

Physical interventions to interrupt or reduce the spread of respiratory viruses: Evidence and implications for public health

Review on which this evidence summary is based:

Jefferson, T., Del Mar, C.B., Dooley, L., Ferroni, E., Al-Ansary, L.A., Bawazeer, G.A., van Driel, M.L., Nair, S., Jones, M.A., Thorning, S., Conly JM. (2011). **Physical interventions to interrupt or reduce the spread of respiratory viruses.** *Cochrane Database of Systematic Reviews*, Issue 7. Art. No.: CD006207

Review Focus

- P** General population
- I** Physical interventions to prevent or reduce transmission of acute respiratory infections (e.g. isolation, personal protection, hand hygiene, etc.)
- C** No intervention or a non-physical intervention
- O** *Primary Outcomes:* death, number of cases of viral illness, and/or severity of viral illness

Review Quality Rating: 9 (strong) *Details on the methodological quality are available [here](#).*

Considerations for Public Health Practice

Conclusions from Health Evidence

- Statistical pooling was limited to nine case-control studies, only two of which were at low risk of bias. These studies consistently demonstrate reduced transmission of acute respiratory illness (ARI) through: **frequent hand washing** (with or without antiseptics) and **barrier measures** (gloves, gowns, and masks in institutional settings), *especially* in combination (**OR 0.09**, 95%CI 0.02, 0.35). These studies were specific to the transmission of SARS, and findings may not generalize to other ARIs.
- While both gloves and gowns show a similar degree of efficacy, the group of case-control studies examining glove use included a greater number of poor quality studies.
- While ARI transmission in young children was reduced in the studies investigating hand washing + surface disinfectant, these studies were of lower quality and findings must be interpreted with caution.
- Despite being a well-done systematic review, most primary studies were at risk of bias (e.g. lack of blinding, loss to follow-up, etc.), and so the effectiveness of interventions may be exaggerated. There is significant variation between study designs, populations and settings, therefore interventions may not be useful across different public health settings.

***The key findings of five retrospective cohort studies were not included in this summary. All five studies had high risk of bias and retrospective designs are generally prone to recall bias.*

General Implications

Based on the available evidence, public health decision makers should:

- prioritize **frequent hand washing** and barrier measures such as **masks (surgical or N95 respirators), gloves and gowns** as means of reducing transmission of respiratory viruses, and particularly SARS. A *combination* of all these appears to be most effective;
- consider that masks were shown to be the best performing intervention across populations, settings and threats; and,
- consider social distancing/isolation/cohorting in hospital - especially paediatrics - as in intervention to reduce ARI transmission

However, there is no, limited, or mixed evidence regarding:

- the use of N95 respirators over simple surgical masks; and,
- the addition of virucidals or antiseptics (e.g. alcohol) to hand washing, hand washing + surface disinfectant, use of quarantine, screening at entry ports, gargling, use of skin cleanser wipes, nose washes, and eye protection.

Evidence and Implications

What's the evidence?

1. Hand washing

- Seven case-control studies, most of moderate quality, demonstrated that frequent hand washing (>10x/day) reduced the odds of SARS transmission by 46% compared to the odds of transmission in the control group (**OR 0.54**, 95% CI 0.44 to 0.67).
- A reduction in respiratory syncytial virus (RSV) was seen among healthcare workers caring for children < 5 years who used hand washing [those with differential diagnosis reduced from 61% (controls) to 5% (intervention)]. Similarly, a hand washing

Implications for practice and policy

1. Hand washing

- Public health decision makers should prioritize hand washing as a means reducing ARI transmission given its demonstrated effectiveness across settings and infections.
- While the highest quality cluster-randomised trials indicate most effect on preventing respiratory virus spread from hygienic measures in younger children, decision makers should consider that one of the studies supporting hand washing as an effective intervention for children <5 years

