

**CADTH RAPID RESPONSE REPORT:
SUMMARY WITH CRITICAL APPRAISAL**

Masks for Prevention of Influenza Transmission in Acute and Long-Term Care Settings: A Review of Clinical Effectiveness, Cost- Effectiveness and Guidelines

Service Line: Rapid Response Service
Version: 1.0
Publication Date: March 20, 2020
Report Length: 15 Pages

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Cite As: Masks for Prevention of Influenza Transmission in Acute and Long-Term care Settings: A Review of Clinical Effectiveness, Cost-Effectiveness and Guidelines. Ottawa: CADTH; 2020 Mar. (CADTH rapid response report: summary with critical appraisal).

ISSN: 1922-8147 (online)

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Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

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Abbreviations

AMSTAR 2	A Measurement Tool to Assess Systematic Reviews 2
CRD	University of York Centre for Reviews and Dissemination
HCW	health care worker
HTA	health technology assessment
MA	meta-analysis
MeSH	Medical Subject Heading
PPE	personal protective equipment
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	randomized controlled trial
SR	systematic review

Context and Policy Issues

Influenza is a viral respiratory infection causing fever, cough, and general aches and pain.¹ Annual vaccination for select high-risk populations, including health care workers (HCW) and other people in contact with those at high risk of influenza, is recommended.¹⁻³ Transmission of influenza between infected HCWs and their vulnerable patients can result in morbidity and mortality.²

Some HCWs are not vaccinated against influenza. In a 2011 Canadian systematic review (SR) of studies from Australia, Canada, Finland, Germany, Thailand, United Kingdom, and the United States of America, the influenza incidence rate amongst unvaccinated HCWs (in any type of care setting) was reported to be 18.69 (95% confidence interval = 15.80 to 22.11) per 100 population, per season.⁴ In such instances, personal protective equipment (PPE) such as surgical masks and procedural masks are used to minimize exposures. However, there is uncertainty as to the evidence regarding the clinical effectiveness of masks at preventing the transmission of influenza between unvaccinated HCWs and patients.

Previous CADTH reports on this topic include a 2017 Summary with Critical Appraisal on the use of respirators for protection against droplet borne illness,⁵ a 2014 Summary with Critical Appraisal on the use of respiratory precautions for protection from infectious agents,⁶ and a 2011 Technology Report on physical interventions to interrupt or reduce the spread of respiratory viruses.⁷ The objective of the present report is to investigate the clinical effectiveness, cost-effectiveness, and evidence-based guidelines regarding the use of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings.

Research Questions

1. What is the clinical effectiveness of masks for unvaccinated health care workers to prevent the transmission of influenza in acute or long-term care settings?
2. What is the cost-effectiveness of masks for unvaccinated health care workers to prevent the transmission of influenza in acute or long-term care settings?
3. What are the evidence-based guidelines regarding the use of masks for unvaccinated health care workers to prevent the transmission of influenza?

Key Findings

Four SRs (one with meta-analysis [MA]), were identified and included in this review. All SRs met the inclusion criteria for this report; however, none of their primary studies met our

eligibility criteria. Thus, the clinical effectiveness of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings remains unclear.

No evidence regarding the cost-effectiveness of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings was identified.

Furthermore, no evidence-based guideline regarding the use of masks for unvaccinated HCWs to prevent the transmission of influenza was identified.

Methods

Literature Search Methods

A limited literature search was conducted by an information specialist on key resources including PubMed, the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused Internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine’s MeSH (Medical Subject Headings), and keywords. The main search concepts were influenza and masks. Filters were applied to limit the retrieval to health technology assessments (HTAs), SRs, and MAs, randomized controlled trials (RCTs), economic evaluations, non-randomized studies (NRS), and guidelines. The search was also limited to English language documents published between January 1, 2010 and February 20, 2020.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Health care workers who have not received influenza vaccination (or unimmunized) who are caring for patients with influenza (i.e., in direct contact with patients) in acute and long-term care settings
Intervention	Surgical or procedure masks (differences in these masks are the way they are secured around head)
Comparator	No surgical or procedure masks
Outcomes	Q1. Clinical effectiveness (e.g., transmission of influenza, length of hospital-stay) Q2. Cost-effectiveness (e.g., cost per quality adjusted life year) Q3. Recommendations regarding the use of masks by unvaccinated health care professionals
Study Designs	Health technology assessments, systematic reviews, randomized controlled trials, non-randomized studies, economic evaluations, evidence-based guidelines

