix
Search software used, name and version, including special features used (eg, explosion)	5-6, Appendix
Use of hand searching (eg, reference lists of obtained articles)	5-6, Appendix
List of citations located and those excluded, including justification	Figure 1, Appendix
Method of addressing articles published in languages other than English	5-6
Method of handling abstracts and unpublished studies	5-6
Description of any contact with authors	5-6
Reporting of methods should include	
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	5-6
Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	5-7
Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	5-7
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	5-7
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	7
Assessment of heterogeneity	7
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	7-8
Provision of appropriate tables and graphics	Figures 1-4, Table 1-2, Appendix
Reporting of results should include	
Graphic summarizing individual study estimates and overall estimate	Figures 2-4, Appendix
Table giving descriptive information for each study included	Table 1, Appendix
Results of sensitivity testing (eg, subgroup analysis)	9-12, Appendix
Indication of statistical uncertainty of findings	9-12, Figures 2-4, Table 2
Reporting of discussion should include	
Quantitative assessment of bias (eg, publication bias)	16
Justification for exclusion (eg, exclusion of non-English-language citations)	16
Assessment of quality of included studies	Table 2, 13
Reporting of conclusions should include	
Consideration of alternative explanations for observed results	16
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	13-14
Guidelines for future research	14-15
Disclosure of funding source	8

References for the Supplementary material

1. Alameer K, Abukhzam B, Khan W, El-Saed A, Balkhy H. Middle East respiratory syndrome coronavirus (MERS-Cov) screening of exposed healthcare workers in a tertiary care hospital in Saudi Arabia. Antimicrobial Resistance and Infection Control. 2015;4.
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Physical distancing, face masks, and eye protection for prevention of COVID-19

The choice of various respiratory protection mechanisms, including face masks and respirators, has been a vexed issue, from the 2009 H1N1 pandemic to the west African Ebola epidemic of 2014,[1] to the current COVID-19 pandemic. COVID-19 guidelines issued by WHO, the US Centers for Disease Control and Prevention, and other agencies have been consistent about the need for physical distancing of 1–2 m but conflicting on the issue of respiratory protection with a face mask or a respirator.[2] This discrepancy reflects uncertain evidence and no consensus about the transmission mode of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). For eye protection, data are even less certain. Therefore, the systematic review and meta-analysis by Derek Chu and colleagues in *The Lancet*[3] is an important milestone in our understanding of the use of personal protective equipment (PPE) and physical distancing for COVID-19. No randomised controlled trials were available for the analysis, but Chu and colleagues systematically reviewed 172 observational studies and rigorously synthesised available evidence from 44 comparative studies on SARS, Middle East respiratory syndrome (MERS), COVID-19, and the betacoronaviruses that cause these diseases.

The findings showed a reduction in risk of 82% with a physical distance of 1 m in both health-care and community settings (adjusted odds ratio [aOR] 0·18, 95% CI 0·09–0·38). Every additional 1 m of separation more than doubled the relative protection, with data available up to 3 m (change in relative risk [RR] 2·02 per m; $p_{interaction}$=0·041). This evidence is important to support community physical distancing guidelines and shows risk reduction is feasible by physical distancing. Moreover, this finding can inform lifting of societal restrictions and safer ways of gathering in the community.

The 1–2 m distance rule in most hospital guidelines is based on out-of-date findings from the 1940s, with studies from 2020 showing that large droplets can travel as far as 8 m.[4] To separate droplet and airborne transmission is probably somewhat artificial, with both routes most likely part of a continuum for respiratory transmissible infections.[4] Protection against presumed droplet infections by use of respirators, but not masks,[5] supports a continuum rather than discrete states of droplet or airborne transmission. Both experimental and hospital studies have shown evidence of aerosol transmission of SARS-CoV-2.[6–8] One study found viable virus in the air 16 h after aerosolisation and showed greater airborne propensity for SARS-CoV-2 compared with SARS-CoV and MERS-CoV.[6]

Chu and colleagues reported that masks and respirators reduced the risk of infection by 85% (aOR 0·15, 95% CI 0·07–0·34), with greater effectiveness in health-care settings (RR 0·30, 95% CI 0·22–0·41) than in the community (0·56, 0·40–0·79; $p_{interaction}$=0·049). They attribute this difference to the predominant use of N95 respirators in health-care settings; in a sub-analysis, respirators were 96% effective (aOR 0·04, 95% CI 0·004–0·30) compared with other masks, which were 77% effective (aOR 0·33, 95% CI 0·17–0·61; $p_{interaction}$=0·090). The other important finding for health workers by Chu and colleagues was that eye protection resulted in a 78% reduction in infection (aOR 0·22, 95% CI 0·12–0·39); infection via the ocular route might occur by aerosol transmission or self-inoculation.[9]

For health-care workers on COVID-19 wards, a respirator should be the minimum standard of care. This study by Chu and colleagues should prompt a review of all guidelines that recommend a medical mask for health workers caring for COVID-19 patients. Although medical masks do protect, the occupational health and safety of health workers should be the highest priority and the precautionary principle should be applied. Preventable infections in health workers can result not only in deaths but also in large numbers of health workers being quarantined and nosocomial outbreaks. In the National Health Service trusts in the UK, up to one in five health workers have been infected with COVID-19,[10] which is an unacceptable risk for front-line workers. To address global shortages of PPE, countries should take responsibility for scaling up production rather than expecting health workers to work in suboptimum PPE.[11]

Chu and colleagues also report that respirators and multilayer masks are more protective than are single layer masks. This finding is vital to inform the

Tim Dirven/Panos Pictures

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See Online/Articles https://doi.org/10.1016/S0140-6736(20)31142-9

proliferation of home-made cloth mask designs, many of which are single-layered. A well designed cloth mask should have water-resistant fabric, multiple layers, and good facial fit.[12] This study supports universal face mask use, because masks were equally effective in both health-care and community settings when adjusted for type of mask use. Growing evidence for presymptomatic and asymptomatic transmission of SARS-CoV-2[13] further supports universal face mask use and distancing. In regions with a high incidence of COVID-19, universal face mask use combined with physical distancing could reduce the rate of infection (flatten the curve), even with modestly effective masks.[14] Universal face mask use might enable safe lifting of restrictions in communities seeking to resume normal activities and could protect people in crowded public settings and within households. Masks worn within households in Beijing, China, prevented secondary transmission of SARS-CoV-2 if worn before symptom onset of the index case.[15] Finally, Chu and colleagues reiterate that no one intervention is completely protective and that combinations of physical distancing, face mask use, and other interventions are needed to mitigate the COVID-19 pandemic until we have an effective vaccine. Until randomised controlled trial data are available, this study provides the best specific evidence for COVID-19 prevention.

CRM and QW declare no competing interests. CRM is supported by a National Health and Medical Research Council Principal Research Fellowship (grant number 1137582).

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The Kirby Institute, University of New South Wales, Sydney, NSW 2052, Australia (CRM); and Beijing Center for Disease Prevention and Control, Beijing, China (QW)

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From: Holmes, Elaine
To: Cole, Teri J
Subject: FW: Lancet Article
Date: June 5, 2020 11:24:49 AM

From: Strang, Robert <Robert.Strang@novascotia.ca>
Sent: June 5, 2020 11:21 AM
To: Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Earle, Lynda inc#478781 kg <Lynda.Earle@nshealth.ca>; Watson-Creed, Gaynor <Gaynor.Watson-Creed@novascotia.ca>; Jackman, Jessica F <JessicaF.Jackman@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Sarbu, Claudia <Claudia.Sarbu@nshealth.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>
Subject: FW: Lancet Article

From: Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>
Sent: June 5, 2020 1:19 AM
To: Strang, Robert <Robert.Strang@novascotia.ca>; Watson-Creed, Gaynor <Gaynor.Watson-Creed@novascotia.ca>
Cc: Johnston, Lynn <Lynn.Johnston@nshealth.ca>; Davis, Ian <Ian.Davis@nshealth.ca>; MacDonald, Tammy <Tammy.MacDonald@nshealth.ca>
Subject: Lancet Article

Hi Rob,

Lynn, Ian and I discussed the Lancet article and Lynn wrote a response that I think is excellent and so have copied for you as follows:

The article actually does not tell us anything that we did not already know (probably not surprising), although having it put together in a systematic review/meta-analysis is nice to see, and the appendix has a wealth of information.

Some observations:

1) In this study, all patients were symptomatic by definition. Most of the settings were in-hospital, which may not reflect risk of transmission from less symptomatic/ill individuals (i.e. those who never seek medical attention or are well enough to go home). The studies included patients with SARS, MERS, and COVID-19, with the preponderance of studies being with non-COVID-19 patients.
2) All of the studies were observational, with the associated inherent bias difficulties. Most studies reported on bundled interventions, making it difficult to tease out the effect of individual interventions. Information on whether there were AGMPs was limited, as was information on whether the patients also wore masks.
3) Physical distancing was strongly associated with protection.
4) Face mask **could** result in a large reduction in risk of infection. When comparing N95s to no face mask, they offered greater protection than did face masks when compared to no face mask. However, none of the studies comparing face masks specifically to no face mask included COVID-19. Furthermore, N95s were not compared to face masks directly. The authors themselves say “in view of the limitations of these data, we did not rate the certainty of effect as high”.
5) Eye protection might provide additional benefits.
6) Authors’ conclusion: “Globally collaborative and well conducted studies, including randomized

trials, of different personal protective strategies are needed regardless of the challenges, but this systematic appraisal of currently best available evidence could be considered to inform interim guidance. "

What is our current guidance?

1 (=3rd observation): 2 metre distance from symptomatic patients regardless of their wearing a mask

2 (=4th observation): wear a face mask when providing care to a symptomatic patient. Wear an N95 when
doing an AGMP.

3 (=5th observation): wear eye protection when providing care to a symptomatic patient

While some may see this study as demonstrating superiority of N95s, it actually does not (and cannot by virtue of its methodology). I see it as in keeping with our recommendations and experience. Although we have had only a small number of inpatients with COVID-19 in NS, we have no conclusive evidence of health care associated transmission to health care workers when precautions were followed (droplet and contact). We will continue to monitor that closely, as well as all evidence as it emerges. But, this study supports what we have seen for years with other viral infections, including 2 randomized trials of masks compared to respirators that did not demonstrate superiority of one over the other.

So ultimately, the article really does support many of the IPAC measures we have put in place over the past few months, and the conclusion around N95 masks being superior to surgical face masks is overstepped (although as Lynn points out, they did qualify this statement). Additionally, the reinforcement of the impact of physical distancing underlines its importance both as an IPAC and PH measure to prevent transmission.

Hope this is helpful - would be happy to chat more.

Jeannette

Jeannette Comeau, MD MSc FRCPC FAAP
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From: Strang, Robert
To: Watson-Creed, Gaynor; Holmes, Elaine; Cole, Teri J
Cc: Doyle-Bedwell, George H
Subject: RE: Updated guidance from WHO - masks
Date: June 8, 2020 5:18:00 PM
Attachments: image001.gif

The key statement in it is "in areas with widespread transmission…" which I see as consistent with the PHAC guidance and our NS position.
Rob

From: Watson-Creed, Gaynor <Gaynor.Watson-Creed@novascotia.ca>
Sent: June 8, 2020 4:22 PM
To: Strang, Robert <Robert.Strang@novascotia.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Cole, Teri J <Teri.Cole@novascotia.ca>
Cc: Doyle-Bedwell, George H <George.Doyle-Bedwell@novascotia.ca>
Subject: Updated guidance from WHO - masks
file:///C:/Users/watsongz/Downloads/WHO-2019-nCov-IPC_Masks-2020.4-eng.pdf
Significant implications of this new guidance from WHO. Was discussed at TAC today. Will likely come to SAC – worthy of our internal discussion soon…
G

Health and Wellness

Gaynor Watson-Creed, MSc, MD, CCFP, FRCPC
Deputy Chief Medical Officer of Health
PO Box 488
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902-424-2358 Phone
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I acknowledge that I reside and work in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People. This territory is covered by the "Treaties of Peace and Friendship" which Mi'kmaq and Wolastoqiyik (Maliseet) People first signed with the British Crown in 1725. The treaties did not deal with surrender of lands and resources but in fact recognized Mi'kmaq and Wolastoqiyik (Maliseet) title and established the rules for what was to be an ongoing relationship between nations.

