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EXPERT OPINION

Respiratory Protection: Lessons Learned from a Global Pandemic

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Abstract: The COVID-19 pandemic exposed the limitations of global health systems' abilities to manage the rapid spread of a novel infectious disease, which was exacerbated by shortages of respiratory protective devices and other critical personal protective equipment (PPE). An advisory panel of experienced health-care professionals with backgrounds in Occupational and Environmental Health and Safety (OEHS), Infection Prevention, Nursing, and Clinical Application Specialists convened to discuss challenges and strategies associated with the selection and use of respiratory protective devices as experienced during the first year of the COVID-19 pandemic. This discussion led to the following recommendations: 1) the need for clear communication of alternative respiratory protection selection and use recommendations in accordance with US regulatory and agency guidance; 2) the need for collaboration between Infection Prevention, OEHS, clinical staff, supply chain/materials management, emergency preparedness, executive leadership, and finance; 3) the need for adequate stockpiling, inventory rotation, and diverse respiratory protection options to accommodate the majority of health-care workers; 4) the need for efficient and innovative strategies to communicate evolving regulatory, agency, and facility recommendations and to deliver appropriate training on respiratory protection; and 5) the need for additional research on respiratory protection use – involving filtering facepiece respirators (FFRs) as well as other respirator types designed to be reused – to balance infection prevention best practices with a sustainable process. In conclusion, these considerations may offer guidance and identify areas for research on preparedness, communication, education, and training to enhance the preparation of health-care facilities including community-based health-care organizations for unexpected public health events.
Keywords: COVID-19, personal protective equipment, PPE, filtering facepiece respirator, infection prevention, environmental health and safety, nursing

Introduction

The onset of the COVID-19 pandemic caused by the coronavirus SARS-CoV-2 resulted in unprecedented challenges to health-care systems and health-care professionals around the world.[1] This was exacerbated by shortages of critical personal protective equipment (PPE), including respiratory protective devices.[2]

Filtering facepiece respirators (FFRs) are used in health care to help reduce wearers' inhalation exposure to airborne biological hazards, including infectious particles such as those containing *Mycobacterium tuberculosis, Measles virus*, and Betacoronavirus. In the United States, the selection and use of respirator types and models can vary by institution due to clinical criteria or hazard and must align with the US Occupational Safety and Health Administration (OSHA) standards, which govern the selection and use of respirators in the workplace. Questions surrounding the selection and use of respirators in both the hospital and community health-care settings abounded early in the pandemic. As information was developing, organizations such as the World Health Organization (WHO), the United States (US) Centers for Disease Control and Prevention (CDC), the US National Institute for Occupational Safety & Health (NIOSH), the US Food and Drug Administration (FDA), OSHA, and others updated and communicated rapidly evolving requirements and recommendations for respirator selection and use.

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Faced with various, overlapping, and sometimes conflicting requirements and recommendations, many health-care institutions and health-care workers (HCWs) were challenged with the implementation and communication of these dynamic requirements. They also struggled to distribute, educate, and train personnel in alignment with the requirements in conjunction with their available supply of FFRs; or find other alternatives such as powered air-purifying respirators (PAPRs) or reusable elastomeric respirators (RR).[3]

The focus of this panel was to develop recommendations for: 1) the selection of respiratory protection, 2) education on the use of respirators, 3) communication strategies for rapidly changing guidance and policy, and 4) the stockpiling/storage of respiratory protection for future public health emergencies.

Materials and Methods

Panel Selection

An advisory panel comprised of six professionals actively supporting a variety of health-care organizations was selected by 3M Medical Solutions Division to discuss their experiences with the use of respiratory protection during the COVID-19 pandemic. The participants represented professionals with expertise in OEHS (MF), Infection Prevention (KMM and EK), Critical Care/Intensive Care Nursing (AVP), Community Health Nursing (CJ), as well as manufacturer Clinical Application Specialists (CJ and WL). The advisory panel convened in St. Paul, Minnesota, on March 3, 2022.