<p>education programme for adult day care centre staff reduced rates of respiratory tract infection [14.5-10.4 per 100 person months to 5.7 ($P<0.001$)]. Both were well-done prospective cohort studies.</p> <ul style="list-style-type: none"> Based on two well-done cluster-RCTs children up to age 5 years in households where members used soap were 50% less likely to have pneumonia (non laboratory confirmed) than those in control households (RR 0.50, 95% CI 0.34 to 0.65). Children up to 24 months (attending child care centres participating in a hand washing program) were 10% less likely to have acute respiratory infections compared with controls. The true effectiveness ranged from 27% to 3% less likely (RR 0.90, 95% CI 0.83 to 0.97). A well-done CBA study of military recruits showed that less frequent hand washing led to greater odds of acquiring a self-reported ARI (annual average of 4.7 vs. 3.2 self-reported infections/recruit). 	<p>was conducted in a developing country, and another in a child care centre. Results may not have the same effect in other settings.</p> <ul style="list-style-type: none"> Evidence specifically supporting the reduction of influenza transmission through the <i>addition of</i> face masks to hand hygiene initiatives is limited to a single study.
<p>2. Wearing Masks</p> <ul style="list-style-type: none"> Seven case-control studies, most of moderate quality, demonstrated that wearing a surgical mask reduced the odds of SARS transmission by 68% compared to the control group (OR 0.32, 95% CI 0.26 to 0.39). Only one RCT of poor quality showed <u>no impact</u> of surgical masks on ARI transmission 	<p>2. Wearing Masks</p> <ul style="list-style-type: none"> Public health programs should consider use of surgical masks to reduce the transmission of ARIs, particularly in the hospital setting, while keeping in mind that studies to-date are specific to SARS and the majority are at moderate risk of bias.
<p>3. Wearing N95 Masks</p> <ul style="list-style-type: none"> One high quality RCT found surgical masks to be non-inferior to N95 masks in preventing transmission of influenza (both to seasonal viruses and nH1N1 viruses) amongst acute care nurses (23.6% and 22.9% in the surgical mask and N95 groups respectively had laboratory confirmation of influenza infection). When participants in three case-control studies (one of low quality) wore N95 masks, the odds of SARS transmission was reduced by 83% compared to the odds of transmission in the control group (OR 0.17, 95% CI 0.07 to 0.43). A cluster-RCT using the Australian equivalent of N95 masks, showed <u>no impact</u> on ARI transmission rates when intention-to-treat analysis was used. 	<p>3. Wearing N95 Masks</p> <ul style="list-style-type: none"> Public health decision makers should consider including N95 masks in programs aiming to reduce the transmission of ARIs, while keeping in mind that studies to-date were specific to SARS; however, evidence from a high quality RCT showed that (in addition to wearing gloves and gowns) surgical masks were <i>non-inferior</i> to N95 masks in preventing transmission of influenza.
<p>4. Wearing Gowns</p> <ul style="list-style-type: none"> When participants in five case-control studies (one of low quality) wore gowns, the odds of SARS transmission was reduced by 67%, compared to the odds of transmission in the control group (OR 0.33, 95% CI 0.24 to 0.45). A controlled before-and-after (CBA) study of moderate quality in a neonatal intensive care unit showed <u>no impact</u> on ARI transmission 	<p>4. Wearing Gowns</p> <ul style="list-style-type: none"> Public health decision makers should consider use of gowns to reduce transmission of ARIs, particularly SARS, while acknowledging some studies supporting their use are at moderate risk of bias.
<p>5. Wearing Gloves</p> <ul style="list-style-type: none"> When participants in six case-control studies (two of low quality) wore gloves, odds of SARS transmission was reduced by 68% compared to control group (OR 0.32, 95% CI 0.23 to 0.45). 	<p>5. Wearing Gloves</p> <ul style="list-style-type: none"> Public health decision makers should consider use of gloves to reduce transmission of ARIs, particularly SARS, while acknowledging some studies supporting their use are at high risk of bias.
<p>6. Combination Interventions</p> <ul style="list-style-type: none"> In two case-control studies (one high-quality, one moderate-quality), use of masks in combination with other barriers led to a reduction in the odds of SARS of 91% transmission when compared with the odds in the controls (hand washing before and after patient contact). The most protective effect came when surgical or N95 masks were worn with a gown and gloves, combined with frequent hand washing (OR 0.09, 95% CI 0.02-0.35). In one well-done, paediatric-based, CBA study, compliance with a glove and gown isolation policy reduced nosocomial RSV transmission (RR for pre- and post-intervention period infection rates 2.9, 95% CI 1.5 to 5.7). Another well-done CBA study combining education and contact precautions, with glove/gown use and hand washing for patients and hospital staff (RR 0.61, 95% CI 0.53 to 0.69). 	<p>6. Combination Interventions</p> <ul style="list-style-type: none"> Public health decision makers should consider advocating the combined use of hand washing and barrier methods, while acknowledging that some studies supporting combined interventions are at moderate risk of bias, and focused on a paediatric hospital setting.