Masking during the COVID-19 pandemic – An update of the evidence | National Collaborating Centre for Environmental Health | NCCEH - CCSNE

NOVEL CORONAVIRUS (COVID-19)

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NOVA SCOTIA

Office of the Chief Medical Officer of Health
Position Statement: COVID-19 and the Use of Non-Medical Masks in the Community
Updated July 7, 2020

Position

The Office of the Chief Medical Officer of Health (OCMOH) recognizes that there are many questions about the use of non-medical masks (NMMs) to prevent the community transmission of COVID-19. As Nova Scotia continues to lift public health restrictions, including the introduction of the Atlantic bubble, the OCMOH has enhanced the guidance regarding NMMs as a proactive measure to assist in preventing the potential increased transmission of COVID-19. This document is an update of the statement published on June 26, 2020.

The use of NMMs in the community needs to be considered along with other core personal public health measures as a layered approach for the prevention of COVID-19. These are:

- staying informed, being prepared and following public health advice
- staying at home when symptomatic or ill
- proper hand hygiene and respiratory etiquette
- physical distancing of 2 metres (6 feet) from others outside of your household
- avoidance of touching one's face, mouth, nose or eyes
- increased cleaning of common, high touch surfaces (e.g. counter tops, doorknobs, taps) in one's personal environment (home, personal workspace) with a disinfecting cleaning product
- staying at home as much as possible if at high risk of severe illness
- reducing personal non-essential travel

The OCMOH **now strongly recommends** that individuals in the community wear a NMM if they have respiratory symptoms (cough, sneezing), and, will be in contact with others or when going out to access medical care or other essential health services.

Given the evidence of COVID-19 transmission by asymptomatic or mildly symptomatic people, the easing of public health restrictions and the increased risk of disease importation, including the introduction of the Atlantic bubble, the OCMOH recommendation around use of NMMs has evolved. The OCMOH **now strongly recommends** the use of a NMM by anyone in situations when exposure to crowded public spaces is unavoidable and consistent physical distancing is not possible (i.e. public transportation, stores, shopping areas and group living situations). If used widely and correctly and on a risk basis, NMMs can reduce viral transmission. The safe and appropriate use[1,2] of a NMM is an additional public health practice that can be taken to protect others.

NMMs should[1,2]:

- allow for easy breathing
- fit securely to the head with ties or ear loops
- be changed as soon as possible if damp or dirty

- be laundered with hot, soapy water and thoroughly dried whenever damp or dirty
- maintain their shape after washing and drying
- be comfortable and not require frequent adjustment
- be made of at least 2 layers of tightly woven material fabric (such as cotton or linen)
- be large enough to completely and comfortably cover the nose and mouth without gaping
- be stored in a clean paper bag until worn again
- be discarded in a plastic lined garbage bin after use if they cannot be washed

NMMs should not[1,2]:

- be shared with others
- impair vision or interfere with tasks
- be placed on children under the age of 2 years
- be made of plastic or other non-breathable materials
- be secured with tape or other inappropriate materials
- be made exclusively of materials that easily fall apart, such as tissues
- have tears or holes
- be used when damp, dirty or damaged
- be removed to talk to someone
- be hung from your neck or ears
- be placed on anyone unable to remove them without assistance or anyone who has trouble breathing

The OCMOH continues to monitor evidence on the use of NMMs and local spread of COVID-19. As evidence and understanding of community transmission evolves, the recommendations and guidance in this position statement may change.

Background

The use of masks for the general public has been reviewed as a possible consideration among various COVID-19 pandemic mitigation strategies. The Public Health Agency of Canada has provided advice that Canadians can use NMMs along with physical distancing, hand hygiene, and other measures to limit the transmission of COVID-19[1]. The World Health Organization (WHO) interim guidance[3] on the use of masks in the context of COVID-19, emphasizes that the use of a mask alone is insufficient to decrease the risk of respiratory virus transmission. Other personal and community level measures should also be adopted to limit the spread of COVID-19. The various types of NMMs with different fabrics, layering sequences and shapes have not been systematically compared and evaluated, however the WHO[3] does provide guidance regarding NMM fabric selection, construction and mask management advice. Globally, medical masks are in short supply and their use should be reserved for health care workers and at-risk individuals when indicated[3].

NOVEL CORONAVIRUS (COVID-19)

novascotia.ca/coronavirus

NOVA SCOTIA

There is no definitive research demonstrating that wearing a NMM in the community protects the person wearing it. However, the use of a NMM is potentially beneficial in preventing an infected person from transmitting virus by limiting spread of respiratory droplets. This may be particularly valuable in settings outside of the person's household. There are populations who may not be able to wear a NMM and so, refraining from judgment and kindness is important. Wearing a NMM is not a substitute for physical distancing, hand washing and other core personal public health measures.

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From: Holmes, Elaine
To: Boland, Melissa L; Cole, Teri J; Ryan, Colleen F; Passerini, Linda
Subject: FW: Mask wearing at seated gatherings
Date: July 29, 2020 7:09:39 AM
Attachments: if-ppih-covid-19-sag-mask-use-in-community-rapid-review.pdf
ATT00001.htm

FYI

From: Strang, Robert <Robert.Strang@novascotia.ca>
Sent: July 28, 2020 8:32 PM
To: Johnston, Lynn <Lynn.Johnston@nshealth.ca>
Cc: Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Davis, Ian <Ian.Davis@nshealth.ca>; McNeil, Shelly <Shelly.McNeil@nshealth.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Patel, Alkesh <Alkesh.Patel@novascotia.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>
Subject: Re: Mask wearing at seated gatherings

Thanks Lynn. I am well aware of this review and it, along with other reviews and position statements have informed the PH position on masks.

Rob

Sent from my iPhone

> On Jul 28, 2020, at 8:18 PM, Johnston, Lynn <Lynn.Johnston@nshealth.ca> wrote:
>
> Sending along a good synthesis of mask use in public. Almost a month old, but I am not aware of anything newer. I am sure you are aware of Alberta's excellent rapid reviews, but you may not have seen this one.
> LJ
> Lynn Johnston, MD MSc FRCPC
> Room 5014 ACC, 5780 University Ave
> Halifax, NS B3H 1V7
> 902-473-5553 (p); 473-7394 (f)
>
> ____
> From: Johnston, Lynn
> Sent: July 28, 2020 8:44 AM
> To: Strang, Robert; Comeau, Jeannette; Kempkens, Daniela
> Cc: Davis, Ian; McNeil, Shelly; Holmes, Elaine; Sommers, Ryan; Cram, Jennifer; Patel,

Alkesh; Hatchette, Todd
Subject: Re: Mask wearing at seated gatherings

Thank you Rob for taking the time to share your perspective. I think discussion is always great. I am sure we could debate the points further, but I suspect we have heard them all many times already!
Lynn

Sent from my BlackBerry 10 smartphone on the Bell network.
Original Message
From: Strang, Robert
Sent: Monday, July 27, 2020 10:36 PM
To: Johnston, Lynn; Comeau, Jeannette; Kempkens, Daniela
Cc: Davis, Ian; McNeil, Shelly; Holmes, Elaine; Sommers, Ryan; Cram, Jennifer; Patel, Alkesh; Hatchette, Todd
Subject: RE: Mask wearing at seated gatherings

Lynn,

A few comments back.
1) the main point on mandatory masking now is to change social norms and greatly increase overall mask use in indoor public places, knowing that this will take several weeks to take effect. Waiting until we have increased virus circulating to do this is too late plus a high rate of mask use ahead of virus re-introduction can help limit the rate of virus spread.

2) While there may not be definitive evidence on this there is enough for every credible PH organization to now have clear recommendations on the importance of general mask use as part of the overall package of PH preventive measures

3) Churches, theatres are not packed as we have clear limits on the gathering numbers that are allowed. That was the whole point of my question - if we have limits on numbers and distancing is there a need for masking while people are sitting?

4) We are not planning an enforcement focus on the use of masks due mostly to the challenges of monitoring "medical reason for not wearing a mask" without creating a huge burden in the health care system as well as the high likelihood of marginalized populations being the focus of enforcement. So no ,churches etc would not be fined if people do not wear a mask.

14(1)

Rob

-----Original Message-----
From: Johnston, Lynn <Lynn.Johnston@nshealth.ca>
Sent: July 27, 2020 7:54 PM
To: Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>
Cc: Davis, Ian <Ian.Davis@nshealth.ca>; McNeil, Shelly <Shelly.McNeil@nshealth.ca>; Strang, Robert <Robert.Strang@novascotia.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Patel, Alkesh <Alkesh.Patel@novascotia.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>
Subject: RE: Mask wearing at seated gatherings

Well, I will probably not add anything that will further the decision, but cannot help but give an opinion.

First of all, I would love to see the study showing that masking substantially reduces the amount of virus entering immediate air space and either persisting in that air space (droplet nuclei) or settling into common surfaces. Most of the studies I have seen have been experiments or demonstrations of what does not come our of the mouth when something is over it (not a shock) and not natural events and the evidence of efficacy more theoretical than anything. So, 14(1) [redacted] There are so many more important things we could be doing (like testing and being more diligent about physical distancing and crowd control). To me, 14(1) [redacted] hopefully the public will not be tired and cynical when that time comes. 14(1) [redacted]

In any event, if churches and theatres are packed, of course physical distancing is impossible. However, when is the last time any of you have been in a packed church or movie theatre? Can there not be crowd control there as there is supposed to be in a restaurant? Quite frankly, 14(1) [redacted]

I think we are getting hung up on the small stuff. My guess is that 14(1) [redacted] By the way, does this mean there will be fines for the churches or will all their little old folks be getting medical exemptions. How is that safer?

20(1) [redacted]

LJ

Lynn Johnston, MD MSc FRCPC
Room 5014 ACC, 5780 University Ave
Halifax, NS B3H 1V7
902-473-5553 (p); 473-7394 (f)

____

From: Comeau, Jeannette
Sent: July 27, 2020 11:59 AM
To: Kempkens, Daniela
Cc: Davis, Ian; McNeil, Shelly; Strang, Robert; Holmes, Elaine; Sommers, Ryan; Cram, Jennifer; Patel, Alkesh; Hatchette, Todd; Johnston, Lynn
Subject: Re: Mask wearing at seated gatherings

Hi Rob,

I agree with Ian and Shelly's thoughts and was also thinking about hand hygiene in the context of taking the mask on and off. Really, the hands should be washed before touching the face (mask) and then also before putting it back on. Additionally, the mask should be stored in a clean dry place (ideally not crumpled in a pocket or purse which I'm sure many are). 14(1) [redacted]

14(1) [redacted]

Jeannette

> On Jul 27, 2020, at 11:57, Kempkens, Daniela <Daniela.Kempkens@nshealth.ca> wrote:
>
> Hi Rob,
>
> The MOHs talked about this at our morning meeting as well.
>
> Taking into account density and number of people in a space, duration of events as well as the likelihood of people laughing, singing, etc. 14(1) [redacted]
>
> 14(1) [redacted]
>
> 14(1) [redacted]

MOHS, please add if I forgot anything.