Literature Search and Review

A literature search was conducted by keyword searches in PubMed, EMBASE, etc., utilizing the following keywords or phrases: "Pandemic and N95" or "N-95" or "N95 Respirator" or "N-95 Respirator" or "N95 Surgical Respirator" "Elastomeric or reusable respirator" or "Personal Protective Equipment" or "PPE" or "Powered Air-purifying Respirator" or "Powered Air Purifying Respirator" or "PAPR" or "Respirator" or "Filtering Facepiece Respirator" or "FFR" or "Respiratory Protection". Prior to the meeting, each panel member was provided with the literature review. The eight (8) references and three (3) guidelines were selected based on their relevance to the use of respiratory protective devices in the medical field.

The objectives of the meeting were the following: (1) Review how the COVID-19 pandemic impacted health-care management of respiratory protection through each of the following lenses: patient care needs and considerations; available respirator options during surge demand; respiratory protection program management requirements; and regulatory, agency, and facility guidance. (2) Share professional experiences with successes and challenges such as HCW perceptions and concerns. (3) Provide recommendations and strategies to support health-care facilities during surge and crisis scenarios related to care delivery and selection and use of respiratory protective devices. The following study is qualitative in scope as the reported findings of the panelists were derived from their respective experiences.

Results

A literature search was conducted to obtain references relevant to the scope of the advisory panel's discussion. Variations of the literature search terms were used to narrow the search to eight key references and three guidelines.[1,3–12] The panelists presented their respective experiences and challenges based on their expertise. Their experiences were framed around changes related to pre-pandemic versus during the early pandemic (March 2020-October 2021) (Table 1), and major challenges encountered during the COVID-19 pandemic (Table 2).

The discussion of this panel led to the following recommendations (Box 1).

- During respiratory protection surge demand circumstances, alternative respiratory protection selection and use recommendations in accordance with US or other country/local regulatory and agency guidance need to be clearly communicated.
- The need for effective and ongoing collaboration between Infection Prevention and Occupational and Environmental Health and Safety, including a broader multidisciplinary team of stakeholders.
- Adequate stockpiling, inventory rotation, and a mix of respiratory protective device options that will accommodate most health-care workers are necessary.

- Efficient and innovative strategies to effectively communicate evolving regulations and recommendations, as well as to deliver appropriate training, are needed. Facilities should look to the respirator manufacturer to help educate on model-specific use instructions and to help identify current implementation guidelines and regulations.
- Additional research is necessary on filtering facepiece respiratory protection usage to balance infection prevention best practices with a sustainable process.

Additionally, through advisory panel consensus, a communication framework (Figure 1) was developed to help provide direction when relaying guidance, policy, education, and any important complex information to a large volume of people within health

Table 1 Panelist Experiences – Pre-COVID-19 Pandemic Vs During COVID-19 Pandemic: Selection, Storage, Usage of Respiratory Protection Equipment