<ul style="list-style-type: none"> One of two prospective cohort studies supported combination interventions for reducing ARI transmission. Use of rapid laboratory diagnosis, cohort nursing and the wearing of gowns and gloves for all contacts with RSV-infected children significantly reduced the odds of nosocomial RSV infection (OR 0.013 to 0.76). This study was at low risk of bias. 	
7. Hand washing with Antiseptic <ul style="list-style-type: none"> In a poor quality, cluster-RCT the use of alcohol gel in addition to hand washing resulted in a 43% reduction in absenteeism from school, while one moderate quality, prospective cohort study found use of hand sanitizer in addition to hand washing reduced absenteeism by 41.9% over 10 weeks. One poorly-reported RCT showed rhinovirus transmission was significantly less likely as compared with controls with use of used salicylic acid or salicylic acid plus pyroglutamic acid ($p < 0.05$). 	7. Hand washing with Antiseptic <ul style="list-style-type: none"> While there is some evidence for the effectiveness of hand disinfection in reducing school absenteeism, results are mixed. Any expenditure of resources related to offering hand disinfectants to reduce ARI transmission should be weighed against the fact the studies examining this intervention are limited in both number and quality.
8. Hand washing + Surface Disinfectant <ul style="list-style-type: none"> Of the four cluster-RCTs involving children and families, two found hand washing + surface disinfectant to be effective for prevention of ARIs (one of which was at high risk of bias). One CBA study showed hand washing + surface disinfectant to be effective in a day care centre, but the study was at very high risk of bias. 	8. Hand washing + Surface Disinfectant <ul style="list-style-type: none"> Public health programs may include hand washing + surface disinfectant, but decision makers should note that evidence to-date is mixed on its effectiveness at reducing ARI transmission, and is at high risk of bias.
9. Hand Disinfection <ul style="list-style-type: none"> Two of three poor quality RCTs demonstrated an effect on rhinovirus transmission with iodine use, while one, well-done prospective cohort study assessing alcohol rub use in student residences led to reductions in symptoms (by 14.8% to 39.9 %) and absenteeism (40% reduction). <u>No impact</u> on the transmission of ARIs (including SARS) with the use of iodine, skin cleanser wipes containing 4% pyroglutamic acid formulated with 0.1% benzalkonium chloride. 	9. Hand Disinfection <ul style="list-style-type: none"> Hand disinfection should not be a program priority for public health given the limited availability and quality of supporting studies.
10. Nose Wash <ul style="list-style-type: none"> Two case-control studies, both of poor quality, demonstrated that use of a nose wash reduced the odds of SARS transmission by 70%, compared to the odds of contracting SARS in the control group (OR 0.30, 95% CI 0.16 to 57). 	10. Nose Wash <ul style="list-style-type: none"> Given the poor quality of limited quantity of available evidence, public health decision makers should avoid investing resources in nose washes for reducing ARI transmission.
11. Distancing, Isolation, Cohorting or Quarantine <ul style="list-style-type: none"> A combination of CBA ($n=6$) and prospective cohort studies ($n=2$), of varying quality, found cohorting in hospitals and/or early identification and physical distancing effective in reducing ARI transmission. <u>No impact</u> on transmission was observed through the use of distancing in a single study of military recruits. <u>Possible impact</u> on SARS transmission achieved through quarantine and port of entry screening given that only 12 cases identified out of over 13 million people screened. 	11. Distancing, Isolation, Cohorting or Quarantine <ul style="list-style-type: none"> Public health programs should not yet rely on port entry screening or quarantine as means of reducing ARI or SARS transmission given the small samples and low quality of available studies. While there is some evidence supporting distancing and cohorting as means of reducing ARI transmission in a hospital particularly in the hospital setting, public health decision makers should consider the available evidence is at moderate to high risk of bias.
12. Eye Protection <ul style="list-style-type: none"> Three case-control studies (two poor quality and one of moderate quality) demonstrated use of eye protection (e.g. goggles) reduced the odds of SARS transmission by 90% compared to the odds of transmission in the control group (OR 0.10, 95% CI 0.05 to 0.17). 	12. Eye Protection <ul style="list-style-type: none"> While there is some evidence supporting the beneficial effect of eye protection for reducing ARI transmission, specifically SARS, public health decision makers should consider the available evidence is at moderate to high risk of bias.
13. Gargling <ul style="list-style-type: none"> <u>No impact</u> on the incidence of mild ARIs with use of gargling with water, or gargling with povidone-iodine. 	13. Gargling <ul style="list-style-type: none"> Given the limited evidence available, public health decision makers should avoid investing resources in gargling – with water or iodine – for reducing ARI transmission.
14. Virucidal Tissues or Impregnated Disposable Handkerchiefs <ul style="list-style-type: none"> Only one of three cluster-RCTs, all of moderate or poor quality, reported fewer new ARIs (9% drop in incidence) with use of handkerchiefs impregnated with virucide. The remaining two showed <u>no impact</u>. A well-done, prospective cohort study found handkerchiefs containing citric acid completely interrupted rhinovirus transmission (participants=16). 	14. Virucidal Tissues or Impregnated Disposable Handkerchiefs <ul style="list-style-type: none"> Virucidal tissues/impregnated handkerchiefs are likely not the best option for public health programs aiming to reduce transmission of ARIs given the mixed evidence of their effectiveness and small study samples.