Daniela

-----Original Message-----

From: Davis, Ian

Sent: Monday, July 27, 2020 10:27 AM

To: McNeil, Shelly <Shelly.McNeil@nshealth.ca>; 'Strang, Robert' <Robert.Strang@novascotia.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Patel, Alkesh <Alkesh.Patel@novascotia.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>; Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Johnston, Lynn <Lynn.Johnston@nshealth.ca>

Subject: RE: Mask wearing at seated gatherings

Rob

I would agree that there is little chance that people are going to be able to physically distance in these settings except potentially once they are sitting and that is even going to be difficult to ensure. On the other hand as you know masks are only an additional level of protection and physical distancing is still the most effective means to limit transmission so wouldn't want people to think that they could pack into a theatre or church and sit side by side at 100% capacity just because they are wearing a mask. I would think that 14(1) [redacted]

14(1) [redacted]

Ian

-----Original Message-----

From: McNeil, Shelly

Sent: Monday, July 27, 2020 9:19 AM

To: 'Strang, Robert' <Robert.Strang@novascotia.ca>; Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Patel, Alkesh <Alkesh.Patel@novascotia.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>; Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Johnston, Lynn <Lynn.Johnston@nshealth.ca>; Davis, Ian <Ian.Davis@nshealth.ca>

Subject: RE: Mask wearing at seated gatherings

I think this is a tough one- when I think about the layout of theatre, it, it the seats are approximately 1 foot apart and the rows are generously 2 feet apart, and the average group is 2-4 people seated together, 14(1)

14(1)

14(1) That said, they make most of their money on food and drink so I can see why the pushback. 14(1)

14(1)

My thoughts

Shelly

Not responsive

Cheers

Shelly

-----Original Message-----

From: Strang, Robert [mailto:Robert.Strang@novascotia.ca]

Sent: Monday, July 27, 2020 7:25 AM

To: Holmes, Elaine <Elaine.Holmes@novascotia.ca>; Sommers, Ryan <Ryan.Sommers@nshealth.ca>; Kempkens, Daniela <Daniela.Kempkens@nshealth.ca>; Cram, Jennifer <Jennifer.Cram@nshealth.ca>; Patel, Alkesh <Alkesh.Patel@novascotia.ca>; McNeil, Shelly <Shelly.McNeil@nshealth.ca>; Hatchette, Todd <Todd.Hatchette@nshealth.ca>; Comeau, Jeannette <Jeannette.Comeau@iwk.nshealth.ca>; Johnston, Lynn <Lynn.Johnston@nshealth.ca>; Davis, Ian <Ian.Davis@nshealth.ca>

Subject: Mask wearing at seated gatherings

I am seeking your opinion on whether the mandatory masking in public places should include people attending seated events such as movies, theatre, worship services once they are seated with appropriate physical distance from others or other family or close social groups as per the gathering requirements in the PH order.

As it is now written masking would be required under the PH order. The rationale for this is that even with distancing masking substantially reduces the amount of virus entering immediate air space and either persisting in that air space (droplet nuclei) or settling into common surfaces.

I have been getting questions about this all weekend asking why seated physically distanced is not sufficient and asking that masks not be required in these situations.

I have the next couple of days to amend the order Before it takes effect on July 32st so any feedback would be appreciated.

BTW, we will be clarifying in the order that performers and officiants at gatherings will not need to wear a mask while doing activities that involve speaking or singing.

Thanks,

Rob

Sent from my iPhone

COVID-19 Scientific Advisory Group Rapid Response Report

Key Research Question: What is the effectiveness of wearing medical masks, including home-made masks, to reduce the spread of COVID-19 in the community? [Updated June 19, 2020]

Context

- On June 5th, 2020, the WHO, despite a limited evidence base, provided guidance on the continuous use of medical masks by health workers and caregivers in areas of known or suspected community transmission regardless of whether direct care to COVID-19 patients is being provided. In addition they provided guidance to decision makers using a risk based approach for the use of masks in areas with community transmission of COVID-19 when physical distancing is difficult (ie. public transit, shops, or other confined or crowded spaces).
- On May 20, 2020, the Public Health Agency of Canada recommended that non-medical masks be used in settings where it is not possible to maintain a 2-metre physical distance. The federal transportation minister then mandated mask use on planes, rail transport, and ships.
- The government of Alberta has initiated distribution of 20 million, single-use non-medical masks to the community which appear to be of high grade (with a 3 layer design, purporting a 96% filtration rate for particles up to 3 um and Delta-R 1.7 which would meet FFP2 requirements).
- Community mask use is now either encouraged or mandatory in over 80 countries, with many jurisdictions encouraging but not mandating the use of cloth masks; however, some countries such as Australia and New Zealand continue to not recommend community masking and have achieved low rates of COVID activity despite the lack of this particular intervention.
- Shortages of medical (procedure, surgical masks) masks and N95 masks for health care workers persist globally and nationally.
- With a focus on recovery and relaxation of social distancing in the context of the stabilization of the initial wave of the pandemic, the general population is returning to community and workplace settings where social distancing will not always be possible, which is driving interest in, and controversies around the use of cloth and home-made masks.

Key Messages from the Evidence Summary

- As medical masks are often bundled with other IPC interventions and have variable compliance, clinical trials on the effectiveness of medical masks have been challenging. Systematic reviews of randomized controlled trials in health care settings have not demonstrated a significant reduction in acute respiratory infections, (ARIs), ILIs or laboratory confirmed viral infections with medical mask use although it is acknowledged there were methodological flaws and smaller underpowered studies in the data analyzed.
- There is a paucity of clinical evidence in favor of using medical masks in the community, with multiple randomized trials demonstrating mixed results which when pooled demonstrate no significant reduction in acute respiratory infections (ARIs), ILIs or laboratory confirmed viral infections. There are some lower quality studies showing a reduction in viral infection rates in households, in transmission of viral respiratory infections in the context of mass gatherings, and in university residences when combined with hand hygiene interventions.
- However, while systematic reviews of randomized clinical trials fail to show significant benefit with medical mask use in community settings, more observational and case-control studies

(both at higher risk of bias), have suggested that masks are protective.

- The reasons for the lack of significant reduction for ARIs in the randomized trials is complex and may include: study design, setting, and human factors associated with wearing masks including low compliance with mask wearing, lack of concomitant hand hygiene, inoculation via the conjunctiva, frequent facial touching and mask adjustment leading to inoculation events, risk compensation behaviours, and self-contamination with inappropriate mask doffing. These possibilities have not been rigorously assessed.
- Laboratory studies investigating the efficacy of masks in filtering viral particles as well as studies in medical settings with laboratory based endpoints for bacterial respiratory pathogens (*Pseudomonas aeruginosa and Mycobacterium tuberculosis*) point to a theoretical benefit to medical mask use as a form of source control (protecting others from the wearer). There are no laboratory studies with SARS-CoV-2 and only one looking at other human coronaviruses.
- There are modelling studies and ecological data suggesting a benefit to medical mask use in the community via a reduction in viral transmission rates (R0) across wide ranges of community transmission levels. While these models are suggestive, they have significant inherent bias based on multiple assumptions including assumptions around mask efficacy in preventing transmission, and bundled interventions.
- Based on lab-based bioaerosol and NaCl aerosol studies, medical masks are superior to homemade cloth masks, but non-medical masks and optimally constructed home-made masks may offer some protection in reducing dispersion of droplets. Laboratory-based studies are of highly variable quality, with only a few studies using industry approved filtration efficiency testing methods.
- The newly released guidance from the World Health Organization suggests decision makers advising on non-medical mask use should take into consideration features of filtration efficiency (FE), breathability, number (and combination) of materials used, shape, coating and maintenance of cloth masks. The WHO suggests minimum Q (filter quality factor) score of the material chosen of 3 (three) based on expert consensus and engineering science and industry standards. They further suggest an optimal combination of material for non-medical masks should include three layers:

    1) an innermost layer of a hydrophilic material (e.g. cotton or cotton blends);

    2), an outermost layer made of hydrophobic material (e.g., polypropylene, polyester, or their blends) and

    3) a middle hydrophobic layer of synthetic non-woven material such as polypropylene, or a cotton layer which may enhance filtration or retain droplets

- There is limited evidence of harms related to community mask wearing with no studies identified that have systematically looked at potential harms. Such harms could include behavioral modifications such as risk compensation/non-adherence to social distancing or optimal hand hygiene practices, self-contamination, induction of facial rashes, and increasing real or perceived breathing difficulties. There are also concerns about poor compliance or tolerance of masks in children or those with cognitive challenges and communication difficulties.
- The only clinical study to examine cloth mask efficacy in preventing repiratory virus transmission was in a healthcare setting, comparing continuous cloth or medical masks use to usual practice. Among the comparator (usual practice) group, a large percentage of individuals used medical masks for part of the time. The study had significant methodological issues but did demonstrate

a significantly higher respiratory viral infection event rate of HCW using a 2-ply cotton cloth masks when compared with the use of standard practice. (Macintyre et al, 2015)

- Pre-symptomatic transmission and asymptomatic transmission of SARS-CoV-2 have been described but the degree to which they contribute to community spread is unclear, At this point, there is no direct evidence that the use of a medical or homemade cloth mask or the wider use of masks in the community significantly reduces this risk. For more information, refer to the Asymptomatic Transmission of SARS-CoV-2 rapid review.

Committee Discussion

There was agreement that although the evidence base is poor, the use of masks in the community is likely to be useful in reducing transmission from community based infected persons, particularly those with symptomatic illness. One member was very concerned, and there was some agreement, that a focus on mask-use could lead to a reduced sense of personal risk, i.e. risk compensation. There is some evidence demonstrating less attention to social distancing and hand hygiene as the mainstays of prevention in a community setting. It was noted that while there is evidence from observational studies that medical masks may reduce ARIs and ILIs in health care settings, that there is no clinical trial evidence that use of non-medical or medical masks in the community reduces viral transmission.

There was agreement that there is insufficient information to make a firm recommendation for the use of home-made (non-medical) masks in the community. In the face of difficulties in quantifying risk of asymptomatic transmission and potential benefit outweighing the harms of wider use of home-made masks in the community, several committee members felt strongly that we should carefully balance the recommendation for community use to reflect the precautionary principle as well as evidence gaps. One member felt that to achieve the maximum population benefit, the majority of people should be wearing masks in settings where physical distancing cannot be maintained. To account for these controversies, which were mostly based on uncertainties in the evidence, a Research Gaps section has been added.

There was concern that we may be over-emphasizing the potential harm associated with the use of non-medical masks in the community, and there was general but not unanimous agreement to reduce this emphasis and focus on the need for systematic research looking at benefits and harms with clinical outcomes.

This update was predominantly based on the WHO revised advice, but it was noted that there is little new evidence aside from information on filtration efficiency of different home-made masks since our last update. There remains a lack of data demonstrating benefit of cloth masks as currently used in the community, beyond lab based filtration studies. There remains a significant disconnect between RCTs and observational study results of community mask use, and significant confounding and bias in ecologic trials. Since the last version of this review, there is very little new data except new syntheses of previous studies, new modeling studies, and some new collations of cloth filtration characteristics. One reviewer commented on the system level issues with supporting medical and non-medical mask use in the community as important elements in addition to the patient level harms.

One reviewer highlighted the importance of identifying specific level of guidance and evidence provided by the updated advice from the WHO. As little additional evidence was highlighted in this review, the emphasis of the WHO report was discussed: “the process of interim guidance development during emergencies consists of a transparent and robust process of evaluation of the available evidence on benefits and harms, synthesized through expedited systematic reviews and expert consensus-building facilitated by methodologists. This process also considers, as much as possible, potential resource implications, values and preferences, feasibility, equity, ethics and research gaps” (WHO, June 5, 2020). Therefore more specific description of the document, recommendations and the risk-based approach to community mask use with consideration of local epidemiology has been incorporated. (https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak)

Lastly, committee members felt that the research gaps section should better highlight the remaining uncertainties regarding mask use in the community, and how they might be addressed. This would include better information about optimal mask construction, as well as more robust evidence about their impact on clinically relevant measures of benefit and harm. Finally, additional details about compliance with medical and non-medical mask use in the community would be helpful.

