


Concise Communication

Opportunities to bridge gaps between respiratory protection guidance and practice in US health care

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Abstract

Healthcare organizations are required to provide workers with respiratory protection (RP) to mitigate hazardous airborne inhalation exposures. This study sought to better identify gaps that exist between RP guidance and clinical practice to understand issues that would benefit from additional research or clarification.

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In the hierarchy of Centers for Disease Control and Prevention/National Institute of Occupational Safety and Health (CDC/NIOSH) infection prevention and control measures, respiratory protection (RP) is an important means of mitigating healthcare personnel (HCP) airborne exposures. The Occupational Safety and Health Administration (OSHA) 1998 Respiratory Protection standard (29 CFR 1910.134) requires that employers provide workers with respirators “when such equipment is necessary to protect the health of such employee[s]” and “shall be responsible for the establishment and maintenance of a respiratory protection program.”¹

Several government agencies, professional, and trade organizations have issued guidance about the proper use of RP in the healthcare workplace (Table 1). Despite an abundance of information about what organizations must do (regulatory) and what organizations should be doing (guidance), evidence suggests inconsistent RP practices and programmatic adherence.^{2–4} Between 2009 and 2016,

the increased number of CDC/NIOSH queries led to a NIOSH-funded study undertaken by The Joint Commission to identify clinical RP issues needing additional guidance or clarification.

Methods

To guide the project, an 8-member expert Technical Advisory Panel (TAP) was convened. Issues were gathered through e-mail queries, interviews, and an electronic questionnaire. A project webpage was developed with the questionnaire link for direct submission. To solicit traffic to the webpage, several methods were used, including e-mail blasts, postings on social media, professional listservs, and flyer distribution at 5 national healthcare conferences.

Structured interviews were conducted with each TAP member and expert clinicians. All submitted data were entered into Microsoft Excel (Redmond, WA) for content analysis; each issue was counted as a discrete record. Staff grouped issues by topic area and reviewed existing guidance to identify issue-specific available answers. A list of issues was sent to each TAP member for determination as to whether the issue was a “clinical conundrum” or an “operational issue.” A clinical conundrum was defined as an issue for which there was no specific recommendation in an existing evidence- or consensus-based guideline, or where there was conflicting guidance. An operational issue was one causing practical, or programmatic implementation challenges. Descriptive frequencies were calculated for each topic area.

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PREVIOUS PRESENTATIONS: The results of this study were presented at the following conferences: (1) The Society for Healthcare Epidemiology of America (SHEA) Spring 2018 Conference on April 19, 2018, in Portland, Oregon; (2) The Association of Occupational Health Professionals in Healthcare (AOHP) 2018 National Conference on September 8, 2018, in Glendale, Arizona; and (3) The International Society for Respiratory Protection (ISRP) 2018 Conference on September 17, 2018, in Denver, Colorado.

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Table 1. Examples of Standards, Guidance, and Recommendations Related to Respiratory Protection (RP) in Health Care