15. Disinfection of Living Quarters <ul style="list-style-type: none"> One case-control study showed odds of SARS virus transmission was reduced by 70%, compared to the odds of transmission in the control group, when living quarters were disinfected (OR 0.30, 95% CI 0.23 to 0.39). 	15. Disinfection of Living Quarters <ul style="list-style-type: none"> The disinfection of living quarters was shown to be highly effective against the transmission of SARS. Public health decision makers should consider, however, that this finding was based on a single study at moderate risk of bias.
Legend: PICO - P – Population, I – Intervention, C – Comparison group, O – Outcomes; CI – Confidence Interval; OR – Odds Ratio; RR – Relative Risk; **For definitions please see the healthevidence.org Glossary	

Why this issue is of interest to public health in Canada

Respiratory viral infections (RVIs) are associated with a wide range of clinical manifestations from upper respiratory tract infections to pneumonia, and are the most common reason for medical consultation in the world.¹ More specifically, respiratory syncytial virus (RSV) is a significant cause of morbidity among children and mortality among the elderly and those who are immunocompromised.² Although RSV usually causes an upper respiratory infection, in 25-40% of cases it progresses to the lower respiratory tract, causing pneumonia or bronchiolitis.² Another RVI, severe acute respiratory syndrome (SARS), affected approximately 8500 persons worldwide and killed 900.³ In Canada, SARS killed 44 people and led to the quarantine of 25,000 individuals in the Greater Toronto Area.³ The recent H1N1 influenza A virus caused serious and widespread illness, so much so that the World Health Organization declared a pandemic June 2009.⁴ As of March 2010, 430 Canadians had died from this pandemic strain.⁵ Moreover, between April and December 2009, the estimated total inpatient cost of H1N1/influenza was \$146 million.⁶ RVIs strain health services, are responsible for excess deaths, and result in huge indirect costs due to absenteeism from work and school.^{7,8} Such circumstances call for interventions, in addition to vaccines and anti-viral medications, to interrupt or reduce the spread of respiratory viruses. *Note* - Respiratory viruses can be transmitted via droplet or airborne routes, and physical interventions to interrupt or reduce their spread should be tailored accordingly.¹⁰

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This evidence summary was written to condense the work of the authors of the review referenced on page one. The intent of this summary is to provide an overview of the findings and implications of the full review. For more information on individual studies included in the review, please see the review itself.

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