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, they were duplicate publications, or were published prior to 2010. Guidelines with unclear methodology were also excluded.

Critical Appraisal of Individual Studies

The included SRs were critically appraised by one reviewer using A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR 2).⁸ Summary scores were not calculated for the

included studies; rather, the strengths and limitations of each included study were described narratively.

Summary of Evidence

Quantity of Research Available

A total of 498 citations were identified in the literature search. Following screening of titles and abstracts, 464 citations were excluded and 34 potentially relevant reports from the electronic search were retrieved for full-text review. Four potentially relevant publications were retrieved from the grey literature search for full text review. Of these potentially relevant articles, 34 publications were excluded for various reasons, and four publications met the inclusion criteria and were included in this report. These comprised four SRs. Appendix 1 presents the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)⁹ flowchart of the study selection.

No relevant HTAs, RCTs, NRSs, economic evaluations, or evidence-based guidelines were identified. Appendix 4 includes one additional reference that did not meet the inclusion criteria of this report but may be of interest.

Summary of Study Characteristics

Four SRs¹⁰⁻¹³ (one with MA),¹³ were identified and included in this review. All SRs¹⁰⁻¹³ met the inclusion criteria for this report; however, none of their primary studies met our eligibility criteria. The population intervention, comparator, and outcomes criteria in these SRs were broader than the inclusion criteria for this report, and specific comparisons of interest were not identified in their included studies

An Australian SR, published in 2019, sought out relevant clinical, epidemiological, and laboratory-based studies conducted in Pakistan, up to December 2017.¹⁰ In a heterogeneous health care setting population, authors compared the use of facemasks or respirators (with or without other concurrent PPE) with various comparators (e.g., any other type of mask or respirator, other PPE, no comparator), and sought a variety of clinical and non-clinical outcomes (e.g., practices around PPE use [e.g., when exposed to a known infectious case, when working with biohazardous material, during aerosol generating procedures],¹⁰ and infection control [not defined]).¹⁰

A Canadian SR, published in 2016, reviewed other SRs and MAs up to July 2016.¹¹ In humans, authors compared the use of pharmacological and non-pharmacological (e.g., hand washing, mask, social distancing) interventions with any comparator.¹¹

A SR published in England in 2012 sought out relevant RCTs, quasi-experimental, and observational studies, up to January 2011.¹² In humans within a health care or community setting, authors compared masks or respirators with any comparator.¹²

Another Australian SR, published in 2011, reviewed trials, observational studies, and any other comparative study design, up to October 2010.¹³ In humans, authors compared any intervention to prevent animal-to-human or human-to-human transmission of respiratory viruses, with doing nothing or another intervention.¹³

Detailed characteristics are available in Appendix 2 Table 2.

Summary of Critical Appraisal

Additional details regarding the strengths and limitations of the included publications are provided in Appendix 3, Table 3.

The strengths and limitations of the SRs¹⁰⁻¹³ were assessed using the relevant components of AMSTAR 2;⁸ however, none of the primary studies included in the SRs were relevant to this report, resulting in a number of checklist items being not applicable.

Two SRs^{11,13} (one with MA)¹³ included clear objectives and inclusion criteria, established a protocol prior to the conduct of the review, and applied no language or date restrictions to the search.