Source	Reference	Focus of RP-Related Content
Occupational Safety and Health Administration (OSHA)	OSHA Respiratory Protection standard (29 CFR 1910.134). Occupational Safety and Health Administration website. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=12716 . Published April 8, 1998. Accessed March 30, 2018.	OSHA's standard on RP
	OSHA Hazard Communication standard (29 CFR 1910.1200). Occupational Safety and Health Administration website. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10099 . Published May 25, 2012. Accessed March 30, 2018.	OSHA's standard on hazardous cleaning chemicals
	Occupational Safety and Health Administration; National Institute for Occupational Safety and Health. OSHA-NIOSH info sheet: protecting workers who use cleaning chemicals. Occupational Safety and Health Administration website. https://www.osha.gov/Publications/OSHA3512.pdf . Published 2012. Accessed March 30, 2018.	
	Hospital respiratory protection program toolkit: resources for respirator program administrators. Occupational Safety and Health Administration website. https://www.osha.gov/Publications/OSHA3767.pdf . Published May 2015. Accessed March 30, 2018.	Detailed guidance for hospitals developing and implementing respiratory protection programs. Includes technical information and program templates
	PPE for emergency response and recovery workers. Occupational Safety and Health Administration website. https://www.osha.gov/SLTC/emergencypreparedness/gettingstarted_ppe.html . Accessed March 30, 2018.	RP for exposure to harmful levels of particulates, chemical vapors, biological agents, and other airborne contaminants
United States Pharmacopeia (USP)	USP general chapter 800: hazardous drugs—handling in healthcare settings. United States Pharmacopeia website. http://www.usp.org/compounding/general-chapter-hazardous-drugs-handling-healthcare . Published December 2017. Accessed December 2018.	RP for compounding, administering, spills, disposal of hazardous drugs
Association of periOperative Registered Nurses (AORN)	Guideline for surgical smoke safety. Association of periOperative Registered Nurses website. http://www.aornstandards.org/content/1/SEC22.extract . Published December 15, 2016. Accessed March 30, 2018.	RP for procedures that generate surgical smoke
Centers for Disease Control and Prevention (CDC) Healthcare Infection Control Practices Advisory Committee (HICPAC)	Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. Centers for Disease Control and Prevention website. https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines.pdf . Updated October 2017. Accessed March 30, 2018.	Describes airborne precautions and environmental and PPE requirements
	MacCannell T, Umscheid CA, Agarwal RK, Lee I, Kuntz G, Stevenson KB; Healthcare Infection Control Practices Advisory Committee. Guideline for the prevention and control of norovirus gastroenteritis outbreaks in healthcare settings, 2011. Centers for Disease Control and Prevention website. https://www.cdc.gov/infectioncontrol/pdf/guidelines/norovirus-guidelines.pdf . Updated February 15, 2017. Accessed March 30, 2018.	Protection from splashes to the face
Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH)	National Institute for Occupational Safety and Health. Recommended guidance for extended use and limited reuse of N95 filtering facepiece respirators in healthcare settings. Centers for Disease Control and Prevention website. https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html . Updated 2014. Accessed December 2018.	When extended use of respirators can be considered in the event of limited supply
Centers for Disease Control and Prevention (CDC)	Tuberculosis (TB) guidelines by topic. Centers for Disease Control and Prevention website. https://www.cdc.gov/tb/publications/guidelines/ . Updated 2018. Accessed April 6, 2018.	RP guidelines for TB
	Jensen PA, Lambert LA, Iademarco MF, Ridzon R; Centers for Disease Control and Prevention. Guidelines for preventing the transmission of <i>Mycobacterium tuberculosis</i> in healthcare settings, 2005. <i>MMWR Recomm Rep</i> . 2005;54(RR-17):1–141.	RP for all persons in the presence of patients with suspected or confirmed TB
	Interim guidance for infection control within healthcare settings when caring for confirmed cases, probable cases, and cases under investigation for infection with novel influenza A viruses associated with severe disease. Centers for Disease Control and Prevention website. https://www.cdc.gov/flu/avianflu/novel-flu-infection-control.htm . Updated January 26, 2016. Accessed March 30, 2018.	RP for novel influenza A viruses associated with severe disease

(Continued)

Table 1. (Continued)

Source	Reference	Focus of RP-Related Content
Society for Healthcare Epidemiology of America (SHEA)	Munoz-Price LS, Banach DB, Bearman G, <i>et al</i> . Isolation precautions for visitors. <i>Infect Control Hosp Epidemiol</i> 2015;36:747–758.	Recommendations for visitors of patients on droplet and airborne precautions
The Joint Commission	The Joint Commission. <i>Implementing Hospital Respiratory Protection Programs: Strategies from the Field</i> . Oakbrook Terrace, IL: The Joint Commission; 2014. The Joint Commission website. https://www.jointcommission.org/topics/respiratory_protection_hospitals_resources_practices.aspx . Published 2014. Accessed December 2018.	Recommendations and case studies to help hospitals implement RP programs
American Association of Occupational Health Nurses (AAOHN)	Respiratory protection program training and resources. American Association of Occupational Health Nurses website. http://aaohn.org/respiratory-protection . Accessed March 30, 2018.	RP course and resources about OSHA's RP standard and requirements
Individual manufacturers	Manufacturer instructions for use; guidance and locations vary according to manufacturer	Equipment use, cleaning and maintenance

Results

Overall, 34 people submitted issues across all information-gathering mechanisms, of which half submitted multiple issues. Among submitters, 13 were physicians, 7 were occupational health practitioners, 5 were respiratory therapists, 4 were infection preventionists, and 2 were nurses (3 missing). Almost half of the submitters ($n = 16$) were affiliated with academic hospitals.