Recommendations

1. In light of concerns around PPE shortages, medical masks should continue to be prioritized for HCWs in direct patient care roles. HCWs should continue to wear medical masks whenever providing direct patient care and whenever social distancing is not possible in health care settings.
2. In the community, medical mask use should be prioritized for those with any symptoms suggestive of COVID-19, as a form of source control. Community caregivers of potentially infectious COVID-19 patients and care providers for those who are more vulnerable to severe infection in the household setting should also wear medical or well-constructed non-medical masks as a form of protection.
3. In settings where social distancing cannot be maintained, medical masks or high-quality non-medical masks should be encouraged as a form of protection for those vulnerable to severe COVID-19 infection outcomes. Vulnerable populations include those over 60 and those with comorbidities or immunosuppression.
4. Evaluation of the extent of community transmission of SARS-CoV-2 is required to continually assess the risks and benefits of community mask use in various situations, although there is insufficient evidence to recommend specific epidemiologic thresholds for this purpose. This is consistent with WHO guidance which advises decision makers to apply a risk-based approach focusing on specific criteria when considering or encouraging the use of masks for the general public that incorporates consideration of local epidemiology. The WHO encourages use of a well-constructed non-medical mask, designed according to the available evidence from materials engineering science, as a possible method of reducing risk of transmission of COVID-19 when social distancing is not possible. Situations where this may be particularly relevant include: on public transportation, workplaces necessitating close proximity to other workers or the public, or when entering and exiting public buildings.
5. In light of widespread interest in masks and anecdotal evidence of potentially harmful, inappropriate use by the public, health officials should widely communicate the need for both optimal mask construction and mask "etiquette". It is important to strengthen the messaging that their use not replace the need for maintaining social distancing and hand hygiene as more important strategies to prevent transmission of COVID-19; and the need to not touch the mask, to replace when soiled or wet and ensure appropriate laundering. Current advice on when and how to wear home-made or non-medical masks is available at: https://www.albertahealthservices.ca/topics/Page16997.aspx#prev

Research Gaps

1. While there is some additional evidence, there is a need for further research into the optimal construction and fabric composition of home-made or non-medical masks and their efficacy in protection against transmission or acquisition of SARS-CoV-2.
2. Currently, we only have theoretical benefit demonstrated in laboratory studies of the filtration capabilities of cloth masks. Further studies assessing population benefits and harms of home-made (non-medical) masks are urgently required. These studies should include RCTs that assess clinical outcomes.
3. Studies evaluating the frequency and compliance of mask use by individuals in clinical and community settings, potentially using longitudinal surveys and/or contact tracing data would be of benefit while awaiting more rigorous trial results.

Summary of Evidence

Since the last update on April 21, 2020, the World Health Organization has provided new guidance on the use of masks in the community. There has also been a significant number of new studies examining their use. However, there is only one new clinical study. The remainder of the studies have been multiple new systematic reviews and meta-analyses of previously published clinical studies, modelling studies, and laboratory-based studies of various homemade materials.

International guidelines and practices for use of masks in the community setting:

World Health Organization guidance on the use of masks in the community

On June 5th, the WHO provided an update to prior guidance from April 6th. 2020.
The process of interim guidance development during emergencies consists of a transparent and robust process of evaluation of the available evidence on benefits and harms, synthetized through expedited systematic reviews and expert consensus-building facilitated by methodologists. This process also considers, as much as possible, potential resource implications, values and preferences, feasibility, equity, ethics and research gaps (https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak).

The primary differences with this update included:
Updated information on transmission from symptomatic, pre-symptomatic and asymptomatic people infected with COVID-19, as well as an update of the evidence of all sections of this document;
• New guidance on the targeted continuous use of medical masks by health workers working in clinical areas in health facilities in geographical areas with community transmission1 of COVID-19;
• Updated guidance and practical advice for decision-makers on the use of medical and non-medical masks by the general public using a risk-based approach;
• New guidance on non-medical mask features and characteristics, including choice of fabric, number and combination of layers, shape, coating and maintenance. (**WHO, June 2020)**
(see Table 1 in the Appendix).

As it relates to the: Targeted continuous medical mask use by health workers in areas of known or suspected COVID-19 community transmission, the updated WHO guidance document suggests the following guidance: (WHO, June 5, 2020)

In the context of locations/areas with known or suspected community transmission or intense outbreaks

of COVID-19, WHO provides the following guidance:
• Health workers, including community health workers and caregivers, who work in clinical areas should continuously wear a medical mask during their routine activities throughout the entire shift; apart from when eating and drinking and changing their medical mask after caring for a patient who requires droplet/contact precautions for other reasons;
• According to expert opinion, it is particularly important to adopt the continuous use of masks in potential higher transmission risk areas including triage, family physician/GP practices, outpatient departments, emergency rooms, COVID-19 specified units, haematological, cancer, transplant units, long-term health and residential facilities;
• When using medical masks throughout the entire shift, health workers should make sure that:
  - the medical mask is changed when wet, soiled, or damaged;
  - the medical mask is not touched to adjust it or displaced from the face for any reason; if this happens, the mask should be safely removed and replaced; and hand hygiene performed;
  - the medical mask (as well as other personal protective equipment) is discarded and changed after caring for any patient on contact/droplet precautions for other pathogens;

• Staff who do not work in clinical areas do not need to use a medical mask during routine activities (e.g., administrative staff);
• Masks should not be shared between health workers and should be appropriately disposed of whenever removed and not reused;
• A particulate respirator at least as protective as a US National Institute for Occupational Safety and Health-certified N95, N99, US FDA surgical N95, European Union standard FFP2 or FFP3, or equivalent, should be worn in settings for COVID-19 patients where AGPs are performed (see WHO recommendations above). In these settings, this includes its continuous use by health workers throughout the entire shift, when this policy is implemented.

To be fully effective, continuous wearing of a medical mask by health workers, throughout their entire shift, should be implemented along with other measures to reinforce frequent hand hygiene and physical distancing among health workers in shared and crowded places where mask use may be unfeasible such as cafeterias, dressing rooms, etc.

The following potential harms and risks should be carefully taken into account when adopting this approach of targeted continuous medical mask use, including:
• self-contamination due to the manipulation of the mask by contaminated hands;
• potential self-contamination that can occur if medical masks are not changed when wet, soiled or damaged;
• possible development of facial skin lesions, irritant dermatitis or worsening acne, when used frequently for long hours
• masks may be uncomfortable to wear;
• false sense of security, leading to potentially less adherence to well recognized preventive measures such as physical distancing and hand hygiene;
• risk of droplet transmission and of splashes to the eyes, if mask wearing is not combined with eye protection;
• disadvantages for or difficulty wearing them by specific vulnerable populations such as those with mental health disorders, developmental disabilities, the deaf and hard of hearing community, and children;
• difficulty wearing them in hot and humid environments.(**WHO, June 5, 2020)**

As it relates to the WHO updated Advice to decision makers on the use of masks for the general public

WHO advises decision makers to apply a risk-based approach focusing on the following criteria when considering or encouraging the use of masks for the general public:

Taking into account the available studies evaluating pre- and asymptomatic transmission, a growing compendium of observational evidence on the use of masks by the general public in several countries, individual values and preferences, as well as the difficulty of physical distancing in many contexts, WHO has updated its guidance to advise that to prevent COVID-19 transmission effectively in areas of community transmission, governments should encourage the general public to wear masks in specific situations and settings as part of a comprehensive approach to suppress SARS-CoV-2 transmission . WHO advises decision makers to apply a risk-based approach focusing on the following criteria when considering or encouraging the use of masks for the general public:

1. Purpose of mask use: if the intention is preventing the infected wearer transmitting the virus to others (that is, source control) and/or to offer protection to the healthy wearer against infection (that is, prevention).
2. Risk of exposure to the COVID-19 virus:
   - due to epidemiology and intensity of transmission in the population: if there is community transmission and there is limited or no capacity to implement other containment measures such as contact tracing, ability to carry out testing and isolate and care for suspected and confirmed cases.
   - depending on occupation: e.g., individuals working in close contact with the public (e.g., social workers, personal support workers, cashiers).
3. Vulnerability of the mask wearer/population: for example, medical masks could be used by older people, immunocompromised patients and people with comorbidities, such as cardiovascular disease or diabetes mellitus, chronic lung disease, cancer and cerebrovascular disease.
4. Setting in which the population lives: settings with high population density (e.g. refugee camps, camp-like settings, those living in cramped conditions) and settings where individuals are unable to keep a physical distance of at least 1 metre (3.3 feet) (e.g. public transportation).
5. Feasibility: availability and costs of masks, access to clean water to wash non-medical masks, and ability of mask wearers to tolerate adverse effects of wearing a mask.
6. Type of mask: medical mask versus non-medical mask

Based on these criteria, (Table 1 in appendix) provides practical examples of situations where the general public should be encouraged to wear a mask and it indicates specific target populations and the type of mask to be used according to its purpose. The decision of governments and local jurisdictions whether to recommend or make mandatory the use of masks should be based on the above criteria, and on the local context, culture, availability of masks, resources required, and preferences of the population.

Masking recommendations

The following link provides a list of countries recommending or requiring community use of masks:
https://masks4all.co/what-countries-require-masks-in-public/
It is updated daily.

Mask provision
Foreseeing impending medical mask shortages, Taiwan enlisted multiple interventions to try to prevent them. These included: state-controlled production and distribution of medical masks with daily, individual, name-based rations of masks (at modest cost) distributed at local drugstore and free provision of masks for school-aged children. South Korea also implemented state control over manufacturing and now provides a weekly ration of two masks (https://www.nytimes.com/2020/04/01/opinion/covid-face-mask-shortage.html).

In Japan (https://english.kyodonews.net/news/2020/04/67ad0dfcd954-delivery-of-cloth-masks-from-govt-starts.html), Hong Kong (https://www.qmask.gov.hk/about/), and Singapore (https://www.gov.sg/article/when-should-i-wear-a-mask) mass-manufactured, re-usable, cloth masks are being provided to citizens. In Hong Kong, pre-registered, low-income families may also receive 5 disposable medical masks per week for 10 weeks at vending machine dispensers (https://finance.yahoo.com/news/world-development-mask-dispensers-live-133000505.html).

The city of Los Angeles is providing garment manufacturers with crude guidelines on sewing non-medical masks (https://www.dropbox.com/s/x9myr2t9mhxd4zo/COVID_Mask-Manufacturer-Packet.pdf?dl=0) that can then be sold to the public.

Current evidence on COVID-19 Transmission:
It is accepted that SARS-CoV-2 is transmitted via droplets (<5 μm) expelled when a patient sneezes or coughs. However, the exact distance droplets can travel has been called into question **(Bourouiba, 2020)**. Others have also posited the possibility of SARS-CoV-2 transmission through ordinary speech (**Asadi S et al, 2020)**. There is also increasing concern regarding pre-symptomatic, pauci-symptomatic, or rarely, asymptomatic transmission of COVID-19, wherein individuals have RT-PCR detectable SARS-CoV-2 from nasal or throat swabs prior to or without development of symptoms **(Bai et al. 2020, Chan et al. 2020, Pan et al. 2020, Kimball et al. 2020, Wei et al. 2020,** and **Li et al. 2020)**. It also appears that viral loads are highest during the early symptomatic phase **(To et al. 2002, Wolfel et al. 2020,** and **Bai et al. 2020**) or even the pre-symptomatic stage. Indeed, **He et al. 2020** infer that infectiousness may peak on or before symptom onset and through modelling, estimate that up to 44% of secondary cases were infected during the index cases' pre-symptomatic stage. Therefore, the main theoretical benefit of masks during the COVID-19 pandemic would be as a form of source control to minimize dispersion of the expelled viral particles from individuals unknowingly transmitting disease.

For more information, refer to the Asymptomatic Transmission of SARS-CoV-2 Rapid Review.