Study selection was not reported as completed in duplicate in two SRs,^{10,13} while data extraction was not reported as completed in duplicate in two SRs.^{10,12} It is possible the former may have resulted in missed studies, while the latter may have resulted in missed data. Two SRs^{10,12} did not indicate having an *a priori* protocol, and details were lacking on the risk of bias assessment or whether there were any significant deviations from the protocol. As such, reporting bias cannot be assessed. Authors of one SR¹⁰ did not report having searched the grey literature; as such, it is possible this may have resulted in missed studies. All SRs reported on their sources of funding.¹⁰⁻¹³

Summary of Findings

Clinical effectiveness of masks for unvaccinated health care workers to prevent the transmission of influenza in acute or long-term care settings

Four SRs¹⁰⁻¹³ (one with MA),¹³ were identified and included in this review. All SRs¹⁰⁻¹³ met the inclusion criteria for this report; however, none of their primary studies met our eligibility criteria. As such, no relevant evidence regarding the use of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings was identified; therefore, no summary can be provided.

Cost-effectiveness of masks for unvaccinated health care workers to prevent the transmission of influenza in acute or long-term care settings

No relevant evidence regarding the cost-effectiveness of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings was identified; therefore, no summary can be provided.

Evidence-based guidelines regarding the use of masks for unvaccinated health care workers to prevent the transmission of influenza

No relevant evidence regarding the use of masks for unvaccinated HCWs to prevent the transmission of influenza was identified; therefore, no summary can be provided.

Limitations

The primary limitation of this report was that there was no relevant evidence identified to answer the research questions.

Conclusions and Implications for Decision or Policy Making

This report sought to identify clinical evidence, cost-effectiveness evidence, and evidence-based guidelines regarding the use of masks for unvaccinated HCWs to prevent the

transmission of influenza in acute or long-term care settings. Four SRs¹⁰⁻¹³ (one with MA)¹³, were identified and included in this review. These SRs had broader inclusion criteria for their population, intervention, comparator, and outcomes. However, none of their primary studies addressed our specific comparisons of interest (i.e., unvaccinated HCWs wearing masks compared to unvaccinated HCWs not wearing masks); therefore, no summary can be provided.