A total of 95 issues were identified: 49 via the structured interview, 21 from the questionnaire and 25 from queries. The most frequently identified issues related to equipment ($n = 24$), hospital-specific practices ($n = 19$), and airborne infectious pathogens ($n = 18$) (Table 2). Also, 13 issues were answerable using published guidance, 34 were considered operational issues, and 48 required TAP determination (16 of which required additional discussion to reach consensus on whether or not it was a clinical conundrum). Ultimately, 27 issues (28.4%) were categorized as clinical conundrums and 68 issues (71.6%) were categorized as operational issues (Table 2).

Discussion

This study identified RP issues in hospital settings for which there was no specific recommendation in existing guidance as well as numerous ongoing operational issues. Frequently, submitted topics presented clinical as well as programmatic and/or operational challenges. Selection of respirators for staff with facial hair continues to cause confusion, especially in surgical or procedural settings. Respiratory protection related to visitors is another such topic. An example is how to prevent HCP exposures to family members who may be the source of a child's tuberculosis (TB). Though not supported by evidence-based guidelines, a 2014 survey of hospital epidemiologists indicated many hospitals require visitors to wear N95 respirators when entering airborne isolation rooms.⁵

Another conundrum related to ambulatory settings that may occasionally encounter patients with airborne infectious diseases (eg, urgent care). Although the OSHA standard applies to all settings, many specialized outpatient settings lack the infrastructure for robust RP programs. In such cases, the value of formal RP programs should be considered relative to the costs and likelihood of encountering such patients.

Although many guidance documents are available, published guidance is not widely recognized among HCP for a variety of reasons. Given multiple sources, it can be difficult to find the answers

to RP-related questions quickly, and not all guidance is available in the public domain. The mechanism for disseminating guidance to frontline users varies widely, which limits timely awareness in the field. For example, during public health emergencies, frequently updated information may be incomplete or confusing due to unknown mode of transmission, etc.

Frontline users also vary substantially in discipline (eg, medicine, nursing, respiratory therapy, environmental services, pharmacy, laboratory) and training. Administrators responsible for respiratory protection programs often face the dual challenge of patient care oversight and safeguarding workers and visitors, which is subject to numerous barriers including resource constraints, competing priorities, and poor safety culture. Even if recommendations and guidance were perfectly consistent across sources and were well understood, information and knowledge gaps and unanticipated situations would eventually emerge that require real-time decision making, as exemplified by the changing RP recommendations during the Severe Acute Respiratory Syndrome, Ebola and 2009 H1N1 influenza outbreak.⁶

Our findings suggest potential opportunities for improvement and longer-term solutions:

- Consolidate information. Since much guidance already exists, it may be useful to repackaging information so it is more practical and easily accessible during a public health emergency.⁷ A single, free, website resource that centralizes all guidance could be developed by key stakeholders like that done for the "Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals."⁸
- Convene experts. Consensus is needed to address key gaps in RP program operational guidance. For example, what are the best strategies for conducting risk assessments? How can medical clearance and fit-testing processes be streamlined during a public health emergency? When faced with ambiguous situations and incomplete information, it often makes sense to base RP decisions on the "precautionary principle."⁹ When and how to step down to less intensive precautions are equally important.⁷
- Improve safety culture. Healthcare leaders should promote a culture of safety for HCP and patients. Empowering people to speak up when witnessing unsafe practices helps establish new norms for the desired behaviors.
- Pursue pragmatic research. Translational effectiveness research is needed to help solve clinical or technical

Table 2. Summary of Issues and Examples of Clinical Conundrums and Practical Challenges