Clinical studies and systematic reviews examining use of medical masks to prevent transmission of COVID-19:
One new clinical study has examined masks for prevention of COVID-19 transmission in the community, specifically, in the household setting. **Wang Y et al, 2020** undertook a retrospective study of 335 people (124 families) to determine characteristics and practices of both the source case and their contacts that were predictors of secondary transmission. They determined that if one or more members of the household (either the primary case or their contacts) wore a mask *before* development of symptoms, there was a 79% reduction in transmission (OR=0.21, 95% CI: 0.06 to 0.79). In another study of 105 cases (imported from Wuhan to other centres) and 392 household contacts, the overall attack rate in households was 16.9%, but was 0% in households of 14 index patients who reportedly self isolated (used masks, dining separately, and residing alone within the home) upon (not before) symptom development (Wei Li et al, 2020).

Clinical evidence for the use of medical masks in mixed settings (clinical and community) prior to COVID-19 has been well summarized in three separate systematic reviews and meta-analyses (**Jefferson et al. 2011, Offeddu et al. 2017, Saunders-Hastings et al, 2017)**. Offeddu et al. focused only on health-care settings, Jefferson et al. 2011 and Saunders-Hasting et al. 2017 looked at mixed settings. All three reviews reported methodologic concerns related to the randomized trials that were often under-powered and prone to reporting biases. Offeddu et al, did a meta-analysis of RCTs comparing any mask (medical or N95) to no masks. They found that masks conferred significant protection against self-reported clinical respiratory illness (RR = 0.59; 95% CI: 0.46–0.77) and influenza-like illness (RR = 0.34; 95% CI: 0.14–0.82) but only a non-statistically significant effect against laboratory-confirmed viral infections. A meta-analysis of observational studies noted a protective effect of medical masks vs. no mask (OR = 0.13; 95% CI: 0.03–0.62) against SARS. Jefferson et al, 2011 undertook a meta-analysis of seven case-control studies (~50% of participants were not health care workers) with 3216 participants and found fewer acute respiratory infections with medical mask use, OR 0.32, 95% CI 0.26 to 0.39. Of all physical interventions (including hand hygiene, gowns and gloves), masks were the most effective. In a meta-analysis of three case-control studies (19% of the participants being in a household setting), Saunders-Hastings et al. found that medical masks provided a non-significant protective effect against pandemic influenza (OR = 0.53; 95% CI 0.16–1.71; I^2 = 48%).

Clinical evidence for the use of masks in the community setting (only) has also been examined, with three systematic reviews by **Brainard et al, 2020 (preprint), MacIntyre et al, 2015, and Barasheed et al, 2016.** Brainard et al, 2020 identified 31 different studies (including pre-post, cross-sectional, case-control, observational, and randomized controlled trials). 12 studies were RCTs. These authors found the evidence to be of low to very low certainty and concluded that “the evidence is not sufficiently strong to support widespread use of facemasks as a protective measure against COVID-19. However, there is enough evidence to support the use of facemasks for short periods of time by particularly vulnerable individuals when in transient higher risk situations.**”** MacIntyre et al. 2015, identified 9 RCTs of facemasks in diverse settings (households and community), and with varied designs and interventions (ie. combination hand washing and facemasks). Due to the heterogeneity, no meta-analysis was undertaken. The results were inconclusive. A copy of the table summarizing these 9 articles is provided in **Table 2** of the **Appendix**. In general, the RCTs included use of a surgical grade facemask but the observational studies did not provide adequate description of the types of masks used.
Barasheed et al. 2016**,** pooled the results of 13 heterogeneously designed studies examining the effectiveness of medical masks at preventing variably defined acute respiratory infection endpoints arising during the Hajj pilgrimage. Based on studies which the authors deemed to be of “average” quality, they found a small, statistically significant benefit (RR 0.89, 95% CI 0.84-0.94). However, pooling of studies of vastly different design may be considered inappropriate from an analytic perspective and it is possible this small difference disappears when a more appropriate pooling is done.

Since the completion of the last review, multiple new systematic reviews, with or without meta-analyses, have been completed. They almost exclusively re-examined the studies already included in the reviews mentioned above.

Any setting:

- **Chu et al, 2020** did a systematic review and meta-analysis **of observational studies** (using frequentist, Bayesian meta-analysis, and random effects meta-regressions) to look at the impact of physical distancing, masks, and eye protection. Their analysis was limited to studies of coronaviruses (SARS-CoV-2, SARS-CoV, and MERS-CoV). They did not identify any randomized controlled trials. They found any masks (N95, medical mask, or 12-16 layer cotton) reduced risk of infection (unadjusted n=10,170, RR 0.34, 95% CI 0.26-0.45; adjusted studied n=2647, aOR 0.15, 95% CI 0.07-0.34) when compared to no mask. When only medical *or* 12-16 layer cotton masks were compared with no mask, the protective effect was diminished but persisted (aOR 0·33, 95% CI 0·17–0·61). There was no comparison of medical masks to cotton masks. When only the 3 community-based studies were included, masks remained protective (RR 0.56, 95% CI 0.40-0.79). Using the GRADE category of evidence, the findings were deemed to be of low certainty. This study was limited by the observational nature of the studies included which are subject to significant bias.

- **Jefferson et al, 2020** (pre-print) updated their previous review looking at physical interventions to stop the spread of respiratory viruses, this time focusing only on **randomized and cluster randomized trials**. 14 trials assessed the impact of mask wearing. Looking at general population, there was no reduction in ILI cases (RR 0.93, 9% CI 0.83 to 1.05) nor in laboratory-confirmed influenza (RR 0.84, 95% CI 0.61-1.17). No benefit was identified in health care workers either.
- **Liang et al. (pre-print)** examined use of any type of mask in any setting in preventing respiratory virus transmission. In the subgroup of non-HCW, a protective effect was found with a pooled OR of 0.53 (95% CI=0.36 - 0.79), this effect persisted in both household (OR=0.60, 95% CI=0.37-0.97) and the non-household settings (OR=0.44, 95% CI=0.33-0.59). The RCTs included in this study scored 3 or 4/5 on the Jadad scale, but it should be noted that this a quality assessment tool whose use is discouraged by the Cochrane Collaboration with concerns of its ability to detect bias.
- **MacIntyre R and Chughtai AA, 2020** looked only at randomized controlled trials. Including eight trials in community settings, and concluded that when masks were used by ill individuals, their well contacts were protected. Of note, these findings were dissimilar from many others in that among health care workers in clinical settings, they found that only continual use of respirators was beneficial, with medical masks found to be less effective and cloth masks were even less effective than medical masks.

Community settings only:

- **Wei et al. (pre-print)** did a systematic review and meta-analysis of 8 RCTs examining any type of mask in the community setting. Masks lowered the risk of developing ILI (pooled RR=0.81, 95% CI: 0.70-0.95).
- In a pre-registered, rapid review using Bayseian analysis, **Pereski et al. (pre-print)** identified 21 studies examining incidence of ILI (variably reported) in the community. All masks types were considered. 1/11 RCTs and 6/10 observational studies found that masks reduced incidence of ILI. They found that while RCTs showed a moderate likelihood of a *small* effect of wearing medical masks in the community to reduce self-reported ILI, the risk of reporting bias was high. The evidence for reduction of clinically or lab-confirmed infection was equivocal. By contrast, observational studies showed that masks reduced incidence of ILI but there was a high risk of confounding and reporting bias. The difference in the findings between RCTs and observational studies was also noted previously by **Brainard et al.**

Cloth masks only:

- **Mondal et al. (pre-print)** looked at the utility of cloth masks in any setting. They included both clinical and non-clinical studies, in what can be more accurately described as a scoping review. They found two clinical studies, only one of which assessed the clinical effectiveness of cloth masks. This was the study by **MacIntyre et al, 2015** which is discussed later in this review. In the laboratory studies, cloth mask filtration efficiency was highly variable, between 3-95%, likely reflecting the highly variable materials and measurement techniques.

Laboratory based studies examining use of medical masks to prevent transmission of COVID-19:
Given the challenges of clinical studies, another approach has been to directly measure the efficacy of medical masks in both filtering exhaled respiratory viruses and in providing a barrier to entrance of pathogens.

In the only laboratory study to look at coronaviruses, **Leung et al, April 2020** found that coronaviruses could be detected in respiratory droplets (>5um) and aerosols (<5 uM) in 3/10 (30%) and 4/10 (40%) of samples collected without medical masks, respectively. They did not detect any virus in respiratory droplets or aerosols collected from participants wearing medical masks.

Multiple other studies have examined the use of masks for preventing spread of other respiratory pathogens. **Milton et al, 2013** found that medical masks reduced influenza viral copy numbers in exhaled samples by ~3-25 fold (depending on the size of the particle). **Johnson et al, 2009** could detect influenza in all samples of exhaled breath where a mask was not worn but detected no influenza virus by RT-PCR with medical masks. In two separate studies medical masks reduced the release of *Pseudomonas aeruginosa* in patients with cystic fibrosis both when worn for short **(Stockwell et al, 2018)** and longer durations **(Stockwell et al, 2018). Dharmadhikari et al, 2012**, examined the benefit of medical masks as a form of source control on a multi-drug resistant tuberculosis ward where exhaust air from patients is delivered to guinea pig exposure chambers. Compared to patients who did not wear a masks, patients who did wear a mask infected 56% fewer guinea-pigs (36/90 vs 69/90 infected guinea pigs).

Two studies have examined the effectiveness of medical masks to protect the wearer, as a barrier against viral bioaerosols. Ma et al, 2020 found that compared with one-layer of polyester, medical masks blocked 97.15% of avian influenza viral bioaerosols while a 4-layer homemade mask blocked 95.15%. The high efficacy rates of the masks may have been related to the unrealistically tight seals in the model used. **Makison-Booth et al, 2013** realistically adhered masks to the face of a mannequin and then measured the amount of viable live influenza virus from the air in front and behind of five different types of surgical masks. They found that medical masks reduced exposure to aerosolized influenza virus by approximately 6-fold.
Thus, the preponderance of lab-based studies (Milton et al 2013, Johnson et al, 2009, Stockwell et al. 2018, Stockwell et al. 2018, Dharmadhikari et al, 2012, and Leung et al, 2020) suggest the benefit of a mask is as a method of source control with reduction of the amount of respiratory virus released by exhaled particles. That is, the public would be protected from respiratory spread of infection from the mask wearer.

Other studies (modelling, ecological, anecdotal, etc) examining use of medical masks to prevent transmission of COVID-19:

Influenza transmission models:
Brienen et al, 2010 developed a population transmission model to explore the impact of population-wide mask use on an influenza pandemic. They assumed that the reduction in infection risk would be proportional to the reduction in exposure to the virus based on particle retention by the mask and mask coverage (number of people appropriately wearing masks). It is unknown if this assumption is valid. They concluded that masks could lower the basic reproduction number, at least delaying, if not containing, an influenza outbreak. A detailed transmission model by **Trachet et al, 2009;** however was less optimistic, concluding that while 10% of the population using N95 masks could result in a 20% reduction in H1N1, even 50% of the population wearing medical masks would only results in a 6%

reduction in number of cumulative cases. In their model, **Yan et al, 2019,** found that at a population-level compliance of 50%, all types of masks—except low-filtration surgical mask—could reduce prevalence of influenza outbreak to <5%. At a compliance rate of 80%, low-filtration surgical masks (not otherwise defined) could reduce prevalence by 50%.

COVID-19 models: In a model assessing various local interventions, **Tian et al, 2020 (preprint)** estimated reductions in the basic reproduction number *R*0 of SARS-CoV-2 with different interventions. Assuming masks reduce *R*0 by a factor $(1 - epm)^2$, where *e* is the efficacy of trapping viral particles inside the mask, and *pm* is the percentage of the population that wears masks – for example, if 50% of the population wears a mask and the mask has a 50% efficacy at trapping particles, *R*0 could drop to 1.35 (down from ~2.4). It is unknown if this assumption is valid.

