Why a Workplace Barrier Face Covering is a Bad Idea

NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy
2024, Vol. 33(4) 191–194

DOI: 10.1177/10482911231193771
journals.sagepub.com/home/new
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Editor's Note: This is a commentary on "Barrier Face Coverings for Workers" by Lisa Brosseau and Jeffrey Stull, which appeared in NEW SOLUTIONS 32(3).

Abstract

It has been proposed that enhanced cloth masks (barrier face coverings (BFCs)) be worn by workers as respiratory protection against airborne SARS-CoV-2. This commentary argues that promoting BFC use is a backward step in protecting workers. BFCs cannot meet NIOSH and OSHA respirator performance standards; superior NIOSH-approved respirators are available, and the proposal undermines the current OSHA requirement that only NIOSH-approved respirators be worn on the job.

Keywords

barrier face coverings, SARS-CoV-2, respiratory protection

The November 2022 issue of NEW SOLUTIONS published an article titled "Barrier Face Coverings for Workers." A barrier face covering (BFC) is another term for a cloth mask. The authors (Dr Lisa Brosseau and Jeffrey Stull) described an effort by a panel of respirator experts to specify minimum filter efficiency requirements for BFCs to be worn by employees in US workplaces in "low risk settings" against SARS-Cov-2.[1] Wearing these BFCs was not limited to certain employment sectors and use by healthcare workers was specifically contemplated. The impetus for the effort was the shortage of approved N95 filtering facepiece respirators (FFRs), especially for healthcare workers, at the start of the Covid-19 pandemic in 2020 to 2021. Let me offer my conclusion at the start—promoting the use of BFCs in the workplace is a bad solution to a supply chain shortage of N95 FFRs.

An *approved* particulate filter respirator is one that has been tested and certified by the National Institute for Occupational Safety and Health (NIOSH), US Department of Health and Social Services, and is intended to reduce inhalation of particulate contaminants, including particles carrying infectious agents like SARS-CoV-2. The N95 FFR is the approved respirator most commonly used by healthcare workers and was the device in short supply in 2020 to 2021. The N95 FFR is a half mask covering the face from the bridge of the nose to under the chin, and is intended to make an adequate seal to the face around its perimeter. Unlike a spray painter's half mask respirator which has an elastomeric facepiece and replaceable air-purifying cartridges, the entire facepiece of the N95 FFR constitutes the air-purifying filter. The forerunners of this class of respirators were first approved in the early 1970s by the former U.S. Bureau of Mines.

According to the general industry respirator standard enforced by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, only approved respirators may be worn against all contaminants in private-sector workplaces.[2] As part of NIOSH approval testing, a N95 filter must remove at least 95 percent of submicron-sized solid challenge particles, that is, permit no more than 5 percent filter penetration.[3] If a worker is required to wear a respirator like a N95 FFR, OSHA also requires that the fit of the respirator to the worker's face be physically evaluated by a test using a challenge agent.[4] Whenever the

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worker dons the respirator, OSHA requires that the worker assess gross face seal leakage via conducting a quick point-of-use seal check.[5] At present, NIOSH approval for a particulate filter respirator does not involve assessing facial fit of the device on a panel of test subjects. NIOSH does not test and certify BFCs.

The proposal described by the authors would test the filter efficiency of a BFC against submicron particles and permit up to 20 percent filter penetration for a "Performance Level 2" BFC, and up to 50 percent filter penetration for a "Performance Level 1" BFC. These values are 4-fold and 10-fold greater, respectively, than the filter penetration permitted by a N95 filter. They are also 667-fold and 1667-fold greater than the 0.03 percent maximum penetration permitted by an approved N100 FFR. The final proposal did not include a maximum level of face seal leakage for a BFC as determined by a physical test. Rather, the article stated that panelists believed no more than 5 percent face seal leakage "was both appropriate and achievable." In other words, it was *assumed* that face seal leakage would be no more than 5 percent. As a respirator expert, I find it highly unlikely that a cloth mask can limit face seal leakage to 5 percent. In contrast, to pass a quantitative fit test for a N95 FFR, OSHA permits no more than 1 percent face seal leakage. In brief, by the key performance measures of filter efficiency and face seal leakage, the proposed BFCs are substantially inferior to the N95 FFR or any other approved particulate filter respirator.