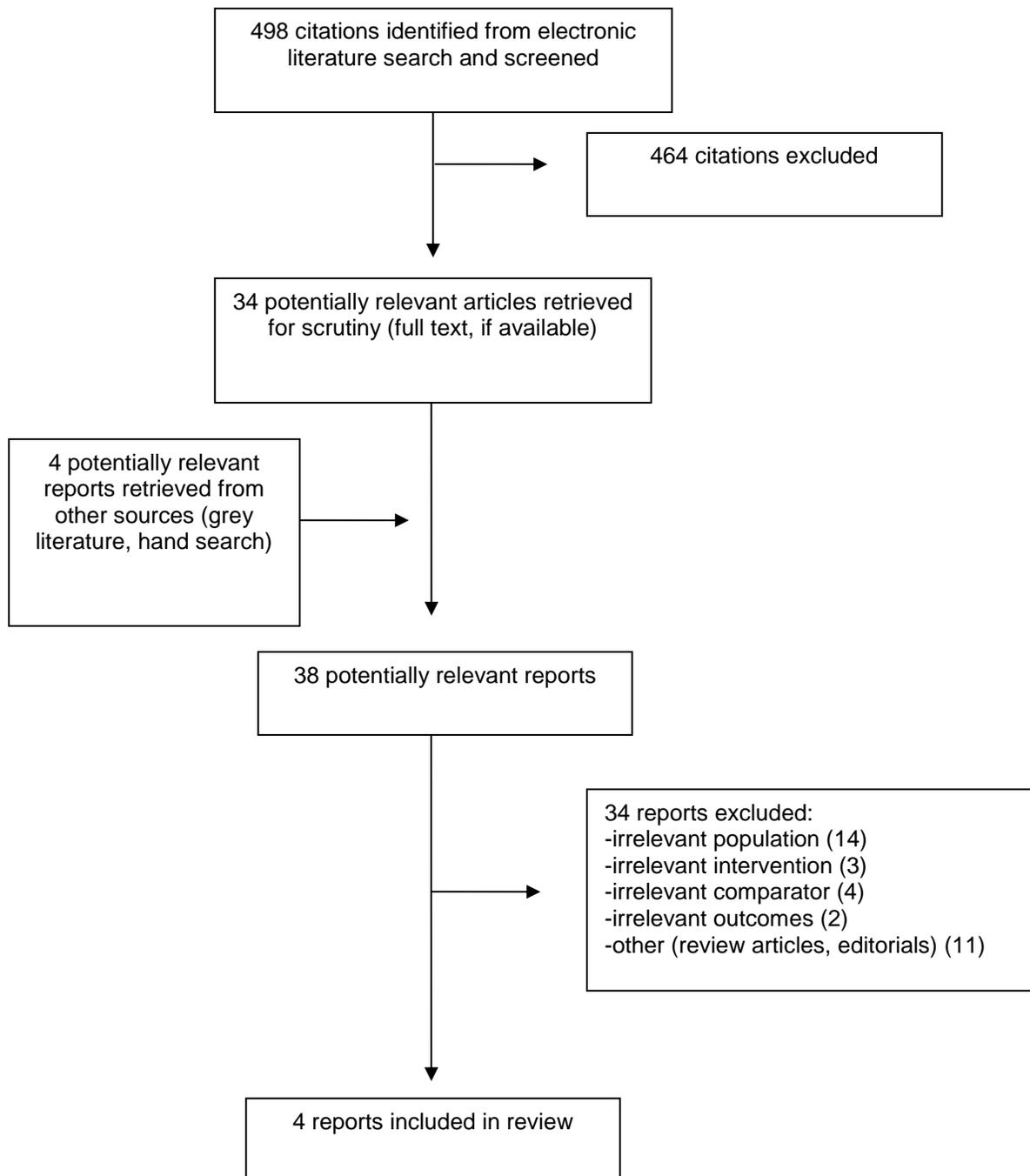
This evidence gap is consistent with the findings in previous CADTH reports. A 2017 Summary with Critical Appraisal did not identify any evidence on the effectiveness of respirators regarding protection against methicillin-resistant *Staphylococcus aureus* transmission.⁵

Further research investigating the use of masks for unvaccinated HCWs to prevent the transmission of influenza in acute or long-term care settings, especially by way of large, methodologically sound RCTs would help reduce this uncertainty.

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Appendix 1: Selection of Included Studies



Appendix 2: Characteristics of Included Publications

Table 2: Characteristics of Included Systematic Reviews

First Author, Publication Year, Country	Study Designs and Numbers of Primary Studies Included	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
<p>Chughtai, 2019¹⁰</p> <p>Australia</p>	<p>Study design: SR of relevant clinical, epidemiological, and laboratory-based studies conducted in Pakistan.</p> <p>Literature search strategy: literature searches in MEDLINE, EMBASE, and Google Scholar, up to December 2017.</p> <p>Number of studies included: in total, 13 studies were included; however, none were relevant to this review.</p> <p>Quality assessment tool: NR</p> <p>Objective: examine the use of PPE for respiratory infections in the Pakistani health care settings.</p>	<p>Various people in health care settings in Pakistan, such as: HCWs, managers, inpatients, medical students, laboratory technicians, dentists, pharmacy students.</p> <p>Relevant studies:</p> <ul style="list-style-type: none"> No primary study specifically discussing unimmunized HCWs wearing a mask intervention compared to unimmunized HCWs wearing no mask. 	<p>Intervention: facemasks or respirators, with or without other PPE.</p> <p>Comparator: any type of mask or respirator; other PPE (e.g., gloves, gowns, surgical cap, shoe covers, eye protection); no comparator</p>	<p>Outcomes:</p> <ul style="list-style-type: none"> Guidelines on PPE use Type of PPE used Practices around PPE use Availability of PPE Infection control
<p>Saunders-Hastings, 2016¹¹</p> <p>Canada</p>	<p>Study design: SR of SRs and MAs</p> <p>Literature search strategy: literature searches in PubMed, MEDLINE, EMBASE, CINAHL, Cochrane Library, and Google Scholar up to July 5, 2016. A manual search of reference lists was also performed.</p> <p>Number of studies included: in total, 17 studies were included; however, none were relevant to this review.</p>	<p>Humans</p> <p>Relevant studies:</p> <ul style="list-style-type: none"> No primary study specifically discussing unimmunized HCWs wearing a mask intervention compared to unimmunized HCWs wearing no mask. 	<p>Intervention: pharmacological and non-pharmacological interventions (e.g., hand washing, mask, social distancing)</p> <p>Comparator: any</p>	<p>Outcomes:</p> <ul style="list-style-type: none"> Clinical or laboratory-confirmed influenza