Eikenberry et al. 2020 developed a mathematical model that adapted the SEIR model of Breinen et al. and Trachet et al. to the COVID19 pandemic epidemiologic parameters and then looked at the impact of varying mask efficacy and compliance rates on transmissions and epidemiologic outcomes (death, hospitalizations). They found that 80% coverage of masks that are only 20% effective could still reduce the effective transmission rate by 1/3. Applied to a case study of Washington state, this could translate into a reduction in mortality of 24-65%. **Javid et al, 2020 (pre-print)** created a simple, proof of principle, SIR model, assuming that masks reduced transmission by 8-16%. Like Eikenberry et al. where there was more mortality benefit seen in areas of lower transmission, Javid et al. noted a more substantial reduction on deaths when the effective R approached 1. Finally, **Worby et al, 2020 (pre-print)** created a SEIRD model to test various strategies for mask allocation (ie. different percentage of allocation to symptomatic vs asymptomatic individuals; or to the elderly population). First, they found that the more effective the mask, the lower the population uptake required. That is, deaths could be reduced by 65% with 15% coverage of a highly effective mask (75%) whereas they would be reduced by only 10% with 30% coverage with a low effectiveness mask (25% containment). In terms of mask allocation, they identified that prioritizing the elderly and maintaining a supply for identified infectious cases is a superior strategy to random distribution.

It should be noted that all the modelling studies listed vary the effectiveness of masks in the model; however, they do not assume that masks can carry harms that could outweigh benefits.

In an ecologic study, **Lo JY et al, 2005** found that in the setting of “community hygienic measures” promotion during the SARS 2003 epidemic in Hong Kong, where ~76% of individuals were wearing masks, the proportion of positive specimens of other respiratory viruses dropped significantly in 2003. A similar finding has been noted in Hong Kong since February 2020, where again mask use has increased with the COVID19 outbreak **(Leung et al, 2020). Kenyon et al. (pre-print)** compared countries who had implemented mask use vs no-mask use (as a binary outcome). At the time of the analysis, 8/49 countries promoted universal mask use. After adjusting for date of the first COVID-19 diagnosis in the country and testing intensity, they found that masking resulted in an average decrease of 326 cases per 1,000,000 inhabitants (linear coefficient -326, -601 to -51, p=0.021). These studies do not allow the effect of masks to be separated from other community measures, including social distancing with school closure, public space closures, hand hygiene, and household hygiene campaigns. When undertaking ecological comparisons, it should be noted that countries such as New Zealand, Australia, Denmark, and Switzerland have had success at containment of their epidemics without the use of universal masking.

There are also two case cluster reports outlining the benefits of community mask use. It is unclear if medical or non-medical masks were used. **Zhang et al, 2013** assessed transmission of influenza A virus on two flights from the United States to China. None of the 9 influenza-infected passengers, compared with 47% (15/32) of control-passengers wore a face mask. Unfortunately, this report does not include any information regarding the location of the other passenger relative to the index case. **Liu et al, 2020** report a case of a SARS-CoV-2 infected male who took two separate buses to return to his hometown. On the first 2-hour bus ride, he did not wear a mask and 5/39 passengers were infected. By contrast, on his second ride, a 50-minute ride, he wore a mask and 0/14 passengers were infected. While **Schwartz et al. 2020** do not focus on the use of a mask by the source case, the source case was masked during a flight from China to Toronto where no SARS-CoV-2 transmissions were identified.

Studies of cloth masks:

Clinical studies

The only clinical study of cloth masks is a cluster randomized trial of cloth masks at all times vs medical masks at all times (2 masks/8h) vs a standard practice arm in hospitals in Vietnam **(Macintyre et al, 2015)**. In this study, cloth mask users had higher rates of ILI compared with the control arm, RR=6.64, 95% CI 1.45 to 28.65 and more laboratory-confirmed virus, RR=1.72, 95% CI 1.01 to 2.94. Compared to medical masks, the RR for ILI was 13.25 in the cloth mask arm and 3.8 in the control (mixed) arm. A possible hypothesis for the worse outcome with cloth masks is that when they become wet, they are more likely to trap viral particles. Alternatively, there may be inadequate washing of the masks.

However, a methodologic concern was that the control arm consisted of high rates of mask wear. Specifically, in the control arm, (170/458) 37% used medical masks and (245/458) 53% used a combination of medical masks and cloth masks, with 24% of control arm participants wearing masks for more than 70% of working hours (versus 57% of participants in the other 2 arms adherent to masks for >70% of working hours). This renders the comparison to have been consistent cloth mask use, to consistent medical mask use, to inconsistent use of any mask type. Therefore, while the study may have conclusively shown the superiority of medical masks to cloth masks in preventing infection acquisition in a health-care setting, it cannot be used to reliably evaluate cloth masks to no masks in a community setting. Given the sudden interest in cloth-mask use, the authors published a response to their own article on March 30, 2020 **(MacIntyre et al. 2020)** wherein they state that HCW should not work without adequate PPE but if they choose to work with a cloth masks, thorough and daily disinfection is required to prevent potential harms. In another commentary, the same author (**MacIntyre CR and Hasanain SJ, 2020)** supports universal masking, stating "There is more evidence supporting face mask use in the community than hand hygiene including in RCTs which compare both interventions directly, so it is inconsistent to advocate hand hygiene as a sound principle but not masks."

Laboratory based studies

Several contemporary and historical studies have looked at whether homemade masks are able to reduce the physical spread of droplets by the mask wearer. In a laser-light scattering experiment, **Anfinrud et al. 2020**, qualitatively showed that while regular speech resulted in droplets ranging in size from 20 to 500 μm, a slightly damp washcloth over the mouth could decrease these forward moving particles. After assessing the filtration performance of a variety of household fabrics (using NaCl aerosols of smaller size than droplets), **Rangesamy et al, 2010** concluded that while markedly inferior to N95 respirators, the filtration rate of some household materials was comparable to surgical masks. **Davies et al, 2013** found that masks made from cotton t-shirt fabric had a filtration efficiency of viral particles of ~50% as compared to ~90% for medical masks and that medical masks were 3 times more effective in blocking transmission than homemade masks. **Dato et al. 2006,** also found some protection against an aerosol challenge with the use of a homemade cotton mask.

We identified two studies examining the theoretical benefit of homemade masks in reducing personal risk of exposure to particles. As previously noted**, Ma et al. 2020,** found a homemade mask of one polyester cloth layer and 4 layers of kitchen paper to be as effective as medical masks in providing protection against avian influenza virus bioaerosols. However, an artificially tight seal may have been present in this model. **van der Sande et al, 2008** found that medical masks provided about twice as much protection as homemade masks against the entrance of particles. Notably and unlike other groups, they did not find that masks significantly prevented outward dispersal.

Since the last update, we identified multiple other laboratory-based studies investigating filtration efficiency, 3 of which were completed since the last update.

Historical studies

- **Greene et al, 1961** had volunteers wear muslin and flannel masks (the standard for medical masks at the time) in a contained chamber. Bacterial recovery on agar sedimentation plates was dramatically reduced (by 88% to >99% depending on the particle size).
- **Quesnel et al, 1975** used a similar chamber to Green et al. and volunteers were asked to try 4 disposable medical masks and one cotton mask. The filtration efficiency of the cotton mask (after 30 minutes of wear) for larger droplets (>3 *μ*m) >99%.

***Air pollution and fine particulate matter (aerosol) studies* (<2.5 *μ*m)**

- A study by **Shakya et al. 2017**, that was assessing filtration potential of cloth masks for fine particulate matter (air pollution related study) noted that the filtration efficiency of three particle sizes (30, 100, and 500 nm) ranged from 15% to 57%, thus they felt that cloth masks would be of limited utility for particles<2.5 *μ*m.
- **Jung et al, 2014**, also assessed a variety of masks for protection against aerosols. Their testing adhered to the Korean Food and Drug Administration (KFDA) [similar to the European Union (EU) protocol] and the National Institute for Occupational Safety and Health (NIOSH) protocols. 44 different types of masks were tested. On average, the aerosols used for testing were less than 2.5 ***μ*m.** The filtration efficiency of medical masks was only about 60% and only in the 2-12% range for cloth handkerchiefs. Pressure drop was also measured. They found that "general masks" and handkerchiefs provided little protection against aerosols.
- **Jang et al, 2015 [only available in Korean; abstract was reviewed],** using polydisperse NaCl aerosols (0.3~10 μm), compared five commercial cloth masks vs. a respirator. The filtration efficiencies varied from 9.5-28.5% as compared with 91% by the respirator but increased by 1.7-6.8 times after folding to create multiple layers. Washing once reduced filtration efficiency. The authors warned that cloth masks were inadequate in protecting against particulate matter.

Bioaerosol and polydisperse NaCl aerosol studies

- **Rodriguez-Palacios et al, 2020 (pre-print)** used household spray bottles filled with a bacterial suspension to see whether various textiles could prevent dispersion of the bacterial solution (which they said mimicked a sneeze) onto agar containing Petri dishes. All the fabrics used, even in one layer, reduced droplet dispersion to <30cm. As a double layer, they were as effective as medical masks and reduced droplet dispersion to <10cm. The relevance of this model is questionable.

- **Wang et al, 2020 (pre-print)** used industry approved standardized tests to compare 17 different fabrics against approved medical masks. Testing pressure difference (breathability), particle filtration efficiency, bacterial filtration efficiency, and resistance to surface wetting, they found that only 3 materials would pass industry standards. The results showed that three double-layer materials including double-layer medical non-woven fabric (example, polypropylene) medical non-woven fabric plus non-woven shopping bag, and medical non-woven fabric plus granular tea towel could meet all the standards of breathability, particle filtration efficiency (>30%), and resistance to surface wetting, and were close to the standard of the bacterial filtration efficiency (>95%).
- **Aydin et al, 2020 (preprint)** compared one brand of medical mask to a variety of homemade fabrics to assess for: efficiency of blocking droplets, breathability, weight, hydrophilicity, and texture. To measure droplet blockage (or filtration) efficiency, they used a metered-dose inhaler (MDI) loaded with fluorescent beads, of similar size to SARS-CoV-2 virus (70-100nm). A petri dish covered with the various materials was then held 36mm and 300mm away from the MDI and the number of fluorescent beads penetrating through to the petri dish were measured. In this study, even one layer of a 100% cotton t-shirt had 91% efficiency. And while a blend of cotton and polyester had only 40% efficiency, this increased to 99.98% with 3 layers. They concluded that multiple fabrics were comparable to a medical mask in terms of filtration and breathability. However, a 2-3 layer cotton/polyester blend was the closest; despite being far less hydrophobic. Of note, the materials appear to have been tightly adhered to the petri dish.
- **Konda et al, 2020** also tested a variety of household materials. They introduced a polydisperse NaCl aerosol into a mixing chamber, where it passed through the material being tested (held down tightly by a clamp). They analyzed particle size with two different particle analyzers and followed the protocol used for testing face respirators in compliance with the NIOSH 42 CFR Part 84 test protocol. For droplets >300nm, several materials had filtration efficiency equivalent to a medical mask (>95% efficiency), including even one layer of a high thread count cotton. However, the authors recommended a hybrid fabric (cotton + silk) that could leverage both mechanical and electrostatic properties. Furthermore, the authors found that even small gaps (hole of 1% surface area) could reduce filtration efficiency by 60%, highlighting the importance of a tight fit
- **Zhao et al, 2020** evaluated common materials using a modified version of the NIOSH standard test procedure for N95 respirator approval. They used NaCl aerosols (0.075 ± 0.02 µm), without taking real-world leakage from around the mask into account, to identify the material with the highest filtration quality factor (*Q*) – a metric that results from a high filtration efficiency (low penetration) with low pressure drop. They identified that polypropylene spunbound, a material commonly found in reusable bags, had the optimal *Q*. While the filtration efficiency was ~6-10% (which was similar to the other fabrics tested), if it were triboelectrically charged or multiple layers were added, its filtration efficiency improved without a concomitant increase in pressure. In fact, as compared with the medical masks they tested (~19-33% filtration efficiency), the five-layer polypropylene had a filtration efficiency of ~50% with a lower pressure drop.