Before COVID-19 Pandemic	During COVID-19 Pandemic
OEHS Management	
LOW demand for surgical FFRs	Extremely HIGH demand for NIOSH-approved surgical FFRs
Limited or no use of reusable elastomeric respirators (RR) in patient care areas– PAPRs often reserved for highly infectious diseases (eg, Ebola), staff who could not wear tight fitting respirators, or other respiratory hazards in non-patient care areas.	Increased use of reusable elastomeric respirators (RR) and PAPRs to help combat or relieve demand for FFRs
Disposable culture, short use of FFRs, typically disposed of after every patient encounter or doffing.	Implemented extended use and limited re-use policies for FFRs per CDC guidelines. Implemented decontamination policies for FFR re-use according to FDA emergency use authorization; since expired June 2021
Limited and sometimes intermittent collaboration with supply chain coordinators	Enhanced and frequent collaboration with supply chain coordinators
Limited FFR models stocked – primarily to accommodate different face sizes	Welcomed stock of many alternatives to NIOSH-approved FFR models to combat shortages
Local supply relegated to central supply/availability on isolation carts	Supply more tightly controlled
Use of NIOSH-approved respiratory protection for airborne infectious particles in clinical areas and other respiratory hazards in non-clinical areas	Considered other options such as high-quality, tight-fitting masks or non-NIOSH-approved FFRs for facilities and support personnel not in direct contact with patients to combat demand for NIOSH-approved FFRs.
Infection Prevention	
Patient diagnosis and national transmission-based precaution guidelines drove requirements for usage of NIOSH-approved FFRs and other respirator types for patient care	Allocation of NIOSH-approved FFRs, very little evidence-based guidance available to drive recommendations on usage of non-NIOSH-approved FFRs
Nursing	
Limited use of NIOSH-approved surgical FFRs and PAPRs for clinical/patient care for those with airborne infectious diseases in acute care	Use of non-NIOSH-approved and different models of FFRs in hospitals and community care setting Introduction on the use of elastomeric respirators, especially as re-use policies were implemented
NIOSH-approved surgical FFRs were single use only	Extended use and re-use of NIOSH-approved FFRs became standard practice
Local supply managed and distributed by central supply departments	Charge Nurse or managers (hospitals) and nurses (community care) managed local distribution of FFRs

Abbreviations: CDC, Centers for Disease Control and Prevention; FDA, Food and Drug Administration; FFR, filtering facepiece respirator; NIOSH, National Institute for Occupational Safety & Health; OEHS, Occupational and Environmental Health & Safety; PAPR, Powered Air Purifying Respirator.

Table 2 Major Challenges Encountered by Panelists During COVID-19 Pandemic

OEHS and Infection Prevention	Nursing
NIOSH-approved FFR supply shortages Introduction of new FFRs as alternative supply	Stocking and maintaining FFR supply
Communication of quickly changing and complex regulatory and agency guidance related to respiratory protection. Including extended use and reuse.	Keeping abreast of rapidly changing guidelines from multiple sources related to respiratory protection
Challenges with fit of non-NIOSH-approved FFRs which were made available by US FDA EUA to help increase the supply of respirators in the US.	Lack of supply of familiar respirators
Improper donning/wear FFRs (eg, masking over FFRs)	Communicating with patients while wearing respirators
Slow adoption of RR usage	Overcoming patient anxiety when treating while wearing respirators
Proper cleaning and disinfection of RR and PAPR– health care vs industrial setting	Potential for discomfort related to prolonged usage of respirators.
Safety concerns related to reuse and extended use	Safety concerns related to reuse and extended use
Returning to conventional (pre-COVID-19) policies	Returning to conventional (pre-COVID-19) policies
Maintaining focus on proper fit Lack of fit testing (and seal checks) in health care setting (misinterpretation of OSHA directives on annual fit testing)	Educating public about COVID-19 and need for respiratory protection.

Abbreviations: EUA, Emergency Use Authorization; FDA, Food and Drug Administration; FFR, filtering facepiece respirator; NIOSH, National Institute of Occupational Health; OEHS, Occupational and Environmental Health & Safety; OSHA, Occupational Safety and Health Administration; PAPR, Powered Air Purifying Respirator; RR, Elastomeric Reusable Respirator; US, United States.

Box 1 Advisory Panel Recommendations on Respiratory Protection Needs of Health-Care Workers in Clinical or Community Settings During a Global Pandemic

Recommendations
• During respiratory protection surge demand circumstances, alternative recommendations related to respiratory protection selection and use in accordance with US regulatory and agency guidance needs to be clearly communicated. • The need for effective and ongoing collaboration between Infection Prevention and Occupational and Environmental Health and Safety including a broader multidisciplinary team of stakeholders. • Adequate stockpiling, inventory rotation, and a mix of respiratory protective device options that will accommodate most health care workers are necessary. • Efficient and innovative strategies to effectively communicate evolving regulations and recommendations as well as deliver appropriate training are needed. Facilities should look to the respirator manufacturer to help educate on current implementation and use recommendations. • Additional research is necessary on filtering facepiece respiratory protection usage to balance infection prevention best practices with a sustainable process.

care. This framework, designated as SAARA, would encompass HCW messaging that would: distill voluminous material into concise, need-to-know information; designate a primary communicator/team to deliver prepared and accurately referenced statements; offer an array of media or communication methods to accommodate diverse means of information consumption; provide relevant, timely, want-to-know information within "living documents" that may be easily found and revised as needed; and only relay information to the recipient that is practical and actionable.

