

## RESPIRATORY INFECTION TRANSMISSION (HEALTHCARE WORKERS): FACE MASKS AND RESPIRATORS

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### Clinical Bottom Line

Respiratory personal protective equipment (PPE), is used to decrease the occupational risk of respiratory infection when vaccination or specific anti-infective treatments are unavailable.<sup>1,2,3</sup> Two main types of respiratory PPE, masks and respirators are used to form a barrier between the healthcare worker and exposure to contaminated body fluids, by preventing inhalation.<sup>1,2,3</sup> Masks, referred to as either medical or surgical masks, are designed to protect the wearer from large respiratory droplets.

Respirators (N95 [United States], FFP2 [Europe], KN95 [China] and P2 [Australia and New Zealand]) are designed to prevent the inhalation of small airborne particles.<sup>1</sup> However, current guidelines for the use of respiratory PPE in healthcare settings are based on limited evidence.<sup>1</sup>

- A systematic review quantified the effectiveness of different respiratory PPE among healthcare workers and compared the protective effect of masks and respirators against bacterial and viral infections. Although the quality of evidence was poor, with a small number of studies prone to reporting biases and lack of statistical power, it was reported that compared to healthcare workers not wearing respiratory PPE, those wearing medical/surgical masks or N95 respirators throughout their entire work shift were significantly more likely to be protected against self-reported respiratory illnesses. Additionally, compared to medical/surgical masks, N95 respirators provided greater protection against self-reported clinical respiratory illness and laboratory-confirmed upper respiratory tract bacterial colonization. Disposable, cotton or paper masks (compared with medical/surgical masks or respirators) were not recommended as protection against respiratory infection transmission. A meta-analysis also suggested a protective, but non-significant, effect against laboratory-confirmed viral infections including severe acute respiratory syndrome (SARS)–Coronavirus (SARS-CoV) for both medical/surgical masks and respirators.<sup>1</sup> (Level 1)
- A systematic review compared the effectiveness of N95 respirators against medical/surgical masks specifically for the prevention of influenza, and found no significant differences between the two. Evidence did not support the use of N95 respirators for medical staff outside of high-risk situations (eg, when in close contact with influenza patients, or those suspected with having influenza).<sup>2</sup> (Level 1)
- Interventions were compared in meta-analysis of two randomized controlled trials (RCTs) (included in the systematic review above): medical/surgical masks worn continuously on shift, continuous N95 respirators at all times on shift, and targeted/intermittent use of N95 respirators only while doing high-risk procedures or barrier nursing of a patient with known respiratory illness. The following laboratory-confirmed outcomes were included in the analysis: (i) viral respiratory infection (detection of adenoviruses, human metapneumovirus, coronavirus 229E/NL63, parainfluenza viruses 1, 2 and 3, influenza viruses A and B, respiratory syncytial virus A and B, rhinovirus A/B and coronavirus OC43/HKU1 by multiplex PCR); (ii) (multiplex PCR) influenza A or B; and (iii) bacterial colonization (*Streptococcus pneumoniae*, *Hemophilus influenzae*, *Bordetella pertussis*, *Chlamydia pneumoniae* and *Mycoplasma pneumoniae*). Compared to all groups, the continuous N95 respirator group showed significantly lower rates of viral respiratory

infection (26/1530, 1.7%), bacterial colonization (79/1530, 5.2%), and droplet-transmitted infections (62/1530, 4.1%). Influenza A and B infection was lowest in the continuous N95 and targeted N95 groups (2/516, 0.4%). Authors noted that there was no clear evidence to support the use of medical/surgical masks against any of their outcomes, but there seemed to be a non-significant trend toward protection, which may become clearer in larger studies. Due to the widespread use of medical/surgical masks in healthcare settings, it was recommended that larger studies are required to measure the efficacy of this type of PPE.<sup>3</sup> (Level 1)