Though there are now many different laboratory studies to draw from, the variability of the methodology of the studies and the variability in their findings make their interpretation challenging. Taken together, these studies suggest that non-medical masks can act as a barrier to outward dispersion of droplets (but not particles <2.5 *µm*). For that reason, WHO states that non-medical masks "should only be considered for source control (used by infected persons) in community settings and not for prevention".

Despite the challenges of interpreting non-medical mask studies, a non-medical mask standard has been developed by the French Standardization Association (AFNOR Group) (https://www.afnor.org/en/faq-barrier-masks/). AFNOR Group defines minimum performance in terms of filtration (minimum 70% solid particle filtration or droplet filtration) and breathability (maximum pressure difference of 0.6 mbar/cm2 or maximum inhalation resistance of 2.4 mbar and maximum exhalation resistance of 3 mbar).

In addition, in its latest interim guidance report (https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak), WHO has now provided guidance on the optimal composition and construction of non-medical masks. They advise that when decision-makers are providing recommendations on masks, they should take filtration efficiency, breathability, number and combination of materials used, shape, coating and maintenance into account. Using the filter quality factor "Q" metric, which is a function of filtration efficiency and breathability (with higher values being better), they advise the following mask composition:

a) Inner layer of a hydrophilic material (cotton or cotton blend)
b) Outer layer of a hydrophilic material (ie. polypropylene, polyester or blend)
c) Middle hydrophobic layer of a synthetic non-material such as polypropylene or a cotton layer

Table 3 in the **Appendix** provides a list of different materials with their corresponding filter quality factor as well as filtration efficiency and breathability.

In terms of fit, they also recommend a tightly-fitted flat-fold or duckbill shape.
(WHO, June 5, 2020)

Theoretical sociological benefits and harms of mask use in COVID-19:

From a sociologic perspective, some have noted that if mask wearing were widespread and not just limited to those who are feeling ill, it would reduce the stigma associated with their use and increase the likelihood of their use in ill individuals. Similarly, mask use may act as a visual cue reminding individuals to maintain physical distance and act as visible signal of social solidarity (preprint, **Howard et al. 2020**). In terms of acting as a visual cue, **Seres et al, 2020** undertook a field experiment where they randomized 300 individuals to "exposure" to an individual wearing a mask vs no-mask. Specifically, the *experimenter* was randomly assigned to wear a mask or not. Then, they took the last position in line-ups (ie. a supermarket, store) and noted the distance with which the subsequent customer would stand. Individuals kept a statistically significantly further distance when someone was wearing a mask. Subsequent survey data suggested this was because it was perceived that a masked person preferred more distance.

Finally, it is becoming increasingly clear that racial minorities are disproportionately impacted by COVID-19 (**Hooper et al, 2020)**. In addition to underlying co-morbidities and structural inequalities (ie. lack of access to healthcare), this discrepancy may be attributed to living conditions and employment. As **Yang, 2020** stated "social distancing is a privilege". For instance, outside of LTC outbreaks, most outbreaks in Calgary, Alberta are occurring at warehouses and workplaces (https://www.alberta.ca/covid-19-alberta-data.aspx#toc-1) where social distancing either cannot be or is not being enforced. Mandatory masking, with provision of masks and targeted education about mask hygiene, may be particularly helpful in such settings.

There are also several possible harms associated with widespread mask use. There is concern that moisture retention could increase the risk of infection which is one possible interpretation of the McIntyre study. Masks may also increase the frequency with which individuals touch their face. There is also concern regarding self-contamination of the hands or face with improper donning and doffing technique. In an observational study of ~10,000 pedestrians in Hong Kong in February 2020, 94% of individuals wore masks (84% of which were medical masks). However, 13% of individuals wore them incorrectly, with 5% wearing them inside out or upside-own and 5% wearing them too low **(Tam et al, 2020).**

The importance of risk-compensation in population-level health interventions has been called into question **(B Pless, 2016).** However, the potential harms of masks in creating a false sense of security and consequent neglect of physical distancing or hand hygiene is raised by the World Health Organization **(WHO, 2020).** A recent study by **Yan et al, 2020 (pre-print)** used smart device location data to determine the time spent at home and at various public locations before and after mask mandates were implemented in 36 different states. They accounted for weather patterns, re-openings orders, and time since stay-at-home orders were implemented. They found that masks mandates were associated with an increase of 4% (20-30 minutes) of time outside the home per day and they specifically noted more trips to restaurants. This suggests that for mask to be beneficial, their efficacy in reducing transmission needs to exceed the increased risk associated with a 4% increase in time away from home.

Another concern is related to the environmental impact of mass use of medical masks. For instance, the sheer numbers of disposable masks that would be required in China would be around 900 million daily and would pose significant disposal challenges **(Wang MW et al, 2020).** Safe disposal concern are already arising throughout Asia (https://www.bangkokpost.com/opinion/opinion/1924908/face-mask-crisis-of-another-design)

Another major concern is the risk of PPE shortages for HCW who are more frequently exposed to SARS-CoV-2 than the general public. Indeed, there have been shortages globally, with some countries banning or threatening to ban export of medical masks (https://www.cnbc.com/2020/04/03/coronavirus-trump-to-ban-export-of-protective-gear-after-slamming-3m.html), and with reports of hoarding and price gouging.

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Authorship and Committee Members

This report was written and updated by Leyla Asadi and scientifically reviewed by Elizabeth Mackay (primary reviewer), Lynora Saxinger (co-chair), and Nelson Lee. The full Scientific Advisory Group was involved in discussion and revision of the document: Braden Manns (co-chair), John Conly, Alexander Doroshenko, Shelley Duggan, Andrew McRae, Jeremy Slobodan, James Talbot, Brandie Walker, and Nathan Zelyas.

COVID-19 Scientific Advisory Group Rapid Response Report

Appendix

The literature search was conducted by Lauren Seal from the AHS Knowledge Resource Service. The literature search was last updated on May 14, 2020.

Medline/PubMed

1 exp Coronavirus/ or exp Coronavirus Infections/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-COV-2.mp. or SARSCOV-2.mp. or SARSCOV2.mp. or SARSCOV19.mp. or Sars-Cov-19.mp. or SarsCov-19.mp. or SARSCOV2019.mp. or Sars-Cov-2019.mp. or SarsCov-2019.mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or "2019ncov".mp. (18987)

2 Masks/ (4203)

3 mask.mp. (28586)

4 masks.mp. (15768)

5 facemask.mp. (1101)

6 "face-mask".mp. (2557)

7 (face adj2 mask*).mp. (3254)

8 2 or 3 or 4 or 5 or 6 or 7 (37583)

9 homemade.mp. (2899)

10 home-made.mp. (2094)

11 "home made".mp. (2094)

12 handmade.mp. (505)

13 "hand made".mp. (346)

14 hand-made.mp. (346)

15 handcraft*.mp. (335)

16 hand-craft*.mp. (321)

17 "hand craft*".mp. (321)

18 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 (6424)

19 8 and 18 (32)

20 8 or 19 (37583)

21 1 and 20 (140)

22 limit 21 to last year (19)

CINAHL

S1 (MH "Coronavirus+")

S2 (MH "Coronavirus Infections+")

S3 coronaviru*

S4 "corona virus"

S5 ncov*

S6 n-cov*

S7 COVID-19 OR COVID19 OR COVID-2019 OR COVID2019

S8 SARS-COV-2 OR SARSCOV-2 OR SARSCOV2 OR SARSCOV19 OR SARS-COV-19 OR SARSCOV-19 OR SARSCOV2019 OR SARS-COV-2019 OR SARSCOV-2019

S9 "severe acute respiratory syndrome cov 2" OR "severe acute respiratory syndrome coronavirus*"

S10 "2019 ncov" OR 2019ncov OR Hcov*

S11 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10

S12 (MH "Masks") 2,140

S13 mask OR masks OR facemask OR face-mask OR face N2 mask OR medical N2 mask OR face N2 cover* 10,693

S14 S12 OR S13 10,693

S15 homemade OR home-made OR "home made" OR handmade OR hand-made OR "hand made" OR handcraft* OR hand-craft* OR "hand craft*" 2,013

S16 S14 AND S15 10

S17 S14 OR S16 10,693

S18 S11 AND S17 87

S19 S11 AND S17 Limiters - Published Date: 20190101-20201231

12

TRIP Pro/Google Scholar/Google/ LitCovid/CEBM/ /Twitter/WHO/Stanford Medicine/REACTing/Nebraska Medicine COVID-19 resources/CAIC-RT – COVID-19 Capacity Tool/NEJM/ The Oakes Academy Coronavirus Clinical Collaboration/CochraneLibrary

("covid-19" OR coronavirus OR COVID19 OR “corona virus” OR ncov OR “n-cov” OR “covid-2019” OR covid2019 OR “SARS-COV-2” OR “sarscov-2” OR sarscov2 OR sarscov19 OR “sars-cov-19” or “sarscov-19” OR sarscov2019 OR “sars-cov-2019” OR “severe acute respiratory syndrome”) AND (mask OR facemask OR “face-mask” OR “face mask” OR “face cover” OR “face covering” OR “homemade mask” OR “home-made mask” OR “handmade mask” OR “hand-made mask” OR “handcrafted mask” OR “hand-crafted mask”)

(mask OR facemask OR “face-mask” OR “face mask” OR “face cover” OR “face covering” OR “homemade mask” OR “home-made mask” OR “handmade mask” OR “hand-made mask” OR “handcrafted mask” OR “hand-crafted mask”)

mask

facemask

face covering

Critical Appraisal

Table 2. Summary of quality assessment results for articles included in this review

				Mixed Methods Appraisal Tool Criteria:	
	Reference	Peer reviewed?	Type of evidence	Are there clear research questions or a clearly identified issue?	Is the collected data or presented evidence appropriate to address the research questions or issue?
1.	Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, van Driel ML, Nair S, Jones MA, Thorning S, et al. 2011. Physical interventions to interrupt or reduce the spread of respiratory viruses. The Cochrane Database of Systematic Reviews. 2011(7):CD006207.	☒ Yes	Systematic review and meta-analysis	☒ Yes	☒ Yes

2.	Offeddu V, Yung CF, Low MSF, Tam CC. 2017. Effectiveness of masks and respirators against respiratory infections in healthcare workers: A systematic review and meta-analysis. Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America. 65(11):1934-42.	☒ Yes	Systematic review and meta-analysis	☒ Yes	☒ Yes
3	Saunders-Hastings P, Crispo JAG, Sikora L, Krewski D. 2017. Effectiveness of personal protective measures in reducing pandemic influenza transmission: A systematic review and meta-analysis. Epidemics. 20(C):1-20.	☒ Yes	Systematic review and meta-analysis	☒ Yes	☒ Yes
4	Brainard J ea. 2020. Facemasks and similar barriers to prevent respiratory illness such as COVID-19: A rapid systematic review.	☐ No (pre-print)	Systematic review and meta-analysis	☒ Yes	☒ Yes
5	WHO. Advice on the use of masks in the context of COVID19. Available at: https://www.who.int/publications-detail/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak .		WHO guidelines		
6	MacIntyre CR, Chughtai AA. 2015. Facemasks for the prevention of infection in healthcare and community settings. BMJ : British Medical Journal. 350(apr09 1):h694.	☒ Yes	Review article	☒ Yes	☒ Yes
7	MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, Rahman B, Dwyer DE, Wang Q. 2015. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 5(4):e006577.	☒ Yes	Cluster randomzied trial	☒ Yes	☒ Yes
8	Leung, N.H.L., Chu, D.K.W., Shiu, E.Y.C. *et al.* Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nat Med* (2020). https://doi.org/10.1038/s41591-020-0843-2	☒ Yes	Randomzied lab-based trial	☒ Yes	☒ Yes
9	Davies A, Thompson K, Giri K, Kafatos G, Walker J, Bennett A. 2013. Testing the efficacy of homemade masks: Would they protect in an influenza pandemic? Disaster Medicine and Public Health Preparedness. 7(4):413-8.	☒ Yes	Laboratory	☒ Yes	☒ Yes
10	Makison Booth C, Clayton M, Crook B, Gawn JM. 2013. Effectiveness of surgical masks against influenza bioaerosols. Journal of Hospital Infection. 84(1):22-6.	☒ Yes	Laboratory	☒ Yes	☒ Yes

