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COMMENTARY

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Respiratory protection for health care workers: A 2020 COVID-19 perspective

Edward L. Petsonk AB, MD[1] | Philip Harber MD, MPH[2]

[1]Department of Medicine, School of Medicine, West Virginia University, Morgantown, West Virginia

[2]Community, Environment & Policy Department, College of Medicine, University of Arizona, Tucson, Arizona

Correspondence
Edward L. Petsonk, AB, MD, PO Box 4122, Morgantown, WV 26505.
Email: epetsonk@hsc.wvu.edu and leepetsonk@gmail.com

Abstract

As the US health care system began to respond to the coronavirus disease-2019 pandemic, demand for respiratory personal protective equipment (PPE) increased precipitously, as did the number of users. This commentary discusses ensuing deviations from accepted respiratory PPE program practices, which potentially increased risk to health care workers. Such lapses included omitting user training and fit testing, provision of unapproved devices, and application of devices in settings and ways for which they were not intended. The temporary compromise of professionally accepted standards due to exigencies must not become the new normal. Rather, the current attention to PPE should be leveraged to enhance practice, motivate vital research, and strengthen professional, governmental, and institutional capabilities to control health care worker exposures to infectious hazards.

KEYWORDS

COVID-19, health care workers, N95, pandemics, respiratory protective devices

1 | INTRODUCTION

In the pandemic of coronavirus disease-2019 (COVID-19), health care workers (HCWs) have marshaled their skills and courage to care for acutely ill patients, and concurrently experienced a great burden of disease and death.[1] The burgeoning need for respiratory personal protection equipment (PPE) precipitated major challenges to supply chains as need for PPE exceeded the capacity of suppliers and strategic reserves. In the United States, shortages triggered contingency and crisis standards of practice which deviated from conventional and accepted best practices.[2] Efforts are underway in the United States to overcome problems with availability and distribution of various PPE. As the role of respiratory protection becomes better defined, and the supply of respirators expands, we believe it is critically important to resume adherence to optimal protective policies and practices. This commentary briefly describes several key areas for which attention is needed.

Effective respiratory protection for HCWs is particularly critical for emerging diseases such as COVID-19, with high case fatality rates, and before modes of transmission are adequately defined and vaccines or effective treatments are available.[3] Multiple reports suggest that airborne particles with viable severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) constitute a perilous threat to HCWs.[4] Transmission may follow only brief exposures and from persons without noticeable symptoms.[5] COVID-19 patient care is frequently associated with aerosol generating activities such as intubation and respiratory therapies.

The key principles underpinning respiratory protection are based upon an extensive foundation of professional knowledge and experience including numerous experimental and observational studies over the last century.[6-8] Respiratory PPE can provide protection only when properly selected, fitted to the wearer, and correctly worn and maintained. Respiratory protection programs (see Table 1) offer users specific skills and knowledge, as well as the technical support essential for successful protection. Training is particularly key for HCWs assigned negative pressure devices, such as filtering facepiece or elastomeric respirators. All HCWs (including support staff) with potential airborne SARS-CoV-2 exposure should be considered for enrollment in a complete respiratory protection program. Program specifics and coverage should be

TABLE 1 Elements of a respiratory protection program

Selecting devices suitable for the specific hazard, tasks, and users
Fit testing for negative pressure filtering respirators
User training to achieve maximum protection
Device maintenance and cleaning
Ongoing monitoring of participant health and program adherence
Periodic program audit and evaluation

adapted based upon expert assessment of personnel hazard levels for each office/facility, from small ambulatory offices to long-term care and critical care units.

2 | DEPARTURES FROM ACCEPTED PRACTICES SHOULD NOT BECOME THE NEW NORMAL

2.1 | Replacement of N95's by surgical and procedure masks

The National Institute for Occupational Safety and Health (NIOSH) guidance indicates that surgical masks do not provide HCWs a reliable level of protection against infectious aerosols[7] and should not be substituted for N95 respirators. Surgical and procedure masks do not seal against the face, and thus permit extensive leakage of aerosols into the breathing zone. Studies have shown that many more particles leak around these masks than penetrate through the filters.[9,10] Two randomized trials of surgical masks vs N95's provided conflicting information about equivalence,[11,12] and although the quality of the evidence was rated as low, some guidelines suggest equivalence.[2] Until this controversy is resolved, HCWs at risk should be provided with fit tested N95 respirators. In addition, HCW's should never be encouraged to rely upon home sewn or other untested cloth masks and bandanas to protect themselves against COVID-19.

2.2 | Omission of fit testing

In the urgency to provide many HCWs with respirators, fit testing procedures were relaxed both for initial assignment and annual retesting.[13] To verify respirators can perform as specified, standard fit testing protocols must be reinstituted and enforced.

2.3 | Reuse of N95s

In the face of shortages, single use respirators have been repurposed as reusable equipment. Essential considerations include uniform decontamination while maintaining integrity of the filter, strap, and face seal. When faced with critical shortages, evidence-based procedures for disinfection, followed by thorough inspection for deformation, deterioration, or soiling before each use may make limited reuse an acceptable contingency practice. An urgent priority is the documentation of feasible procedures for reliable and safe reuse for each specific respirator product,[14] which also offers potential future cost savings. Guidelines are needed for safe collection, storage, and transport of masks, as well as the effective operation and maintenance of decontamination equipment.

