

Respirators, Masks and Face Coverings, Oh My!

July 21, 2020

As states and cities reopen amidst the COVID-19 pandemic, there is an increased interest and desire for an understanding of the different types and purposes of face coverings and respiratory personal protective equipment. Personal protective equipment or “PPE” is a term that has become more commonly used in recent months due to transmission of SARS-COV-2. PPE is equipment worn to minimize exposure of the wearer to hazards from various sources. PPE can include face shields, safety glasses, gloves, respirators, surgical masks, coveralls, vests, full body suits as well as fire resistant clothes, shoes, ear plugs or earmuffs, hard hats, etc. Here we are discussing respiratory PPE and cloth face coverings. PPE has been effective in protecting workforces, trades, and employees from the risk of exposure to any number of hazardous substances and chemicals in workplaces and is now being used in public life to protect against the potential exposure to infectious diseases such as SARS-Cov-2 (COVID-19). Due to the human-to-human exposure sources of coughing, sneezing, loud or close talking, and heavy breathing, infectious disease transmission may occur when aerosolized respiratory droplets enter the breathing zone and are inhaled by others. What we have learned from aerosol transmission science is that the risk of transmission in enclosed indoor spaces is much higher than the risk of transmission in outdoor, open air spaces, due to the air movement, dilution and ability to practice physical distancing. (<https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/deciding-to-go-out.html>) There have been many sources of information regarding the use, proper wear, and type of PPE and cloth face covering, leading to confusion and inconsistent usage. As the science continues to develop on COVID-19 it is increasingly clear that wearing PPE and cloth face coverings are an important component of control that can be implemented in the workplace as well as in public settings. Education on PPE and cloth face coverings is crucial in efficacy of that control. This includes educating employers, the workforce and the public on what to wear, who is being protected, how to properly fit, and where to wear PPE versus cloth face coverings is a big task and comes from numerous sources. We look to the CDC, the FDA, NIOSH, and the AIHA as reliable and creditable sources for guidance.



As designed PPE is manufactured to protect the wearer from hazardous substances and materials that cannot be removed from an environment using any other controls. Respiratory PPE is designed to protect a wearer from hazards in the air around us such as gases, hazardous substances, and particles. Respiratory PPE comes in numerous forms and include air-purifying respirators (APRs) and atmosphere-supplying respirators. These can range from supplied air respirators (SARs) and self-contained breathing apparatus (SCBAs) commonly worn by fire fighters, to filtering facepiece respirators (FFRs) which include several classes of filters such as N95 masks. Each type of respiratory PPE has an intended use and purpose for which it was



designed. Air-purifying respirators have filters, cartridges, or canisters through which air from the environment passes through, and contaminants are filtered out before they can be breathed in by the wearer. Atmosphere-supplying respirators provide clean air directly to a user from a source other than the air immediately surrounding the user, such as a tank.

https://www.osha.gov/SLTC/etools/respiratory/respirator_selection_airvsatmos_resp.html

The current public debate surrounding wearing masks, face coverings or PPE focuses primarily on 3 types: 1) reusable cloth face coverings, 2) disposable surgical masks, and 3) filtering face piece respirators (FFRs – mainly N95s). We are providing a brief summary on these three types, including the intended use, efficacy, and reasoning for wearing a mask, cloth face covering or FFR.

Filtering Facepiece Respirators (FFR's): are non-powered particulate filtering, air purifying masks. These masks are tested and certified by the National Institute for Occupational Safety and Health (NIOSH) and the filters have alpha designations such as “P”, “R” and “N” according to the ability of the filter to resist degradation when tested using liquid oil; eg. P series= Oil Proof; R series = Resistant to Oil; and N Series= “Not Oil Proof”. Further these respirators carry a numeric designation assigned to reflect the efficiency with which the filters prevent particles from penetrating the mask. NIOSH approves FFRs that have filtration efficiency levels of 95%, 99% and 99.97%. Hence a “P” series FFR with a filter efficiency of 99% is called a “P99” or an “N” series FFR with a filter efficiency of 95% is called an “N95”. (Akduman & Akçakaoç Kumbasar, 18th World Textile Conference, 2018). (<https://iopscience.iop.org/article/10.1088/1757-899X/460/1/012013/pdf>) Of the FFRs, the N95 is the most commonly used filtering facepiece respirator. Unlike cloth face coverings, FFR's are intended to protect the wearer from a variety of exposure sources including dust, particulates, airborne droplets and biohazards. FFR's do not protect against non-particulate hazards such as gases or vapors. N95 masks are designed to be tight-fitting and create a seal around a wearers nose and mouth with no inward leakage. All FFRs should be fit-tested for the individual wearer and are intended for single-use applications although there have been developments in decontamination systems for reuse. (<https://www.battelle.org>) As the COVID-19 pandemic began to spread through the United States the N95 masks, typically used by and required for use by first responders, medical personnel, and those in hazardous workplaces showed indications of limited availability and/or slow manufacturing distribution. The CDC, recognizing the desire to reserve these masks for those with the highest likely risk of heavy and repeated exposure to the virus, namely medical personnel and first responders, has not recommended N95 masks for public use. (<https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html>) The N95 masks continue to be in short supply and the public has been asked to use one of the two options below for facial coverings.