- World Health Organization interim guidance on the use of masks and respirators for the 2019 coronavirus disease (COVID-19) state:<sup>4,5</sup>(Level 5)
  - When providing direct care to COVID-19 patients a medical/surgical mask should be worn. If aerosol-generating procedures are performed on COVID-19 patients, then a respirator N95 or FFP2 standard (or equivalent) should be worn instead.<sup>4</sup>
  - Wearing a medical/surgical mask is one of the prevention measures that may limit the spread of certain respiratory diseases, including COVID-19. However, a mask alone is insufficient protection and other measures (eg, practicing safe hand hygiene) should accompany the use of a mask.<sup>5</sup>
  - Cloth (eg, cotton or gauze) masks are not recommended for use by practicing health professionals under any circumstances.<sup>5</sup>
  - If a mask is worn: (1) it must be placed to cover the mouth and nose, and tied securely to minimize any gaps; (2) the mask itself it should not be touched while wearing or when removing; (3) if inadvertent touching of the exterior of the mask occurs, hands must be immediately cleaned with soap and water, or alcohol-based hand rub; (4) replace a medical/surgical mask when it becomes damp and discard single-use masks immediately after use; and (5) do not re-use a single-use mask.<sup>5</sup>
- Clinical practice guidelines and expert opinion recommend the following regarding the use of face masks and respirators for the control of respiratory infection:<sup>6,7</sup>
  - A medical/surgical mask or fit-tested respirator should be worn by healthcare workers when within 1.8 meters of a suspected, or laboratory-confirmed, influenza patient.<sup>6</sup>
  - Airborne precautions (in addition to standard precautions) must be implemented when entering a patient care area where there is known or suspected respiratory infection. This includes a correctly fitted P2 (or equivalent) respirator.<sup>7</sup>
- Two studies – a laboratory-based pilot study followed by a clinical study – investigated the external areas of masks likely to contain maximum viral particles. Laboratory results were confirmed when the clinical study revealed positivity rates of 10.1% (15/148) for commonly isolated viruses from masks worn by healthcare workers for a six- to eight-hour shift. Authors concluded that contamination on masks increased with use ( $\geq$  six hours) and recommended that protocols on duration of mask use should specify a maximum time of continuous use; however, they were unable to give advice on the length of time to wear a mask.<sup>8</sup> (Level 3)
- A systematic review and meta-analysis investigated the effect of physical distance, face masks, and eye protection on transmission of SARS-CoV-2, SARS-CoV, and MERS-CoV in healthcare and non-healthcare (eg, community) settings. Results suggest that wearing face masks protects people (both healthcare workers and the general public) against coronaviruses, and that eye protection could confer additional benefit. However, none of these interventions afforded complete protection from infection. For healthcare workers and administrators, the findings of the review 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. Other basic measures like hand hygiene are still needed in addition to physical distancing and use of face mask

and eye protection.<sup>9</sup> (Level 3)

- A systematic review and meta-analysis evaluated the effectiveness of the use of masks to prevent SARS-CoV-2 transmission. The study concluded that there was nearly a 70% reduced risk of COVID-19 infection for healthcare workers. Additionally, the review indicated that both N95 masks and general masks were effective, but their comparative effectiveness has not yet been confirmed.<sup>10</sup>(Level 3)
- A systematic review evaluated the use of masks and respirators by the community, health care workers, and sick patients for prevention of infection. The study concluded that the respirator is superior to a face mask in protecting healthcare workers provided it is used continuously and not intermittently.<sup>11</sup>(Level 1)
- A systematic review investigated the effectiveness of face masks against respiratory infections, including coronavirus. The study found little evidence to support the effectiveness of face masks to reduce the risk of COVID-19 infection. However, the use of N95 respirators or air supplying respirators in addition to the principles of personal hygiene, frequent hand washing, and the use of disinfectants can reduce the prevalence of COVID-19 in health care providers.<sup>12</sup> (Level 1)
- A systematic review compared N95 respirators with surgical masks for the protection of health care workers against acute respiratory infections in a healthcare setting. The study showed that there was no significant difference between N95 respirators and surgical masks when used by healthcare workers to prevent transmission of acute respiratory infections from patients. On the other hand, findings from the surrogate exposure studies suggest that N95 respirators are superior to surgical masks for filter penetration, face-seal leakage, and total inward leakage under laboratory conditions. Finally, these results are not generalizable to infections transmitted primarily through airborne routes (i.e. tuberculosis, measles and varicella) or for protection from acute respiratory infections during aerosol-generating medical procedures.<sup>13</sup>(Level 1)

## Characteristics Of The Evidence

This evidence summary is based on a structured search of the literature and selected evidence-based health care databases. The evidence in this summary comes from:

- A systematic review of six RCTs and 23 observational studies, including two meta-analyses; one of RCTs and other of observational studies.<sup>1</sup>
- A systematic review of six RCTs involving 9,171 participants.<sup>2</sup>
- The pooled results of two RCTs: continuous use of N95 respirators (pooled data from both trials); n=1,530; targeted N95 respirator use (data from trial two only; n=516); continuous use of medical masks (pooled data from both trials; n=1,064) and a control group (data from trial one only; n=481).<sup>3</sup>
- Clinical practice guidelines.<sup>4,5,6,7</sup>
- A descriptive study involving 12 doctors and nurses from infectious diseases, respiratory/chest wards, and intensive care units.<sup>8</sup>
- A systematic review and meta-analysis of 172 observational studies involving 25,697 patients.<sup>9</sup>
- A systematic review of meta-analysis of six case control studies involving 1,233 participants.<sup>10</sup>
- A systematic review of 19 RCTs.<sup>11</sup>
- A systematic review of five studies (research design not reported in the review).<sup>12</sup>
- A systematic review and meta-analysis of six clinical studies (three RCTs, one cohort and two case control studies) and 23 surrogate exposure studies.<sup>13</sup>

## Question

What is the best available evidence regarding the effectiveness of face masks and/or respirators in reducing the transmission of respiratory infections among healthcare workers?