I characterize the worker BFC proposal as a better-than-nothing approach to preventing airborne infection. That is, should no approved respirators be available, BFCs are better than nothing. That statement is true as posed, but there were appropriate approved respirators available in 2020 to 2021. And with competent stockpiling going forward, N95 FFRs and other appropriate respirators should be available when the next airborne pathogen pandemic inevitably occurs.

To my understanding, there was never a shortage of approved elastomeric half mask respirators equipped with N100 or P100 filters, and these devices arguably allow less face seal leakage than do N95 FFRs. Unlike many FFRs, an elastomeric half mask allows a seal check to be performed, and the elastomeric facepiece and its filter cartridges are reusable over numerous work shifts. However, in the healthcare setting, wearing an elastomeric half mask is frowned upon by managers, purportedly because the respirator's appearance scares patients. Although some may find the elastomeric half mask more uncomfortable to wear than a FFR, it affords substantial advantages over the FFR for protection against an airborne pathogen that causes serious morbidity and mortality like SARS-CoV-2. Powered air-purifying respirators (PAPRs) with high efficiency filters are even more protective. In preparation for the next airborne pathogen pandemic, elastomeric half masks and PAPRs can and should be stockpiled.

Aside from there being no need to market inferior BFCs for workers, recommending their workplace use undermines the OSHA requirement that an employer provide only NIOSH certified respirators. The proposal was oriented toward using workplace BFCs as respiratory protection against SARS-CoV-2, and the authors stated that BFCs were not intended "where respirators are required for other workplace hazards." Those other hazards involve toxic particles, gases and vapors. However, if BFCs may be worn against a deadly airborne pathogen like SARS-CoV-2, why not allow wearing them against toxicants like crystalline silica, lead, and asbestos aerosols, especially if airborne exposure levels to those substances do not exceed regulatory limits? Allowing BFC use against SARS-CoV-2 or other airborne pathogens creates a slippery slope, and I contend one that can and should be avoided going forward.

The NEW SOLUTIONS authors noted that NIOSH personnel were members of the expert panel assembled in February 2021. In May 2021, NIOSH proposed guidance for 2 levels of "workplace performance masks" providing at least 50 percent and 80 percent filtration efficiency, respectively, along with quantitative limits on face seal leakage. I do not know if NIOSH indicated that these BFCs were limited to SARS-CoV-2, because the May 2021 guidance (Version 1.0) has been replaced by a June 2023 guidance (Version 2.0) titled "Making Enhanced Performance Barrier Face Coverings."[6] Version 2.0 states that enhanced BFCs are source control devices that reduce infectious aerosol emission and offer "a degree of particulate filtration to reduce the amount of inhaled particulate matter by the wearer."

Version 2.0 is silent about the circumstances in which BFCs can be worn, but a related NIOSH guidance titled "Strategies for Conserving the Supply of N95® Filtering Facepiece Respirators"[7] indicates that enhanced BFC use is a "crisis capacity strategy" when stocks of N95 FFRs are low. Enhanced BFCs are again described as source control devices for emitting infectious aerosols, *and* as devices that "reduce the amount of inhaled particulate," that is, provide respiratory protection. But in the very next sentence NIOSH states: "However, they are not meant to replace respiratory protection." This messaging impresses me as an attempt to simultaneously make an affirmative statement and disavow it—BFCs worn by workers provide respiratory protection but at the same time are not meant to be respiratory protection.

I think the reluctance of both NIOSH and the authors to acknowledge that BFCs were being proposed as respirators against an airborne pathogen was due to the following. They well understood that efforts by respirator scientists and NIOSH to improve the quality of the respirators provided to U.S. workers had been ongoing for half a century, that substantial advances had been made, and that endorsing the use of inferior BFCs was a step backwards. Frankly, I fail to understand why the expert panel and NIOSH focused on

replacing N95 FFRs with BFCs and not with elastomeric half masks as well as situational-specific PAPRs.

