



1275 K Street, NW, Suite 1000
Washington, DC 20005-4006
Phone: 202/789-1890
Fax: 202/789-1899
apicinfo@apic.org
www.apic.org

APIC Position Paper: Extending the Use and/or Reusing Respiratory Protection in Healthcare Settings During Disasters

**Co-Authored by APIC Emergency Preparedness Committee, Public Policy Committee and
Regulatory Review Panel**

Lead Author:

Terri Rebmann, PhD, RN, CIC

Secondary Authors:

Sharon Alexander, MPH, BSN, MT(ASCP), CIC

Judene Bartley, MS, MPH, CIC

Theresa Cain, RN, IC

Barbara Citarella, RN, BSN, MS, CHCE

Michael Cloughessy, MS, BSEH, REHS, CIC

Bill Coll, M. Pub.Aff, LP

Tracy Cox, RN, CIC

Susan A. Dolan, RN, MS, CIC

Patty Gray, RN, CIC

Linda R. Greene, RN, MPS, CIC

Steve Hilley, RN

Raed M. Khoury, MA, MPH, MT(ASCP), CIC, ARM, CHSP, CPHQ, CSHA

Sharon P. Krystofiak, MS, MT(ASCP), CIC

Sue LaPointe, RN, MSED, CIC

Dianne Moroz, RN, MS CIC, CCRN

Frank E. Myers, III, MA, CIC

Michael Olesen, BS, MPHc, CIC

Patricia Rosenbaum RN, CIC

Barbara Russell, RN, MPH, CIC

Jacie Russell, MPH, CIC, CHEP

Stephen Streed, MS, CIC

Rachel L. Stricof, MT, MPH, CIC

William Wagner, ScD, CHCM, CHSP, CHEP

I. Introduction

Various types of respiratory protection are used in healthcare facilities, including reusable and disposable respirators, as well as different types of masks. Use of each requires advance planning in the event of a disaster, especially one involving an acute respiratory disease. Disasters involving an acute respiratory disease (i.e., an infectious disease disaster) consist of bioterrorism, an outbreak of an emerging infectious disease, or a pandemic. Planning for respiratory protection during an infectious disease disaster includes estimating the facility's needs related to respiratory protection supplies, assessing current supplies, having contracts or mechanisms for obtaining additional supplies, and developing policies related to use and allocation of respiratory protection when supplies are insufficient or unavailable. For example, some reusable respirators, such as



powered air purifying respirators (PAPRs), require attention to maintaining supplies of batteries and cartridges as well as proper cleaning and disinfecting. Use of N-95 respirators requires fit-testing and maintaining appropriate inventory of types and sizes used in surgical suites (valveless) as well as for patients requiring airborne precautions/isolation. Respirators used for routine care in healthcare facilities must be certified by the National Institute for Occupational Safety and Health (NIOSH); surgical/procedure masks are cleared by the U.S. Food and Drug Administration (FDA).

Respiratory protection is only one strategy for preventing infection spread during an infectious disease disaster. The Centers for Disease Control and Prevention (CDC) has outlined a hierarchy of control measures to prevent the spread of novel H1N1, with personal protective equipment (PPE) in the form of respiratory protection as the last line of defense.¹ These guidelines serve as the foundation for recommendations on extending the use and reuse of respirators outlined in this document. Other critical interventions for preventing infection spread during an infectious disease disaster include source control (i.e., eliminating potential exposures), and implementing engineering and administrative controls. Examples of interventions to eliminate potential exposures and implement engineering and administrative controls include screening patients and visitors for illness, promptly isolating potentially contagious individuals, and offering vaccinations to healthcare personnel. See the CDC's (2009) *Interim Guidance on Infection Control Measures for 2009 H1N1 Influenza in Healthcare Settings, Including Protection of Healthcare Personnel* issued 10/14/2009 (refer to CDC's H1N1 page for most current version) for a full list of control measures as well as when and how they should be implemented.¹

Respiratory Protection Supply

During past infectious disease disasters, such as the early part of the 2009 novel H1N1 pandemic, shortages of disposable N-95 respirators were reported.² Healthcare facilities and agencies must address shortages of respiratory protection in their emergency management plan, including ways to conserve respirators. It is essential that this takes place before the facility's respiratory protection supplies are depleted.

