

## Take Action to Address the Worldwide Shortage of Respirators and Face Protection for COVID-19 Response

This alert is a call to action to address the shortage of PPE and respirators needed to protect healthcare workers who are assigned to care for patients who are suspect or confirmed COVID-19 cases. We know from past pandemics that frontline healthcare workers have a high risk of exposure. Historically and in the current pandemic there have been reports of large numbers of healthcare workers being infected and some deaths. Protecting our healthcare workers is not only a moral imperative but essential to maintaining the necessary professional staff to provide care to the infected and diseased during this crisis.

### Why do healthcare workers need respiratory protection?

Short-range aerosol transmission is likely an important means of transmission of COVID-19. Multiple studies have documented aerosol transmission for influenza, SARS, and MERS. These pathogens show many similarities to COVID-19. The precautionary approach requires preventing aerosol exposure to healthcare workers.

#### What is an aerosol?

Simply defined, it is tiny particle, or a droplet suspended in air.

Have you ever seen dust particles traveling through the air in a beam of light? Some of these eventually deposit on surfaces, but many remain airborne for long periods. Have you ever used hairspray or aerosolized cooking oil? Many of those droplets remain airborne nearby as you inhale particles and smell hairspray and cooking oil for several minutes. The same thing happens when someone coughs or sneezes. Talking, breathing, coughing, and

sneezing create an aerosol containing particles in a range of sizes, with some viable infectious organisms present in both small and large particles.

*Figure 1 Coughing, laughing, breathing emit aerosols*

Contrary to popular belief, the larger particles (5 to 15 micrometers [ $\mu\text{m}$ ]) will not immediately drop to the ground but will remain airborne for several minutes. Smaller particles (less than 5  $\mu\text{m}$ ) will remain in the air for many minutes or even hours.

All particles will immediately begin to evaporate because mucus contains a lot of water which means the range of particle sizes will decrease overall. Smaller particles are more likely to remain



Some of the information for this fact sheet has been taken from CIDRAP commentary COVID-19 transmission messages should hinge on science: <http://www.cidrap.umn.edu/news-perspective/2020/03/commentary-covid-19-transmission-messages-should-hinge-science>

airborne. In the absence of air currents, airborne particles will disperse slowly throughout a space.

The Wuhan, China, experience supports the likelihood of close-range aerosol transmission. After initially receiving and treating COVID-19 patients in the existing healthcare system and experiencing healthcare worker infections, China deployed a tiered hospital model very similar to that used for patients with Ebola virus disease in the United States. Patients with critical or severe symptoms were moved into designated wards or hospitals while those with mild

*Figure 2 Full and half face elastomeric respirators and cartridges*



symptoms were cohorted in temporary hospitals in repurposed buildings. Healthcare workers wore full protection, including a gown, head covering, N95 filtering facepiece respirators, eye protection, and gloves.

The experience from China and elsewhere emphasizes the importance of separating infectious patients by using dedicated treatment facilities or separating areas of hospitals used for diagnosing and treating them. Additionally, when possible, limiting the number of healthcare workers involved in assessing and treating COVID-19 patients will limit potential exposure and help conserve PPE. Use of engineering controls such as UV irradiation, HEPA filtration, and negative air pressure are also recommended, but should be implemented by qualified professionals.

### What action can I take?

**1)** Hospital and healthcare worker unions should work with local and state health department officials to reach out to the local labor councils or State Federations of Labor and construction industry and union officials to request donations of respirators and to help with the shortages. If large numbers of healthcare workers get sick, the entire society will suffer.

**2)** In addition to N95s, N99s, N100s may be used as well as many other respirators and cartridges that provide a higher level of respiratory protection than the N95 respirator. The number tells you the percentage of submicron particles that the respirator can filter out. There is also an R and P version of these respirators. The R and P relate to use in an oily environment. Although healthcare is

*Figure 3 Full face elastomeric respirator*



not an oily environment these P and R respirators are equally good at filtering out sub-micron particles and can be used in healthcare.

**3)** Elastomeric reusable respirators should also be used. They are equivalent or greater in protection and can use cartridges for N95, N99, and N100 as well as P and R versions of those filters. They have the advantage that they are reusable, provide a better seal to the face, and can be assigned to individual workers. Construction company safety officers, union trainers, NIEHS Worker Training Program grantees, and university-based safety and health programs, and local chapters of the American Industrial Hygiene Association should be solicited to provide fit testing and training on donning/doffing, disinfection, storage, and maintenance of these respirators. Some people have found elastomeric respirators available from respirator suppliers, hardware stores, or donations from construction unions and companies.

*Figure 5 Elastomeric Half-Face Respirator*



**4)** PAPRs (powered air purifying respirators) provide a higher level of protection and are reusable. They are especially useful for high risk procedures like bronchoscopy or sputum induction but can also be used for protecting healthcare workers in patient rooms for suspect or known COVID 19 cases. They also

do not require fit testing and are more comfortable for the wearer.

*Figure 4 Powered Air Purifying Respirator (PAPR)*



**5)** Face shields and goggles to prevent mucocutaneous exposure to splash and splatter and other PPE are also on short supply. It is very important to address eye protection because eye exposures are the most frequent type of mucocutaneous exposures. Facilities using multiple use (reusable) eye protection must have safe decontamination practices in place (refer to product instructions for use) and those with disposable eye protection in place must have safe disposal practices in place. If respirators are being reused, use of a face shield may be a viable physical barrier to better protect the integrity of that respirator. They are also essential to protect workers from body fluids and large particles.