The reader may ask—If there is no present shortage of N95 FFRs, and if there will not be a future shortage, why would an employer want to have its workers wear BFCs? The reason is economics. Workplace BFCs would cost less to buy than N95 FFRs and other approved respirators, and if BFCs are not classified as respirators (despite their serving as respirators), employers could avoid the OSHA requirements for respirator fit testing and wearer training. The NEW SOLUTIONS authors recognized the latter circumstance when they stated that BFCs could be worn "without the programmatic requirements of a respirator for workers …" In the healthcare sector, many infection control practitioners have argued since the 1990s that surgical masks (not classified as respirators) provide the same degree of inhalation protection as do N95 FFRs. If NIOSH continues to state that BFCs provide respiratory protection against SARS-CoV-2 and airborne pathogens, in general, I foresee healthcare employers advocating for BFC use in place of approved respirators. Minutes from a November 2022 meeting of the Healthcare Infection Control Practices Advisory Committee (HICPAC), a group providing guidance to the Centers for Disease Control and Prevention (CDC) on infection control practices in healthcare settings, stated somewhat cryptically: "… there is a future question regarding how to manage the arrival of the Workplace Performance and Workplace Performance Plus masks. The WG [Working Group] has discussed holding off on that … to figure out how these best fit as a product option once they become more readily available and particularly once the FDA process becomes clearer in terms of medical utilization."[8] The interest by infection control personnel in making BFCs "a product option" is an aspect of the slippery slope to which I alluded.

As I noted, NIOSH did not specify the settings in which BFC use was appropriate. The NEW SOLUTIONS authors said that BFCs were intended for workers in "low risk settings," but did not specify what scenarios corresponded to low risk. Quantifying infection risk is fraught with uncertainty. In fact, the expert panel concluded "there was no definitive guidance in place to set specific cut-offs" (qualitative or quantitative) for what constituted low versus high infection risk settings. But if infection risk *were* quantified as a probability, the question would then become—what probability of a SARS-Cov-2 infection is low enough such that wearing a BFC rather than a NIOSH-approved respirator is acceptable? I very much appreciate that defining the acceptable risk of a deadly infection is a complicated undertaking that should involve participation by a broad range of stakeholders, and in particular, by those who face the risk on the job. I imagine that complexity was, in part, the reason the expert panel did not offer a value.

Rather than try to quantitatively or qualitatively describe what was meant by a low risk setting, the authors explained how BFCs could lengthen what they termed the "time to infection," that is, the time to receive a dose (number) of active SARS-CoV-2 imparting a 50 percent probability of infection. This dose was designated ID. Reducing the rate at which a dose is accumulated due to BFC use by a worker and/or an infectious person increases the time needed to reach the ID value. For comparison purposes, the authors used a baseline close contact exposure of 15 min, which was the CDC criterion for conducting contact tracing. The authors noted that the CDC's criterion was not supported by any scientific evidence. To be clear, the authors did *not* say that <15 min of close contact was a low risk exposure, and did *not* contend that an infection risk of, say, 49 percent for SARS-CoV-2 was low. However, I think some non-technical readers might incorrectly draw that conclusion, because it nominally seems reasonable that if the CDC did not call for contact tracing given <15 min of close contact, the CDC must believe such an exposure imparts a low risk of infection.

The authors did not fully describe their dose-infection response model, but I believe it was of the form: $R=1-(1-p)^D$, where R is infection risk [0-1], p is the probability that a single active virus deposited in the respiratory tract can cause infection [0-1], and D is the integer dose received. If D is a Poisson random variable with expected value $f\times\mu_D$, the expected risk of infection is well approximated as follows: $E[R]=1-\exp(-f\times\mu_D\times p)$.[9] In my notation, μ_D is the expected dose received without BFC use, f [0-1] is the fraction of μ_D received given the impact of an exposure control measure. If $f=1$ (no control impact) and the product $\mu_D\times p$ equals 0.693, then $E[R]=0.5$ (50 percent), and μ_D is also the infectious dose 50 percent value.

The authors were correct in stating that for $f<1$ due to BFC use by the worker and/or the infectious source, the time to accumulate ID would be increased by the factor 1/f. At the same time, it should be understood that a decrease in the dose need not produce a strictly proportionate decrease in infection risk. For example, if $p=.01$ and $f\times\mu_D,=69.2$, then $E[R]=0.50$. If $p=.01$ and f decreases 2-fold such that $f\times\mu_D=34.6$, then $E[R]=0.29$, which is less than a 2-fold decrease in risk.

In summary, the proposal described in the NEW SOLUTIONS article is a backward step in protecting workers. It advocates for workplace BFCs that cannot meet NIOSH and OSHA respirator performance standards, that are not needed for protecting against SARS-CoV-2 and other airborne pathogens, and that undermine the current OSHA requirement that only NIOSH-approved respirators be worn on the job.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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