Discussion

The discussion of this panel led to several recommendations to help navigate changing dynamics with respiratory protection selection and use, collaboration between departments responsible for supporting worker health and safety,

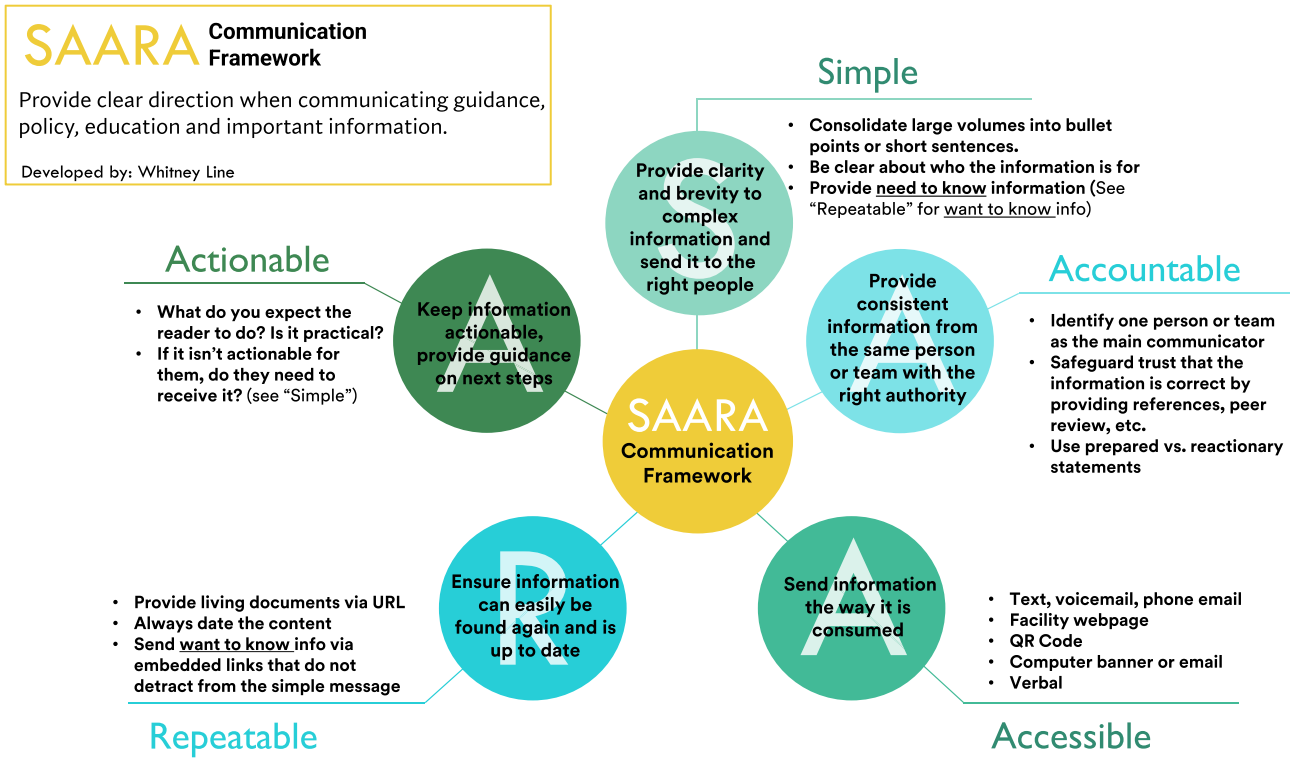

Figure 1 The SAARA Communication Framework (developed by Whitney Line, BSN, RN, PHN) aims to enhance messaging for facility-/field-based health care workers by improving the relay of guidance, policy, education, and important complex information.

devising communication strategies to convey rapidly changing guidance and provide training, as well as the need for continued research to balance infection prevention with a sustainable process.