First Author, Publication Year, Country	Study Designs and Numbers of Primary Studies Included	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
	<p>Quality assessment tool: AMSTAR 2</p> <p>Objective: examine the effectiveness of any intervention to contain human transmission of pandemic influenza.</p>			
<p>Bin-Reza, 2012¹²</p> <p>England</p>	<p>Study design: SR of relevant RCTs, quasi-experimental, and observational studies</p> <p>Literature search strategy: literature searches in PubMed, Bandolier, Cochrane library, CINAHL, and others, up to January 12, 2011. A manual search of reference lists was also performed.</p> <p>Number of studies included: in total, 17 studies were included; however, none were relevant to this review.</p> <p>Quality assessment tool: the Critical Appraisal Skills Programme tools for randomised controlled trials, case-control studies and cohort studies</p> <p>Objective: examine the use of masks and respirators to reduce transmission of influenza</p>	<p>Humans in a health care or community setting</p> <p>Relevant studies:</p> <ul style="list-style-type: none"> No primary study specifically discussing unimmunized HCWs wearing a mask intervention compared to unimmunized HCWs wearing no mask. 	<p>Intervention: masks or respirators,</p> <p>Comparator: any</p>	<p>Outcomes:</p> <ul style="list-style-type: none"> Laboratory-confirmed or clinically diagnosed influenza and other viral respiratory infections
<p>Jefferson, 2011¹³</p> <p>Australia</p>	<p>Study design: SR of relevant trials, observational studies, and any other comparative design.</p>	<p>Humans</p> <p>Relevant studies:</p> <ul style="list-style-type: none"> No primary study 	<p>Intervention: any interventions to prevent animal-to-human or human-to-human transmission of</p>	<p>Outcomes:</p> <ul style="list-style-type: none"> Death Numbers of cases of viral illness

First Author, Publication Year, Country	Study Designs and Numbers of Primary Studies Included	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
	<p>MA was performed on homogeneous data.</p> <p>Literature search strategy: literature searches in CENTRAL, CINAHL, and others, up to October 2010. A manual search of reference lists was also performed.</p> <p>Number of studies included: in total, 67 studies were included; however, none were relevant to this review.</p> <p>Quality assessment tool: NR</p> <p>Objective: review the effectiveness of physical interventions to interrupt or reduce the spread of respiratory viruses</p>	<p>specifically discussing unimmunized HCWs wearing a mask intervention compared to unimmunized HCWs wearing no mask.</p>	<p>respiratory viruses (e.g., screening at entry ports, isolation, quarantine, social distancing, barriers, PPE, hand hygiene)</p> <p>Comparator: doing nothing; another intervention</p>	<ul style="list-style-type: none"> Severity of viral illness

AMSTAR 2 = A Measurement Tool to Assess Systematic Reviews 2; CENTRAL = Cochrane Central Register of Controlled Trials; CINAHL = Cumulative Index to Nursing and Allied Health Literature; EMBASE = Excerpta Medica database; HCW = health care worker; MA = meta-analysis; MEDLINE = Medical Literature Analysis and Retrieval System Online; NR = not reported; PPE = personal protective equipment; PubMed = Public MEDLINE; RCT = randomized controlled trial; SR = systematic review.