2.4 | Use of filtering masks not certified by NIOSH

Federal regulations require masks to meet multiple test specifications to be certified as an N95. In the face of initial N95 shortages, the Food and Drug Administration issued an Emergency Use Authorization to accept devices produced by some foreign manufacturers under specific conditions. Fraudulent and unsafe devices have been reported, and many have been recalled. This loosening of respirator testing requirements should be withdrawn as the US production capacity increases and imported devices undergo the required assessments.

2.5 | Emphasis on filtering facepiece respirators vs other aerosol exposure controls

N95 respirators are an important component of HCW respiratory protection, but other controls should receive greater attention. Powered air purifying respirators (PAPRs) use a battery powered blower to filter out contaminants and provide the user with a continuous flow of clean air, usually through a loose-fitting hood or helmet. PAPRs are likely to offer greater protection and do not generally require fit testing, making them particularly desirable during rapid rollout conditions. Some HCWs have reported interference with hearing, but PAPRs are generally very well-tolerated and are perceived by HCWs to be more protective than filtering facepiece respirators (FFRs) in high-risk settings.[15] The high initial purchase cost is offset in part by a reduced ongoing need for disposable FFRs. Alternative negative pressure filtering devices such as elastomeric respirators (tight sealing and reusable by design) have higher initial cost than N95s, but may be less expensive to use in the long run. Furthermore, whenever respiratory protection is recommended, feasible engineering controls (eg, exhaust hoods for capturing exhaled materials; filtered/enclosed ventilators and suctioning systems), administrative and work practice controls (eg, minimizing personnel entering rooms of infected patient), and effective prehospital triage and isolation, should be instituted.

3 | RESPIRATORY PROTECTION PRACTICES FOR HCW IN THE CURRENT PANDEMIC NEED TO BE ADDRESSED

3.1 | Enhanced respiratory protection for particularly high-risk procedures

While a fit tested N95 can generally provide satisfactory HCW protection, high hazard procedures such as bronchoscopy and

suctioning in patients with COVID-19 may create much greater exposures and, therefore, warrant use of a more protective approach.[16,17] HCW protection in these settings is more reliably assured by a reusable PAPR functioning within specification, or alternatively, a demonstrably effective vacuum hood or other filtered local exhaust device, in combination with an N95. In addition to the greater assigned protection factor for PAPR's in comparison with other devices, PAPR's with a shrouded hood covering the head and neck provide an additional barrier to contamination.

3.2 | Program oversight and audit

Respiratory protection programs have multiple components and are designed and managed by professionals with comprehensive technical knowledge of hazard assessment, device selection and maintenance, user ability, fit testing, and program management. Occupational health professionals (eg, trained occupational nurses, physicians, and hygienists) provide unique expertise, in cooperation with infection control staff, to guide respirator selection, medical evaluation of users, fit testing, audits, and regulatory compliance.

3.3 | Irritation and subjective discomfort

Respirators or surgical masks worn continuously over an entire shift may result in noticeable discomforts. As the prominence of COVID-19 decreases, HCW discomfort may deter adherence. Conversely, the current crisis may provide a strong impetus for increasing support among HCWs and leadership for comprehensive respiratory protection programs. HCWs are demanding adequate respiratory protection, and this interest should lead to greater adherence and improved practices, as the specter of COVID-19 (eventually) abates.

3.4 | Arbitrary distinction between droplet and aerosol transmission

The early US recommendations for controlling HCW exposure were based upon the concept of droplet dispersion, in which large exhaled particles neither remain airborne nor travel far. Subsequent policies and recommendations acknowledged that aerosol transmission, with longer time suspended in the air and greater spatial dispersion, is important. Recent COVID-19 experience argues for eliminating the arbitrary distinction between infectious droplets and aerosols in transmission of respiratory disorders.

3.5 | Training and supervision

Proper placing (donning) and removing (doffing) of respirators are essential for reducing the risk of infection to the user and others. This requires specific training and regular supervision for both technique and compliance. It is particularly demanding since hand washing is necessary both before and after placing, fit checking, and removing the device.

3.6 | Organizational coordination and systems

Analyses of recent disease outbreaks (SARS 2003, H1N1 2009, and MERS 2012) have highlighted the disproportionate risk for health care system workers, and the need for strengthening governmental and commercial systems, procedures, policies, and communications, to facilitate more effective protections during anticipated future outbreaks.[8,18,19] Enhanced collaboration is desirable among the several US and international agencies responsible for testing and approval of respiratory PPE.

4 | SUMMARY

Comprehensive programmatic approaches are essential whenever respiratory protective devices are included as a part of an infectious aerosol exposure control strategy for HCWs. Prompt action is needed to remedy a number of recognized problems. Deficient approaches and short cuts can result in harm to individuals and weaken the country's capacity to provide health care. As the United States continues to progress in managing the multiple challenges of the pandemic, HCWs and their families need to be assured they are being provided the best available health protections, based upon state-of-the-art science, proven technologies, effective training, and professional program management.

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ETHICS APPROVAL AND INFORMED CONSENT

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ORCID

Edward L. Petsonk http://orcid.org/0000-0003-4877-0736
Philip Harber https://orcid.org/0000-0003-0290-4989

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