#### **Reuse of N95s.**

<https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html>

The NIOSH guidance on reuse of disposable respirators during a shortage/crisis in the link above advises to hang used respirators in a designated storage area or keep them in a clean, breathable container such as a paper bag between uses. **Do not place them into an airtight**

container, such as a zip lock bag as this could promote microbial growth. To minimize potential cross-contamination, store

Figure 6 Surgical N95, Courtesy of 3M



respirators so that they do not touch each other and the person using the respirator is clearly identified. Storage containers should be disposed of or cleaned regularly.

Because disposable respirators are not intended for reuse, methods for disinfection for reuse during the shortage are just emerging. These are methods of last resort and should only be done by trained professionals who understand the pros and cons of each methodology and who can establish an administrative process to do so safely. It is not clear currently how much these methods degrade the respirators. The methods include use of ultraviolet (UV) irradiation, autoclaving, or disinfectant chemicals. UV if not properly conducted and maintained poses a serious risk of damage to eyes and skin. Some of the chemical methods proposed include use of known carcinogens and mutagens and should be avoided. The detailed UV procedure being used by Nebraska Medical may be downloaded at: <https://www.nebraskamed.com/for-providers/covid19, but any organization considering decontamination should review their own process to assure N95 integrity and organism reduction>. This site also contains a model policies, procedures, and training videos on donning and doffing of PPE.

### A surgical mask is NOT respiratory protection

The surgical or procedure mask is intended to prevent patient contamination by infectious droplets that can cause healthcare associated infections from HCW's respiratory tract. Secondly, they provide a barrier protecting HCW's nose and mouth from large droplet splashes, sprays of infectious material. Particles can enter at edges of the surgical mask. It is recommended to place a surgical or procedure mask onto people (patients) who are suspect or confirmed to be COVID-19 cases.

### What about homemade surgical masks and respirators?

Respirators and surgical masks are manufactured using melt blown fiber that is a very tightly bound polymer-based material that does not allow the virus to penetrate through it. It filters out the sub-micron (one millionth of a meter) particles. Homemade surgical masks and homemade respirators while they can be considered a physical barrier for splashes and splatters, they **do not** protect healthcare workers to the same level from being infected from the viral particles because they likely do not use a proper filter materials and likely do not provide a tight facial seal. In a relevant study, the researchers found that cloth masks resulted in increased risk of infection due to moisture retention, reuse of cloth masks, and poor filtration

**AIHA Local Sections:** <https://www.aiha.org/get-involved/local-sections/local-section-websites>

**Contact your area chapter of the Association of General Contractors**

**Contact your State Federation of Labor or Area Labor Council**

**Contact your State and Local Health Department**

**Authors:**

Jonathan Rosen, MS CIH FAIHA [jrosen396@gmail.com](mailto:jrosen396@gmail.com) (518)225-0882

Shawn Gibbs, PhD, MBA, CIH

Lisa Brosseau, ScD

Amber Mitchell, DrPH, MPH, CPH

© Copyright Organizations are hereby granted permission to place their organizational identifier and contact information on this publication. Any changes to the content must first be cleared by the authors.

**References:**

- 1) Lisa Brosseau, CIDRAP March 16, 2020 COMMENTARY: COVID-19 transmission messages should hinge on science, <http://www.cidrap.umn.edu/news-perspective/2020/03/commentary-covid-19-transmission-messages-should-hinge-science>
- 2) Rachael M. Jones, Lisa M. Brosseau, Aerosol Transmission of Infectious Disease, JOEM Volume 57, Number 5, May 2015 <https://www.ncbi.nlm.nih.gov/pubmed/25816216>
- 3) NIOSH/CDC Pandemic Planning, Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings <https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html>
- 4) MacIntyre CR, Wang Q, Seale H, et al. A randomized clinical trial of three options for N95 respirators and medical masks in health workers. Am J Resp Crit Care Med 2013 Feb 14 <https://www.ncbi.nlm.nih.gov/pubmed/23413265>
- 5) Lindsley et al (2016) Viable influenza A virus in airborne particles expelled during coughs versus exhalations. Influenza and Other Respiratory Viruses 10(5), 404–413 <https://www.ncbi.nlm.nih.gov/pubmed/26991074>
- 6) NIOSH [2015]. Workplace solutions: preparedness through daily practice: the myths of respiratory protection in healthcare. By Krah J, Novak D, Stradtman L. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2016-109. <https://www.cdc.gov/niosh/docs/wp-solutions/2016-109/pdfs/2016-109.pdf?id=10.26616/NIOSH PUB2016109>
- 7) Dawei Wang, Bo Hu, Chang Hu, et al Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China, JAMA, February 7, 2020 JAMA. doi:10.1001/jama.2020.1585

- 8) Amgad A. Elkholya, Rebecca Grant, Abdullah Assirid, et al, MERS-CoV infection among healthcare workers and risk factors for death: Retrospective analysis of all laboratory-confirmed cases reported to WHO from 2012 to 2 June 2018, *Journal of Infection and Public Health* 13 (2020) 418–422
- 9) Shalhoub S, Al-Hameed F, Mandourah Y, Balkhy HH, Al-Omari A, Al Mekhlafi G.A, et al. (2018) Critically ill healthcare workers with the middle east respiratory syndrome (MERS): A multicenter study. *PLoS ONE* 13(11): e0206831. <https://doi.org/10.1371/journal.pone.0206831>
10. Damon C. Scales, Karen Green, Adrienne K. Chan, et al, Illness in Intensive Care Staff after Brief Exposure to Severe Acute Respiratory Syndrome *Emerging Infectious Diseases* Vol. 9, No. 10, October 2003
11. MacIntyre CR, Seale H, Dung TC, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open* 2015;5: e006577. doi:10.1136/bmjopen-2014-006577
12. International Safety Center. EPINet Report for Blood and Body Fluid Exposures, 2018. <https://internationalsafetycenter.org/wp-content/uploads/2019/07/Official-2018-EPINet-US-BBF-Summary-FINAL.pdf>