Appendix 3: Critical Appraisal of Included Publications

Table 3: Strengths and Limitations of Systematic Reviews and Meta-Analyses using A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR 2)⁸

Strengths	Limitations
Chughtai, 2019 ¹⁰ Australia	
<ul style="list-style-type: none"> • Included studies were adequately described • Source of funding (no funding) was reported 	<ul style="list-style-type: none"> • No protocol was reported to be established prior to the conduct of the review • The choice of included study designs (clinical, epidemiological and laboratory-based studies) was not justified • Although authors searched at least two databases and provided their search strategy, they did not justify their language restriction. Furthermore, grey literature searching was not reported • Study selection and data extraction were not reported as completed in duplicate • A list of excluded studies was not provided • Publication bias was not investigated and the impact on results of the review not discussed • Funding of the included studies was not reported • Although authors provided a statement on conflicts of interest, they did not discuss how these were managed
Saunders-Hastings, 2016 ¹¹ Canada	
<ul style="list-style-type: none"> • A protocol was established prior to the conduct of the review and registered with an International prospective register of SRs (PROSPERO 42016039803) • Study selection and data extraction were completed in duplicate • No language or date restrictions were applied • Authors provided a statement on conflicts of interest (none) • The authors provided explanation for including only SRs and MAs • Included studies were adequately described • A list of excluded studies and the reason for exclusion was provided • Heterogeneity was present and the authors provided a satisfactory explanation for, and discussion of, its impact on the results • Source of funding (none) was reported 	<ul style="list-style-type: none"> • Funding of the included studies was not reported
Bin-Reza, 2012 ¹² England	
<ul style="list-style-type: none"> • Study selection was completed in duplicate 	<ul style="list-style-type: none"> • Although authors provided a statement on conflicts of interest, they did not discuss how these were managed

Strengths	Limitations
<ul style="list-style-type: none"> • Authors provided a discussion of the likely impact of risk of bias of individuals studies on the results of the review • Source of funding (Health Protection Agency and the European Centre for Disease Prevention and Control) was reported • Included studies were adequately described 	<ul style="list-style-type: none"> • No protocol was reported to be established prior to the conduct of the review • A list of excluded studies was not provided • Review authors did not report on source of funding for the included studies • Publication bias was not investigated and the impact on results of the review not discussed
Jefferson, 2011 ¹³ Australia	
<ul style="list-style-type: none"> • The objectives and inclusion/exclusion criteria were clearly stated and included components of the population, intervention, comparator, and outcomes • A protocol was established prior to the conduct of the review • Multiple databases were searched, authors provided key words and search strategy, and no restrictions were applied to the search. • Data extraction was performed in duplicate • A list of excluded studies was provided, along with the reason for exclusion • Included studies were adequately described • Bias was assessed • Authors used an appropriate method for statistical combination of the results, they justified combining the data and used an appropriate weighted technique to combine study results (i.e., fixed effect model) • Authors provided a discussion of the likely impact of risk of bias of individuals studies on the results of the review • Sources of funding were disclosed (United Kingdom National Institute for Health Research, the National Health and Research Council of Australia, and the World Health Organization) • Authors provided a statement on conflicts of interest (none known) 	<ul style="list-style-type: none"> • Study selection was not reported as performed in duplicate • Although authors provided a statement on conflicts of interest, they did not discuss how these were managed • The choice of included study designs was not justified • Review authors did not report on source of funding for the included studies • Publication bias was not investigated and the impact on results of the review not discussed

Appendix 4: Additional References of Potential Interest

Consensus statement

Ontario Agency for Health Protection and Promotion, Provincial Infectious Diseases Advisory Committee. Annex B – Best Practices for Prevention of Transmission of Acute Respiratory Infection. Annexed to: Routine Practices and Additional Precautions in All Health Care Settings. Toronto ON: Queen's Printer for Ontario; 2013:

<https://www.publichealthontario.ca/-/media/documents/bp-prevention-transmission-ari.pdf?la=en>.