## Best Practice Recommendations

- An N95 respirator (or equivalent) should be worn continuously during high-risk situations such as aerosol-generating procedures with patients known to have a respiratory infection. (Grade A)
- If a mask is worn, it should be placed to cover the mouth and nose and tied securely to minimize any gaps. (Grade B)
- During high-risk exposures, the use of respirators and evidence-based hand hygiene techniques to prevent the transmission of respiratory infection is recommended. (Grade A)
- A medical/surgical mask should always be worn when providing direct patient care to a patient with known or suspected respiratory infection. (Grade A)
- A mask should not be touched while wearing or when removing; if inadvertently touching the mask, hands must be immediately cleaned with soap and water, or alcohol-based hand rub. (Grade B)
- Medical/Surgical masks should not be worn for more than six hours and should be changed immediately when they become damp. (Grade B)
- Cloth (eg. cotton or gauze) masks are not recommended under any circumstances. (Grade B)

## References

1. Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of masks and respirators against respiratory infections in healthcare workers: a systematic review and meta-analysis. *Clin Infect Dis*. 2017; 65(11):1934-42.
2. Long Y, Hu T, Liu L, Chen R, Guo Q, Yang L, et al. Effectiveness of N95 respirators versus surgical masks against influenza: A systematic review and meta-analysis. *Int J Evid Based Health*. 2020;.13(2):93-101.
3. MacIntyre CR, Chughtai AA, Rahman B, Peng Y, Zhang Y, Seale H, et al. The efficacy of medical masks and respirators against respiratory infection in healthcare workers. *Influenza Other Respir Viruses*. 2017; 11(6):511-7.
4. World Health Organization (WHO). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). 2020. Accessed 26 March 2020 from [https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE\\_use-2020.1-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf) [[https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE\\_use-2020.1-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf)]
5. World Health Organization (WHO). Advice on the use of masks in the community, during home care, and in health care settings in the context of COVID-19: interim guidance. 2020. Accessed 26 March 2020 at <https://apps.who.int/iris/handle/10665/331493> [<https://apps.who.int/iris/handle/10665/331493>]
6. Centers for Disease Control and Prevention (CDC). Interim guidance for the use of masks to control seasonal influenza virus transmission. Accessed 26 March 2020 at <https://www.cdc.gov/flu/professionals/infectioncontrol/maskguidance.htm> [<https://www.cdc.gov/flu/professionals/infectioncontrol/maskguidance.htm>]
7. National Health and Medical Research Centre (NHMRC). Australian Guidelines for the prevention and control of infection in healthcare. 2019. Accessed 26 March 2020 from <https://www.nhmrc.gov.au/about-us/publications/australian-guidelines-prevention-and-control-infection-healthcare-2019#block-views-block-file-attachments-content-block-1> [<https://www.nhmrc.gov.au/about-us/publications/australian-guidelines-prevention-and-control-infection-healthcare-2019#block-views-block-file-attachments-content-block-1>]
8. Chughtai AA, Stelzer-Braid S, Rawlinson W, Pontivivo G, Wang Q, Pan Y, et al. Contamination by respiratory viruses on outer surface of medical masks used by hospital healthcare workers. *BMC Infect Dis*. 2019; 19(1):491.
9. Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ, 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; 395(10242):1973–87.
10. Li Y, Liang M, Gao L, Ahmed M, Uy J. Face masks to prevent transmission of COVID-19: a systematic review and meta-analysis. *Am J Infect Control*. 2021; 49:900-6
11. MacIntyre C, Chughtai A. A rapid systematic review of the efficacy of face masks and respirators against coronaviruses and other respiratory transmissible viruses for the community, healthcare workers and sick patients. *Int J Nurs Stud*. 2020; 108:103629.
12. Dehaghi BF, Ghodrati-Torbati A, Teimori G, Ghavamabadi LI, Jamshidnezhad A. Face masks vs. COVID-19: a systematic review. *Invest Educ Enferm*. 2020; 38(2):e12.
13. Smith JD, MacDougall CC, Johnstone J, Copes RA, Schwartz B, Garber GE. Effectiveness of N95 respirators versus surgical masks in protecting health care workers from acute respiratory infection: a systematic review and meta-analysis. *CMAJ*. 2016; 188(8):567–74.

## Archived Publications

1. JBI-ES-3735-1 (Published at 12 October 2021)
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For details on the method for development see Munn Z, Lockwood C, Moola S. The development and use of evidence summaries for point of care information systems: A streamlined rapid review approach. Worldviews Evid Based Nurs. 2015;12(3):131-8.

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