Planning

The CDC outlines four ways of conserving respirators^{1,3}; these actions need to be considered as part of the disaster planning process:

- Implement engineering and administrative controls to decrease the number of healthcare personnel who require the use of respiratory protection
- When supply of N95 respirators is limited, identify the use of alternatives to disposable N-95 respirators and use whenever feasible [noting that the priority for all types of respirators is protection of personnel during procedures that put healthcare personnel at risk from exposure, such as performing aerosol-generating procedures on patients with novel H1N1]. Alternatives to disposable N-95 respirators include the following:
 - Other NIOSH-certified N-, R-, or P-class respirators
 - Re-useable elastomeric respirators
 - Advantages: Elastomeric half-mask and full facepiece respirators can be reused and have greater durability compared to disposable respirators



- Disadvantages: These include difficulty communicating, the need for training on their use, and the inability to use them during surgical or other procedures involving a sterile field because of the device's exhalation valve
- Elastomeric respirators must be decontaminated according to the manufacturer's instructions after each use
- Powered air purifying respirators (PAPRs)
 - Advantages: PAPRs have the advantages of providing eye protection, being comfortable to wear, allowing use if the user has facial hair, and not requiring fit-testing
 - Disadvantages: These include inability to auscultate patients' heart and lungs, limited ability to communicate when wearing the device, patient apprehension (especially among pediatric patients), and the need for training on proper use and care of the PAPR⁴
 - PAPRs must be decontaminated according to the manufacturer's instructions after each use
- Extend the use and/or reuse disposable N-95 respirators (see section II below)
- Prioritize allocation of disposable N-95 respirators and surgical/procedure masks based on exposure risk (see section III below)

The following recommendations from APIC were developed from existing federal, public policy, and international agencies' guidelines including the CDC, FDA, Occupational Safety and Health Administration (OSHA), World Health Organization (WHO) and the Institute of Medicine (IOM); it is an update to 2008 APIC recommendations.⁶ This guidance is directed at extending the use or reusing disposable N-95 respirators and surgical/procedure masks since these are the types of respiratory protection most likely to be available in all healthcare settings. They are also likely to be the type of respiratory protection provided to healthcare facilities during infectious disease disasters because they are being stockpiled by federal agencies.

Assumptions

These recommendations are based on the premise that existing recommendations and guidelines are followed when supplies are adequate. It is also assumed that healthcare facilities will implement all hierarchy of controls as outlined by the CDC, including eliminating potential exposures and using engineering and administrative controls. This document only addresses extending the use and/or reusing respiratory protection; other documents should be consulted for information on other control measures needed to prevent disease spread during infectious disease disasters.^{1,3}

II. Recommendations for extending the use and/or reusing respirators

Disposable N-95 respirators, when used solely to prevent occupational exposure to *Mycobacterium tuberculosis*, can be safely reused until contaminated, damaged, or no longer form a good seal.⁵ Unlike *Mycobacterium tuberculosis*, which is transmitted exclusively via airborne droplet nuclei, most other respiratory pathogens are transmitted primarily via direct and indirect (droplet) contact with respiratory secretions. Therefore the exterior of respiratory



protection used in caring for patients with respiratory pathogens other than TB can become contaminated and serve as a reservoir for infectious agents. Special precautions must be taken when extending the use or reusing disposable respiratory protection to prevent healthcare personnel exposure.

Extended use of respiratory protection is defined as the wearing of a disposable respirator during serial patient encounters without the removal or re-donning of the device between encounters.³ Reuse of respiratory protection consists of removing and re-donning the device between encounters.³ Both of these actions pose a transmission risk to healthcare personnel due to potential respirator contamination. This transmission risk can be minimized if healthcare personnel adhere stringently to hand hygiene before and after handling the respiratory protection device.