1. During Respiratory Protection Surge Demand Circumstances, Alternative Recommendations Related to Respiratory Protection Selection and Use in Accordance with US Regulatory and Agency Guidance Needs to Be Clearly Communicated

In early 2020, due to a spike in demand for PPE in the United States during the COVID-19 public health crisis, the CDC, NIOSH, FDA, and OSHA regularly updated guidance on the selection and use of respiratory protection in health care, balancing optimization of respirator supply with preservation of health-care workers' health and safety. To guide US health-care facilities' use of PPE, these agencies published numerous documents and tools, such as the Strategies for Optimizing the Supply of N95 Respirators[3] (CDC), Technical Report on Filtering Facepiece Respirators with an Exhalation Valve[13] (NIOSH), Emergency Use Authorizations[14] (FDA), and Temporary Enforcement Guidance on Annual Fit Testing[15] (OSHA). Most guidance was intended to be time-limited to the COVID-19 public health crisis and stressed the importance of returning to conventional infection prevention practices once PPE availability increased. Guidance could be revoked or modified at any time as these agencies continued to assess community transmission, hospitalization rates, and PPE availability.

The information contained in the above documents is thorough and plentiful. To ensure compliance with ever-changing regulations and guidance was time-consuming and labor-intensive, often falling to a small number of staff in employee health, safety, or infection prevention. It required a baseline knowledge of US regulating bodies and how they work together, keeping abreast of daily updates to documents, and cross-referencing agencies and best practice groups. At times, it also required sorting through conflicting guidance from multiple Federal agencies. This then required synthesizing information applicable to a specific region, health-care system, hospital, etc. Subsequently, decisions had to be made on allocating the limited on-hand FFR supplies while trying to comply with evolving guidance and adhere to

manufacturer's user instructions. Many of those within health-care systems became overwhelmed, lacking the resources to effectively manage this challenge in addition to their already demanding workload.

Health-care facilities needed additional support to interpret, synthesize, and disseminate the above information to their workforce. Information is often cascaded via staff meetings, telephonic communications and voice messaging, email, or text message. Historically, any changes in an acute care setting are communicated through daily huddles between RN Managers/Supervisors/Charge Nurses and floor staff, hard copy memos posted throughout the unit, or via online learning modules. The receipt of necessary information in a timely, accurate, and accessible manner proved to be challenging, especially for many staff who were working in new capacities, units, roles, or facilities. Also, many nurses do not work a standard schedule or in fixed facilities (eg, community health nurses), and yet still require respirators and information to help protect them from SARS-CoV-2.

HCWs need credible and accessible information to know which type of respirator is most appropriate for use, based on the anticipated hazard and clinical environment and according to the current best practice guidance for use and reuse. This includes a need for education and training on alternative respiratory protection types, such as reusable elastomeric respirators (RR) and Powered Air Purifying Respirators (PAPRs). The OSHA Respiratory Protection Standard 29 CFR 1910.134 requires specific outcome requirements for respirator training.[10] Based on the experiences of the panelists, it is important that training for health-care end users addresses the following outcomes: the ability to a) correctly indicate the acceptable respirator type according to the anticipated hazard and clinical environment; b) describe how each respirator the employee may wear functions; c) properly use respirators, including any limitations on their use specific to the clinical environment; d) properly don and doff according to manufacturer's user instructions, including an emphasis on actions or situations that may impact the effectiveness of the respirators (eg, facial hair, alteration of the respirator, etc.); e) identify individuals available to assist in troubleshooting as needed; and f) display proper reuse techniques according to manufacturer's instructions, US agency guidance, and US regulatory requirements, including OSHA regulations and infection prevention strategies to help reduce the risk of cross-contamination. This should include a thorough understanding of cleaning and maintenance requirements for reusable respirators.