Disposable Surgical Masks have been used in the medical industry for decades, are recognizable as doctor's masks and are most often made of at least a three-ply layer of material such as

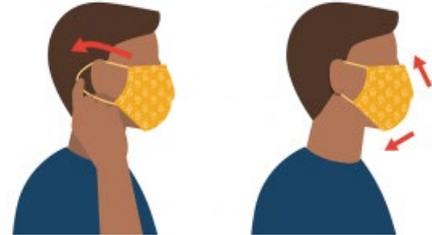
polypropylene. The Food and Drug Administration (FDA) approves brands of surgical masks for use provided they meet minimum testing criteria for fluid and pressure resistance, filtration efficiency and materials. (Akduman & Akçakaoç Kumbasar, 2018) Surgical masks are single use and not intended to be shared. Surgical masks do not form a seal around the nose and mouth and do not require fit-testing which entails a breathing test and physical. Surgical masks by design provide protection for the wearer against splashes and sprays of bodily fluids (i.e., droplets) containing potentially infectious materials. In this capacity, surgical masks are considered PPE. They are also worn to protect others, such as patients, from the spread of infection or disease by the wearer (i.e. surgeons and dentists). Surgical masks do not provide a complete protection from germs and other contaminants because of the loose fit between the surface of the mask and face. (<https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-surgical-masks-and-face-masks>) The CDC has not suggested use of surgical masks for the general public, due to the limited supplies of these types of masks and the need in health care settings. (<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html>)



Re-Usable Cloth Face Covering Masks are currently the most widely available face coverings for use by the general public. Cloth masks are face coverings designed to be washed and re-used. In contrast to FFR's and disposable surgical masks, cloth masks provide the wearer a minimal level of protection from inhalation exposure and the primary purpose of cloth face coverings are to prevent the wearer from infecting others when a wearer coughs, breathes, talks, sneezes, or laughs. For this reason, cloth face coverings are not considered to be "PPE". (<https://www.osha.gov/SLTC/covid-19/covid-19-faq.html#collapse6>) In recent months, re-usable cloth masks have become widely available for purchase from local, national, cottage industry and home-based retailers. Tutorials, video and written instructions on the production of re-usable cloth face coverings come from all different sources. The U.S. Surgeon General, Dr. Jerome Adams created a brief video on how to quickly craft a cloth face covering from common household items such as towels or t-shirts and rubber bands (<https://www.youtube.com/watch?v=tPx1yqvJgf4>) and the CDC provides step by step instructions. (<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-make-cloth-face-covering.html>)

According to a recently published study by researchers at the University of Chicago (Abhiteja Konda, et al. *Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks*. *ACS Nano* 14 (5), 6339-6347 (2020)), filtration efficiency of cloth masks improved when multiple layers of fabric were used versus a single layer, when fabrics used had high thread count and/or electrostatic properties, and when a combination of fabrics was used; eg a 600 -thread count cotton mask, with 2 layers of silk (or polyester spandex chiffon), the cloth masks had a filtration efficiency upward of 90%. (<https://www.nbcboston.com/investigations/consumer/nbc-boston-responds/making-a-homemade-mask-heres-what-fabric-you-should-be-using/2131949/>)

When planning on using a re-usable cloth face mask, a person should first wash their hands, put the mask over their nose and mouth, fit it snugly against the sides of the face without gaps and make sure breathing is easy. Ill-fitting face coverings make a large difference between being protected from and being



exposed to a hazard. (<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-wear-cloth-face-coverings.html>) When wearing a cloth mask, both the nose and mouth of the wearer must be covered. People should not touch their faces while wearing a mask, and if they do, they should wash their hands afterward. Once finished using the mask, the wearer should remove masks touching only the ear loops and place them in an area to be washed. (<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-wash-cloth-face-coverings.html>) The efficacy of reusable cloth masks lies not only in wearing masks properly but also in proper disinfection after use.

Training is essential for correct respirator, surgical mask and face covering use as it provides the wearer with knowledge regarding the capabilities and limitations of each.

(<https://www.osha.gov/Publications/OSHA3079.pdf>) For employers, a written health and safety plan should include a component on infectious disease as well as a training protocol for use of respiratory PPE and cloth face coverings. For the public, agencies such as the FDA and CDC provide extensive guidance on appropriate use and care of respiratory PPE. As with all controls, it is vital to understand that the efficacy of respirators, masks and face coverings hinges on use and wear, a concept similar to herd immunity wherein a large portion of the population (more than 50%) must wear masks in public spaces to break a cycle of transmission. (Richard O. Stutt, et al., *Proc. R. Soc. A* 476: 20200376. (<https://doi.org/10.1098/rspa.2020.0376>)).

SARS-CoV-2 has dramatically changed our environment for the foreseeable future and hopefully the use of respirators, masks and face coverings will become more universally accepted as a method to reduce transmission. As public health scientists, risk assessors and occupational professionals discover more about COVID-19 transmission in public and in workplaces, workers, employers and the public should find practical and acceptable ways to manage and mitigate our own risks and those of others to hazards in our societal environments. Changing behaviors concerning mask usage involves awareness, education, scientific understanding, and the acceptance of new social norms. The more individuals and groups wear masks the more accepted the practice becomes and exposure risk is lessened. By effectively

wearing PPE or masks in public or work environments where physical distancing is not possible, we are effectively reducing the spread of infection to COVID-19.

(https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3584834)

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