If supplies are likely to be limited, healthcare organizations should conserve supplies as follows, considering vaccine availability for the specific pathogen:

- 1. Strongly encourage healthcare personnel to be vaccinated against the agent involved in the infectious disease disaster (such as influenza vaccine during an influenza pandemic), when such vaccine is available.** This will create an immunized cadre of healthcare personnel for whom respiratory protection will be less critical.
- 2. Extending the use or reusing respiratory protection is preferred over prioritizing the allocation of N-95 respirators and surgical/procedure masks based on exposure risk**
- 3. Extended use is preferred over reuse³**

Practices for extending the use and/or reusing a respirator:

- The respirator should only be worn and/or reused by a single wearer
- The respirator should not be removed, adjusted, or touched during patient care activities
- Avoid contamination during use by not touching the outside of the respirator
- Care should be taken to prevent touching the inside of the respirator
- The respirator should be discarded after being used during an aerosol-generating procedure
- The respirator should be discarded if it becomes grossly contaminated with the patient's body fluids, including blood or respiratory secretions. Note: this may be difficult for the wearer to discern. Healthcare personnel should be aware that even if not visibly soiled, the external surface of the respirator is considered to be contaminated
- The respirator must be discarded if it becomes obviously soiled or damaged (e.g., creased, torn, or saturated) or if breathing through the device becomes difficult
- Consider using a surgical/procedure mask⁷ or face shield³ over the respirator to reduce/prevent contamination of the device. If masks are also in short supply, face shield use should be encouraged to help conserve masks
 - Care should be taken during removal of the mask or face shield to ensure the respirator is not contaminated



- The surgical/procedure mask must be discarded after a single use. If reusable, the face shield must be decontaminated between uses
- Hand hygiene should be performed after removing the face shield or mask and before removing the respirator
- Perform hand hygiene before and after handling/touching the respirator

The following are examples of situations/locations in which extended use may be both practical and feasible when supplies are limited: triage clinics/areas, in-patient units that house large numbers of infected patients, or isolation units dedicated to patients with known or suspected infections. Each facility should conduct a risk assessment and develop a contingency plan that includes examination of their patient population, healthcare personnel immune/vaccination status, and physical structure in terms of the feasibility of implementing an extended and/or reuse protocol.

In addition to the above, the following recommendations should also be followed when reusing a respirator:

- The respirator should be removed carefully to avoid cross-contamination
- Personnel should be instructed to use hand hygiene after putting the respirator on and following removal/placement in a storage location
- The respirator should be stored in a clean, dry location that prevents it from becoming contaminated and maintains its physical and functional integrity⁸
 - Store the respirator in a breathable container, such as a paper bag, or hang the respirator in a designated area^{3,8}
 - If the respirator is to be stored in a container, the container/bag should be labeled with the user's name
 - The container/bag is a single use item because the inside can become contaminated due to storing a used respirator; therefore, the container/bag should be discarded after the respirator is re-donned⁹
 - Consider labeling the respirator with the user's name to prevent staff from reusing another's respirator; labeling should be written on the straps whenever feasible to prevent damage to the respirator⁸
- The respirator should be inspected before each use to ensure its physical integrity is intact and a seal-check should be performed by the healthcare personnel to ensure an adequate fit
 - Respirators that are damaged or cannot achieve an adequate fit during the seal check should be discarded

III. Prioritize allocation of N-95 respirators and masks based on exposure risk

If respirator/mask supplies are scarce or insufficient even after the facility has obtained additional supplies from local, regional, or national sources, examined the feasibility of reusable respirators (PAPRs, elastomeric respirators, etc.), and implemented extended use and/or reuse procedures, protocols should be followed to prioritize healthcare personnel to receive respirators/masks based on their exposure risk; *exposure risk* should be determined based on the



healthcare facility's exposure risk analysis that is part of emergency management planning, including personnel's immune status.