APPENDIX

Table 1: Situations and types of masks recommended for use in the community (from the World Health Organization, June 2020 interim guidance "Advise on the use of masks in the context of COVID-19")

https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak

Situations/settings	Population	Purpose of mask use	Type of mask to consider wearing if recommended locally
Areas with known or suspected widespread transmission and limited or no capacity to implement other containment measures such as physical distancing, contact tracing, appropriate testing, isolation and care for suspected and confirmed cases.	General population in public settings, such as grocery stores, at work, social gatherings, mass gatherings, closed settings, including schools, churches, mosques, etc.	Potential benefit for source control	Non-medical mask
Settings with high population density where physical distancing cannot be achieved; surveillance and testing capacity, and isolation and quarantine facilities are limited	People living in cramped conditions, and specific settings such as refugee camps, camp-like settings, slums	Potential benefit for source control	Non-medical mask
Settings where a physical distancing cannot be achieved (close contact)	General public on transportation (e.g., on a bus, plane, trains) Specific working conditions which places the employee in close contact or potential close contact with others e.g., social workers, cashiers, servers	Potential benefit for source control	Non-medical mask
Settings where physical distancing cannot be achieved and increased risk of infection and/or negative outcomes	Vulnerable populations: • People aged ≥60 years • People with underlying comorbidities, such as cardiovascular disease or diabetes mellitus, chronic lung disease, cancer, cerebrovascular disease, immunosuppression	Protection	Medical mask
Any setting in the community*	Persons with any symptoms suggestive of COVID-19	Source control	Medical mask

*This applies to any transmission scenario

Table 2. Summary of high level evidence (GRADE guidelines) on facemasks in the household setting (from: Raina MacIntyre, and Abrar Ahmad Chughtai BMJ 2015;350:bmj.h694)

Study, year of publication	Design, participants	Mask type, intervention	Outcome	Results	Comments, limitations, biases
Cowling[11] 2008	• Cluster RCT • 198 index cases and household contacts • Hong Kong	• Medical masks • Hand hygiene • Control	• Self reported influenza symptoms • Laboratory confirmed influenza (by culture or RT-PCR) in household	• No significant difference in rates of laboratory confirmed influenza (OR 1.16, 95% CI 0.31 to 4.34) and ILI (0.88, 0.34 to 2.27) in the medical masks arm versus control arm	• Both index cases and household contacts used medical masks • This pilot study was small and underpowered • Compliance 45% in index cases and 21% in household contacts • Compliance data showed that some index cases in the control and hand hygiene arms used medical masks
Cowling[12] 2009	• Cluster RCT • 407 index cases and 794 household contacts • Hong Kong	• Hand hygiene • Masks + hand hygiene • Control (education)	• Self reported influenza symptoms • Laboratory confirmed influenza (by RT-PCR) in household	• No significant difference in rate of laboratory confirmed influenza in three arms • Significant difference if masks + hand hygiene together applied within 36 hours of illness (OR 0.33, 0.13 to 0.87) • Hand hygiene alone was not significant	• No separate medical mask arm, making it difficult to evaluate the efficacy of masks • Both index cases and household contacts used masks • Compliance 49% in index cases and 26% in household contacts using masks • Compliance data showed that some index cases in the control and hand hygiene arms used medical masks
MacIntyre[13] 2009	• Cluster RCT • 145 child index cases and well adult household contacts • Australia	• Medical masks for contacts • P2 respirators (equivalent to N95) for contacts • Control	• Self reported ILI • Laboratory confirmed respiratory infection	• No significant difference in ILI and laboratory confirmed respiratory infections in all three arms • Adherent use of P2 or medical masks significantly reduced the risk of ILI (HR 0.26, 0.09 to 0.77)	• Only household contacts used medical masks • Low compliance: 21% of household contacts wore masks often/always
Aiello[14] 2010	• Cluster RCT • 1437 well university residents • Michigan, USA	• Medical masks • Medical masks + hand hygiene • Control	• Self reported ILI • Laboratory confirmed influenza (by culture or RT-PCR)	• No significant difference in ILI in three arms • Significant reduction in ILI in the medical masks + hand hygiene arm over 4-6 weeks ($P<0.05$)	• Self reported ILI • Not all ILI cases (n=368) were laboratory tested (n=94) • No data on compliance
Larson[15] 2010	• Block RCT • 617 households • Manhattan, USA	• HE • HE + hand sanitiser • HE + hand sanitiser + medical masks	• Self reported ILI • Self reported URI • Laboratory confirmed influenza through culture	• No significant difference in rates of URI, ILI, or laboratory confirmed influenza between the three arms • Significantly lower secondary attack rates of URI/ILI/influenza in the HE	• No separate medical masks group • Household contacts used medical masks • Low compliance and around half of household in the masks arm used
Canini[16] 2010	• Cluster RCT • 105 index cases and 306 households • France	• Medical mask (as source control to be used by index case) • Control	• Self reported ILI in household	• No significant difference in the rates of ILI between the two arms (OR 0.95, 0.44 to 2.05)	• Trial stopped early owing to low recruitment and influenza A/H1N1-pdm09 in subsequent year
Simmerman[17] 2011	• Cluster RCT • 465 index patients and their families • Thailand	• Hand hygiene • Hand hygiene + medical masks • Control	• Self reported ILI • Laboratory confirmed influenza by PCR and serology in family members	• No significant difference in secondary influenza infection rates between hand hygiene arm (OR 1.20, 0.76 to 1.88) and hand hygiene plus medial masks arm (1.16, 0.74 to 1.82)	• No separate medical mask group • Owing to H1N1 pandemic, hand and respiratory hygiene campaigns and mask use substantially increased among the index cases (from 4% to 52%) and families (from 17.6% to 67.7%) in control arm
Aiello[18] 2012	• Cluster RCT • 1178 university residents • Michigan, USA	• Medical masks • Medical masks + hand hygiene • Control	• Clinically diagnosed and laboratory confirmed influenza (by RT-PCR)	• No overall difference in ILI and laboratory confirmed influenza in three arms • Significant reduction in ILI in the medical masks + hand hygiene arm over 3-6 weeks ($P<0.05$)	• Good compliance: medical mask + hand hygiene group used masks for 5.08 h/day (SD 2.23) and medical mask group used masks for 5.04 h/day (SD 2.20) • Self reported ILI • Effect may have been due to hand hygiene because medical masks alone not significant
Suess[19] 2012	• Cluster RCT • 84 index cases and 218 household contacts • Berlin, Germany	• Masks • Masks + hand hygiene • Control	• Laboratory confirmed influenza infection and ILI	• No significant difference in rates of laboratory confirmed influenza and ILI in all arms by intention to treat analysis • The risk of influenza was significantly lower if data from two intervention arms (masks and masks + hand hygiene) were pooled and intervention was applied within 36 hours of the onset of symptoms (OR 0.16, 0.03 to 0.92)	• Around 50% participants wore masks "mostly" or "always" • Participants paid to provide respiratory samples

CI=confidence interval; CRI=clinical respiratory infection; HCW=healthcare worker; HE=health education; HR=hazard ratio; ILI=influenza-like illness; OR=odds ratio; PCR=polymerase chain reaction; RCT=randomised controlled trial; RR=relative risk. RT=reverse transcriptase; SD=standard deviation; URI=upper respiratory tract infection.

Table 3. Non-medical mask filtration efficiency, pressure drop and filter quality factor* (from the World Health Organization, June 2020 interim guidance "Advise on the use of masks in the context of COVID-19" Adapted from Jung et al, 2014 and Zhao et al, 2020)

https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak

Table 3. Non-medical mask filtration efficiency, pressure drop and filter quality factor*

Material	Source	Structure	Initial Filtration Efficiency (%)	Initial Pressure drop (Pa)	Filter quality factor, Q ** (kPa^{-1})
Polypropylene	Interfacing material, purchased as-is	Spunbond (Nonwoven)	6	1.6	16.9
Cotton 1	Clothing (T-shirt)	Woven	5	4.5	5.4
Cotton 2	Clothing (T-shirt)	Knit	21	14.5	7.4
Cotton 3	Clothing (Sweater)	Knit	26	17	7.6
Polyester	Clothing (Toddler wrap)	Knit	17	12.3	6.8
Cellulose	Tissue paper	Bonded	20	19	5.1
Cellulose	Paper towel	Bonded	10	11	4.3
Silk	Napkin	Woven	4	7.3	2.8
Cotton, gauze	N/A	Woven	0.7	6.5	0.47
Cotton, handkerchief	N/A	Woven	1.1	9.8	0.48
Nylon	Clothing (Exercise pants)	Woven	23	244	0.4

* This table refers only to materials reported in experimental peer-reviewed studies. The filtration efficiency, pressure drop and Q factor are dependent on flow rate. ** According to expert consensus, three (3) is the minimum Q factor recommended.

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From: Doyle-Bedwell, George H
To: Holmes, Elaine; Cole, Teri J; Billard, Bev A; Watson-Creed, Gaynor; Strang, Robert
Cc: Doyle-Bedwell, George H
Subject: Mask Quick Lit Search
Date: July 14, 2020 2:19:41 PM
Importance: High

Dear All:

Thank you Elaine for the call, it helped me get my head around this. I ran a quick two pronged internet search using some or all of these key words: COVID, Non Medical Masks, Masks, Community, Contraindications as both a general browser search (google) and more focused in PubMed. There was nothing on Masks COVID Community and Contraindications in PubMed.

All the material that I was able to find is here: G:\PH\Medical\EMERGENCY PLANNING\COVID-19\Masks\Medical Evidence NMM

I was not able to find much at all and nothing beyond the Canadian Thoracic Society (CTS) Paper (which we had already) which stated:

- We recommend that all patients with underlying lung disease follow this recommendation to reduce the risk of spreading the SARS-CoV-2 virus.
- If patients cannot tolerate wearing this added protection, we recommend that they avoid or minimize circumstances in which physical distancing is not possible.
- There is NO evidence that wearing a face mask will exacerbate (cause a 'flare up' of) an underlying lung condition.

Moreover, the references in the CTS paper did not directly tie to reasons not to wear a mask. Most focused on the effectiveness of the masks (at least in their titles).

I looked at the following materials:

- Canadian Thoracic Society recommendations regarding the use of face masks by the public during the SARS-CoV-2 (COVID-19) pandemic
- BCCDC Advice on Masking
- CDC Effectiveness of Cloth Masks
- PHAC Guidance on Non Medical Masks and Face Coverings
- WHO Advice on the use of masks in the context of

COVID-19 (2020 June 05)

The WHO guidance is the most in depth but it does not contain suggests of when not to wear masks nor any contraindications to mask wearing. They do mention those who cannot tolerate a mask should use tissues if they sneeze, etc.

I further did key word searches on the documents themselves: should not, cannot, contraindicated, health risk and the only places where those key words got a hit were in regard to social distancing, mask cleaning, etc. Nothing about why someone would be medically contraindicated to where a mask.

I think there was some mention of not using masks in the SAC discussion on high performance athletes.

I was talking with both Elaine and Dr. Strang on this 14(1) [redacted] 14(1)

Thank you
Take Care
George

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Withheld

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