

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

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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?

Clinical Bottom Line

Respiratory personal protective equipment (PPE), are used to decrease the occupational risk of respiratory infection when vaccination or specific anti-infective treatments are unavailable.¹⁻³ Two main types of respiratory PPE are used to form a barrier between the healthcare worker and exposure to contaminated body fluids, by preventing inhalation; masks and respirators.¹⁻³ 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.¹ However, current guidelines for the use of respiratory PPE in healthcare settings are based on limited evidence.^{1,4-7}

- 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 (SARSCoV) for both medical/surgical masks and respirators.¹ (Level 1)
- A systematic review compared the effectiveness of N95 respirators against medical/surgical masks specifically for the prevention of influenza finding no significant differences between the two. Evidence did not support the use of N95 respirators for medical staff outside of high-risk situations (e.g. when in close contact with influenza patients, or those suspected with having influenza).² (Level 1)
- Interventions were compared in meta-analysis of two 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*, *Haemophilus 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.³ (Level 1)

- World Health Organization interim guidance on the use of masks and respirators for the 2019 coronavirus disease (COVID-19) state:^{4,5} (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.⁴
 - 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 (e.g. practicing safe hand hygiene) should accompany the use of a mask.⁵
 - Cloth (e.g. cotton or gauze) masks are not recommended for use by practicing health professionals under any circumstances.⁵
 - 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.⁵
- Clinical practice guidelines and expert opinion recommend the following regarding the use of face masks and respirators for the control of respiratory infection:
 - 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.⁶
 - 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.⁷
- 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 (> 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.⁸ (Level 3)

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.¹
- A systematic review of six randomized controlled trials (RCTs) involving 9,171 participants.²
- 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 2 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).³
- Clinical Practice Guidelines.⁴⁻⁷
- A descriptive study involving 12 doctors and nurses from infectious diseases, respiratory/chest wards, and intensive care units (ICU).⁸

Best Practice Recommendations

- 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)
- 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)
- 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 (e.g. 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.
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-IPCPE_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>
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>
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>
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.

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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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