Topic and Subtopic	Issues Lacking Guidance or Guidance Conflicts (Conundrum)		Issues Causing Practical Challenges With Guidance (Operational)	
	No. Received	Example	No. Received	Example
Airborne infectious pathogens (n = 18)				
Emerging pathogens (novel or unknown pathogens)	1	How do you prepare for RP related to unknown or novel pathogens?	1	Where should healthcare organizations or staff go for advice regarding respiratory protection during outbreaks associated with novel pathogens?
Known pathogens sometimes requiring RP (eg, measles, zoster, influenza)	3	What is the preferred type of RP for HCW related to suspected measles? What RP should family members and visitors use? How is it affected by immune status?	5	Should N95 respirators be used for influenza?
Known pathogens for which there is a lack of scientific consensus on need for RP	2	Are respirators needed during podiatric procedures on patients with fungal infections on their foot?	2	Are there situations in which aerosolization of norovirus occurs (eg, toilet flushing or violent vomiting)? Is RP needed?
Known pathogens always requiring respiratory protection (eg, TB, MERS, SARS)	1	If family member is the likely source of TB, what RP is required for protecting HCW from becoming exposed through contact with families?	2	In pediatric patients with TB, are the requirements different from adults?
Known pathogen not requiring respiratory protection	0	N/A	1	What respiratory protection is needed for patients diagnosed with rhinovirus?
Procedure-related (n = 13)				
Aerosol-generating procedures	0	N/A	4	What RP is needed when performing bronchoscopies?
Surgical smoke	2	What is needed for laser procedures on patients with HPV?	0	N/A
Procedures performed in surgical suite	4	How should one handle staff who fail N95 fit testing but need respiratory protection while maintaining a sterile surgical field (thus cannot use a PAPR)?	0	N/A
Procedures performed outside the surgical suite	2	What type of RP should be used in the MRI suite (especially when some have metal components)?	1	What type of RP is needed for air medical transport staff?
Hazardous materials (n = 13)				
Hazardous medication aerosolization, compounding and/or administration	4	What type of RP is needed when compounding or administering hazardous drugs? USP requirements differ for whether the drugs are in powder (regular N95) or liquid form (surgical N95).	3	What RP is needed for staff working with Ribavirin, Gentamycin, Amikacin, Tobramycin, Amphotericin B? What about pediatric doses of ribavirin?
Handling and spill containment of hazardous medications	0	N/A	2	What do you do if the respirators in chemo spill kits are different from those respirators on which staff were fit tested?

(Continued)

Table 2. (Continued)

Topic and Subtopic	Issues Lacking Guidance or Guidance Conflicts (Conundrum)		Issues Causing Practical Challenges With Guidance (Operational)	
	No. Received	Example	No. Received	Example
Hazardous chemicals used for cleaning, disinfecting and sterilization agents	0	N/A	3	How do you ensure people know when respirators are needed with floor cleaning chemicals, particularly those being sprayed?
Other (eg, formaldehyde, oily aerosols)	0	N/A	1	What type of RP is needed for exposure to oily aerosols?
Equipment-related (n = 24)				
Eye protection	1	How do you overcome challenges with poor fit when wearing N95 with goggles?	0	N/A
Respirators	2	Can EHFR cartridges be decontaminated?	16	How do you handle employees who cannot pass a fit test due to facial hair?
Environment	0	N/A	4	Are there ventilation and airflow systems that better protect workers?
Supply shortages	0	N/A	1	Is there really sufficient supply for a pandemic?
Regulatory requirements (n = 8)				
Fit testing	1	How do you determine who needs to be fit tested? Are there tools and templates for conducting a risk assessment, other than the one that exists for TB?	4	Do EHFRs require fit testing?
Medical clearance	0	N/A	2	Is there a better process? The current questionnaire is too time consuming and clearance process is not effective.
Other	1	Are nonhospital settings required to have respiratory protection programs (eg, ambulatory and dialysis settings)?	0	N/A
Other (n = 19)				
PPE use when transporting patients	0	N/A	1	What type of PPE is needed for both staff and patients when transporting a patient with active TB?
Not healthcare worker related (eg, visitors, patients)	3	How do you protect visitors entering isolation rooms? What type of RP is needed for immunocompromised patients and their visitors?	4	Visitors see staff wearing respirators in room but when patient comes out of the room he or she is wearing a mask. How do you explain and educate others about this?
Related to current practices at healthcare organizations	0	N/A	11	What do you do when workers do not feel comfortable letting managers know that PPE is not available when needed or that RP is not being used when it should be?