Healthcare organizations should develop *prioritized respirator use* protocols as follows:

- 1. Facilities should maintain a reserve stock of respirators/masks that will be used during aerosol-generating procedures and/or with patients who are known or suspected of being infected with an airborne microorganism, such as *Mycobacterium tuberculosis*. Consider a contingency plan wherein reusable respiratory protection, such as PAPRs, is available for personnel who need to care for those with suspected or active TB disease.**
- 2. Airborne-transmitted diseases:** Priority for respirator use should be given to healthcare workers providing care for patients with obligate and preferential airborne-transmitted diseases, such as active tuberculosis disease
 - Laboratory studies indicate that surgical and procedure masks do not offer appropriate respiratory protection against small particle aerosols (i.e., airborne droplet nuclei) and should not be used unless particulate respirators are not available when dealing with diseases transmitted by the airborne route¹⁰⁻¹²; *if a particulate respirator is not available, use a tightly-fitting surgical/procedure mask*¹³
- 3. Aerosol-generating procedures:** Priority for respirator use should be given to healthcare personnel performing aerosol-generating procedures^{1,3,9,14}
 - During disasters involving an airborne spread disease, aerosol-generating procedures should only be performed by staff wearing an N95 respirator or other respirator protection that is at least as protective as an N95 respirator^{1,9}
 - If the healthcare facility is completely out of respirators (disposable or reusable) and aerosol-generating procedures must be performed on a patient with an airborne spread disease, the healthcare personnel involved in the procedure should wear a surgical/procedure mask. Use of a surgical/procedure mask in this type of dire situation is preferable to using no facial protection at all. **It is important to note that this scenario should not occur;** healthcare facilities should use contingency planning to ensure they have adequate respiratory protection supplies for staff through obtaining additional respirators, utilizing reusable respirators, extending the use and/or reusing disposable respirators, and implementing control measures (such as vaccinating personnel) to decrease the need for respirators. In addition, healthcare personnel in this situation should follow infection prevention strategies to decrease their risk of infection, including following Standard Precautions and performing hand hygiene.

Aerosol-generating procedures that pose a higher risk of exposure than routine patient care activities consist of the following:

- Intubation, extubation, bronchoscopy, sputum induction, cardiopulmonary resuscitation, open suction of airways, and autopsy^{1,9,15}

Other medical procedures have been identified as having the potential to generate limited amounts of respiratory aerosols, although the risk of infection transmission associated with these procedures varies, depending on the disease involved.^{1,16} Disease-specific guidelines should be consulted when determining if the following aerosol-generating medical procedures should be considered high risk for infection transmission and thus receive priority for respirator usage:

- Administering nebulizer treatments, collecting nasopharyngeal samples, use of high-flow oxygen, positive pressure ventilation via face mask (e.g., BiPAP, CPAP), and high-frequency oscillatory ventilation^{1,16}
- When feasible, it is preferred that staff who have not been immunized against the specific agent be given priority for respirators over immunized staff when conducting aerosolizing procedures on patients who are known to be infected with the agent involved in the infectious disease disaster during times of limited supplies (i.e., non-immunized personnel should be provided a respirator; immunized personnel would be provided a surgical/procedure mask). In most situations, healthcare personnel's immune status will need to be evaluated contextually because it will not be feasible to draw titers or conduct other tests to ensure immunity quantitatively. Immunogenicity should be based on the date of vaccination and the vaccine-specific time needed to develop an immune response.

4. Healthcare personnel at risk of infectious complications: Allocating limited supplies of respirators should be prioritized for healthcare staff who are at greatest risk from complications of infections³

- The risk analysis will vary from event to event, depending on the infectious agent involved, but should include assessing the task being performed in terms of the duration and intensity of the encounter (i.e., personnel exposure risk), personnel immune/vaccination status, and personnel health status that may affect their risk of infection (such as being immunocompromised, pregnant, etc.)

5. Healthcare staff who are not in the high-exposure/priority groups (i.e., those who are not assigned to care for patients who are known or suspected of being infected with an airborne transmissible disease, involved in routine patient care that does not involve aerosol-generating procedures, and/or those who do not meet the criteria for being at high risk of complicated infection) should be provided with FDA-cleared surgical/procedure masks³

- Switching to an FDA-cleared surgical/procedure mask for healthcare staff who are not in the high-exposure/priority groups during *prioritized respirator use* mode is considered a temporary measure only. Every effort should be made to obtain additional respirators as soon as possible



6. If the facility is unable to obtain or conserve N95 respirators per the *prioritized respirator use* protocols above and/or supplies of N95 respirators are depleted despite conservation efforts:

- **Surgical/procedure masks can provide benefits against large droplet exposure, and should be worn by healthcare personnel when providing care to patients who have signs/symptoms of a respiratory illness.**¹⁷ In time of such dire shortages, they should be used in order to reduce exposure potential.
 - Select surgical/procedure masks that can be tied tightly or have elastic straps (not ear loop masks that do not form a seal)
 - Disposable surgical/procedure masks should fit the user's face tightly and be discarded immediately after use. If the mask gets wet or dirty with secretions, it must be changed immediately¹⁴
 - Perform hand hygiene before and after touching/handling the mask

7. If supplies of surgical/procedure masks are insufficient or unavailable:

- If supplies of FDA-cleared healthcare surgical/procedure masks become depleted:
 - Consider the use of full face shields that protect the wearer's eyes and mouth for staff who have been immunized against the specific agent involved in the infectious disease disaster rather than having them use a respiratory protective device when caring for a patient who is known to be infected with the agent involved in the infectious disease disaster; this will help conserve the supply of respirators/masks for personnel at high risk from complications of infection (i.e., non-immunized personnel)
 - Respirators that are FDA-cleared for general public use during public health emergencies can be used in healthcare settings, but do not provide the same level of protection as N-95 or higher level respirators; it is not known if FDA-cleared respirators are more protective than FDA-cleared surgical/procedure masks.¹⁷ Respirators that are FDA-cleared for general public use during public health emergencies should only be used in healthcare settings in dire circumstances. All other efforts at conserving and obtaining NIOSH-certified respirators or FDA-cleared surgical/procedure masks should be made before proceeding with this type of respirator in healthcare settings
 - Controversies exist regarding how to proceed when supplies of disposable N-95 or higher level respirators, FDA-cleared healthcare surgical/procedure masks, and masks/respirators that are FDA-cleared for general public use during public health emergencies are depleted/unavailable¹⁸
 - Review of the scientific literature identified a published letter detailing construction of a handmade, reusable cotton mask. This type of mask is currently available in Asia and may be constructed quickly during a pandemic if all other resources have been exhausted. Cloth/woven masks may provide some level of protection based on anecdotal and/or limited evidence.¹⁹⁻²¹ APIC hesitates to discourage their use if all other mask/respirator options have been exhausted by the healthcare facility, but cautions that these masks are not as



protective as NIOSH-certified respirators or FDA-cleared surgical/procedure masks

- Dust masks, such as those commonly sold at home improvement stores, have been shown to be less protective than NIOSH-certified N95 respirators²² and therefore should not be used in healthcare settings to prevent the transmission of infectious agents. There is no evidence regarding dust mask performance versus an FDA-cleared surgical/procedure mask in preventing infection transmission; therefore, no recommendation can be made regarding their use in healthcare facilities

IV. Regardless of the availability of respirators or surgical/procedure masks, environmental control measures, respiratory hygiene/cough etiquette, and extreme vigilance with proper hand hygiene are critical in minimizing the likelihood of exposure.

Research into respiratory protection is continuing and infection preventionists should keep abreast of developments from CDC, FDA, and IOM concerning the use of masks and respirators developed for the public in the likelihood of a pandemic or other conditions requiring respiratory protection^{7,17-21}