Note. RP, respiratory protection; HCW, healthcare worker; TB, tuberculosis; MERS, Middle Eastern respiratory syndrome; SARS, severe acute respiratory syndrome; HPV, human papilloma virus; PAPR, powered air purifying respirator; MRI, magnetic resonance imaging; USP, United States Pharmacopeia; EHFR, elastomeric half-face respirator; PPE, personal protective equipment.

conundrums, such as RP for fungal infections, surgical smoke, and contingency planning for shortages, including reprocessing. Research is underway on improved respirator designs that address user discomfort and clinical assessment challenges.¹⁰

To our knowledge, this is the first attempt to identify clinical issues in which clarification of RP guidance might be needed from a wide range of stakeholders. Nevertheless, our study has several limitations. We cannot assume that the results are generalizable or that the issues are comprehensive, and we may have missed existing guidance pertaining to clinical conundrums.

Our findings are consistent with those of Peterson *et al.*⁴ in that hospital staff were often unclear about which type of RP was needed and about when and how to use it. Challenges related to respirator discomfort (eg, heat, diminished visual field, and communication difficulties) are similar to findings from previous research regarding respirator tolerability.³

Finding answers to clinical conundrums, operational programmatic gaps, and practice gaps should be addressed through future research, education, and policy initiatives. Addressing these issues is the first and necessary step to improved RP. The health and safety of healthcare workers and patients depends on it.

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References

1. OSHA Respiratory Protection standard (29 CFR 1910.134). Occupational Safety and Health Administration website. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=12716. Published 1998. Accessed March 30, 2018.
2. Yarbrough MI, Ficken ME, Lehmann CU, *et al.* Respirator use in a hospital setting: establishing surveillance metrics. *J Int Soc Respir Prot* 2016;33:1–11.
3. Radonovich LJ Jr, Cheng J, Shenal BV, Hodgson M, Bender BS. Respirator tolerance in health care workers. *JAMA* 2009;301:36–38.
4. Peterson K, Novak D, Stradtman L, Wilson D, Couzens L. Hospital respiratory protection practices in 6 US states: a public health evaluation study. *Am J Infect Control* 2015;43:63–71.
5. Munoz-Price LS, Banach DB, Bearman G, *et al.* Isolation precautions for visitors. *Infect Control Hosp Epidemiol* 2015;36:747–758.
6. Institute of Medicine (US) Committee on Respiratory Protection for Healthcare Workers in the Workplace Against Novel H1N1 Influenza A; Liverman CT, Harris TA, Rogers MEB, Shine KI, editors. *Respiratory Protection for Healthcare Workers in the Workplace Against Novel H1N1 Influenza A: A Letter Report*. Washington, DC: National Academies Press; 2009.
7. HICPAC meeting minutes. Healthcare Infection Control Practices Advisory Committee (HICPAC) website. <https://www.cdc.gov/hicpac/pdf/2017-November-HICPAC-Meeting-508.pdf>. Published November 2017. Accessed April 6, 2018.
8. Yokoe DS, Anderson DJ, Berenholtz SM, *et al.* Introduction to “A compendium of strategies to prevent healthcare-associated infections in acute care hospitals: 2014 updates.” *Infect Control Hosp Epidemiol* 2014;35:S1–S5.
9. Martuzzi M, Tickner JA, editors. The precautionary principle: protecting public health, the environment and the future of our children. World Health Organization website. http://www.euro.who.int/_data/assets/pdf_file/0003/91173/E83079.pdf, p. 7. Published 2004. Accessed October 20, 2017.
10. Gosch ME, Shaffer RE, Eagan AE, Roberge RJ, Davey VJ, Radonovich LJ Jr. B95: a new respirator for health care personnel. *Am J Infect Control* 2013;41:1224–1230.