References

1. Centers for Disease Control and Prevention. (2009). Interim guidance on infection control measures for 2009 H1N1 influenza in healthcare settings, including protection of healthcare personnel. Retrieved October 20, 2009 from: http://www.cdc.gov/h1n1flu/guidelines_infection_control.htm
2. Rebmann, T., and Wagner, W. (in press). Infection preventionists' experience during the first months of the 2009 Novel H1N1 Influenza A pandemic. *American Journal of Infection Control*.
3. Centers for Disease Control and Prevention. (2009). Questions and answers regarding respiratory protection for infection control measures for 2009 H1N1 influenza among healthcare personnel. Retrieved October 20, 2009 from: http://www.cdc.gov/h1n1flu/guidance/ill-hcp_qa.htm
4. Centers for Disease Control and Prevention. (2006). Interim guidance on planning for the use of surgical masks and respirators in health care settings during an influenza pandemic. Retrieved November 4, 2006 from: <http://www.flu.gov/professional/hospital/maskguidancehc.html>
5. Centers for Disease Control and Prevention. (2005). Guidelines for the prevention of TB in healthcare settings. *Morbidity and Mortality Weekly Report*, 54(RR17), 1 - 141.
6. Rebmann, T., Wilson, R., Bartley, J., and Stricof, R. L. (2009). Update on infection prevention in disaster planning: New resources and policies. *American Journal of Infection Control*, 37(3), 205-255.
7. Institute of Medicine. (2006). Reusability of facemasks during an influenza pandemic: Facing the flu committee on the development of reusable facemasks for use during an influenza pandemic. Board on Health Sciences Policy. Retrieved April 26, 2006 from: <http://www.nap.edu/catalog/11637.html>
8. Occupational Safety and Health Administration. (2007). Pandemic influenza preparedness and response guidance for healthcare workers and healthcare employers. Retrieved March 14, 2008 from: http://www.osha.gov/Publications/OSHA_pandemic_health.pdf
9. Occupational Safety and Health Administration. (2009). OSHA statement re: H1N1-related inspections. Retrieved October 20, 2009 from: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=16602
10. Cooper, D. W., Hinds, W. C., Price, J. M., Weker, R., and Yee, H. S. (1983). Common materials for emergency respiratory protection: Leakage tests with a manikin. *American Industrial Hygiene Association*, 44, 720-726.

11. Weber, A., Willeke, K., Marchioni, R., Myojo, T., McKay, R., Donnelly, J., et al. (1993). Aerosol penetration and leakage characteristics of masks used in the health care industry. *American Journal of Infection Control*, 21, 167-173.
12. Pippin, D. J., Verderame, R. A., and Weber, K. K. (1987). Efficacy of face masks in preventing inhalation of airborne contaminants. *Journal of Oral Maxillofacial Surgery*, 45, 19-23.
13. World Health Organization. (2007). Avian influenza, including Influenza A (H5N1), in humans: WHO interim infection control guideline for health care facilities. Retrieved October 20, 2009 from http://www.who.int/csr/resources/publications/AI_Inf_Control_Guide_10May2007.pdf
14. World Health Organization. (2007). Infection prevention and control of epidemic- and pandemic-prone acute respiratory diseases in health care. WHO Interim Guidelines. Retrieved November 11, 2008 from: http://www.who.int/csr/resources/publications/WHO_CD_EPR_2007_6/en/index.html
15. Cal/OSHA. (2009). Cal/OSHA interim enforcement policy on H1N1 and Section 5199 (aerosol transmissible diseases). Retrieved October 20, 2009 from: http://www.dir.ca.gov/dosh/SwineFlu/Interim_enforcement_H1N1.pdf
16. Centers for Disease Control and Prevention. (2004). Severe acute respiratory syndrome. Supplement I: Infection control in healthcare, home, and community settings. Retrieved November 12, 2005 from: <http://www.cdc.gov/ncidod/sars/guidance/I/index.htm>
17. U.S. Food and Drug Administration. (2009). Masks and N95 respirators. Retrieved October 25, 2009 from: <http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/MedicalToolsandSupplies/PersonalProtectiveEquipment/ucm055977.htm>
18. U.S. Food and Drug Administration. (2007). Respirators for public health emergencies. June 12, 2007 Retrieve from: <http://www.fda.gov/consumer/updates/respirators061107.html>
19. Dato, V. M., Hostler, D., & Hahn, M. E. (2007). Simple respiratory mask. *Emerging Infectious Diseases*, 12(6), 1033-1034.
20. World Health Organization. (2004). Advice for people living in areas affected by bird flu or avian influenza. Retrieved November 27, 2007 from: http://www.who.int/csr/disease/avian_influenza/guidelines/advice_people_area/en/index.html
21. Centers for Disease Control and Prevention. (2007). Interim public health guidance for the use of facemasks and respirators in non-occupational community settings during an influenza pandemic. Retrieved May 2, 2007 from: <http://www.pandemicflu.gov/health/index.html#communities>
22. Rengasamy, S., Eimer, B. C., and Shaffer, R. E. (2008). Nanoparticle filtration performance of commercially available dust masks. *Journal of the International Society for Respiratory Protection*, 25, 27-41.

December 4, 2009