2. The Need for Effective and Ongoing Collaboration Between Infection Prevention and Occupational and Environmental Health and Safety, Including a Broader Multidisciplinary Team of Stakeholders

Prior to the onset of the pandemic, the primary focus of infection prevention (IP) was promoting the safety of the patient and staff during patient care by helping to reduce the risk of transmission of health-care-associated infections and other infectious diseases. More broadly, overall HCWs' health and safety was primarily the responsibility of OEHS. In some cases, the respective roles of IP and OEHS were siloed, as their responsibilities and priorities varied. During the pandemic, the health and safety of HCWs was prioritized, and it became broadly recognized that this had profound implications for patient safety and maintenance of a sustainable workforce. Given shared priorities and the evolving challenges of the pandemic, it became apparent that enhanced and ongoing collaboration between OEHS and IP was necessary to support a culture of safety for both HCWs and patients. This partnership remains critical as a strategy to help ensure readiness for additional public health emergencies, provision of safe patient care, and maintenance of a sustainable workforce.

Additionally, it is critical that these two functions, along with other key stakeholders, are included as decision-makers related to PPE. During the COVID-19 pandemic, in some cases, decisions were made at the state level. For example, in New York and California, as part of the states' Surge and Flex emergency preparedness requirements, hospitals and nursing homes were required to maintain a 60-to-90-day supply of PPE at a usage rate equal to the average daily rate that PPE was used between April 13, 2020, and April 27, 2020.[16–18] State requirements notwithstanding, the pandemic demonstrated that consideration should be given to establishing a multi-disciplinary team(s) to make decisions on what would constitute an adequate PPE supply, based on a risk assessment, risk tolerance, and usage rates. Members of the team should include, for example, representatives from IP, OEHS, clinical and/or nursing staff, supply chain/materials management, emergency preparedness, executive leadership, and finance.

3. Adequate Stockpiling, Inventory Rotation, and a Mix of Respiratory Protective Device Options That Will Accommodate Most Health-Care Workers are Necessary[19]

During the COVID-19 pandemic, respirator demand drove many facilities to work with unfamiliar suppliers and purchase respirator models for which their employees had not been previously fit tested. Many suppliers and supply contracts limited the quantity of respirators that facilities could purchase at one time. Despite conservation and re-use measures, many facilities continued to experience significant shortages of respirator supplies relative to demand. To offset similar supply chain pressures in the future, panel participants noted the need for facilities to establish a diverse respirator inventory consisting of respirators with characteristics that would accommodate most health-care workers. The need to maintain an adequate stockpile of respirators and to identify multiple suppliers/distributors was also discussed.[20]

As no single respirator will fit 100% of the population, more than one respirator model is needed to help protect staff. The OSHA Respiratory Protection Standard requires that employees be allowed to choose respirators from a "sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user".[10] OSHA does not currently define "sufficient number". It is the employer's responsibility to determine how many respirator models are sufficient to fit their employee population. In practice, budgetary constraints, inventory logistics, and purchasing contracts often limit the number of respirator models available to employees.

The influx of different respirator models led to a need for increased fit testing, which impacted staff resources and time. Data-supported manufacturer information regarding fit for different respirators, such as the percentage of the typical workforce a respirator may successfully fit, should be made available to facilitate respirator selection. Data specific to the health care workforce demographics would be even more useful. This information would allow facilities to choose respirators having a high likelihood of fitting, and consequently, it could help to maximize safety. Higher rates of successful first fit tests could also reduce the amount of staff time required for fit testing and potentially decrease associated costs and waste. Finally, making manufacturer fit data available could also help promote the evolution of respirator design.

Respirator supply, inventory, and fit testing challenges during the pandemic highlighted the utility and dependability of reusable elastomeric respirators (RR), which are designed to be cleaned, disinfected, and reused countless times during their useful life. Health-care organizations that had built robust RR programs reported more secure respirator availability and often higher confidence among health-care workers in their respirators' effectiveness.[19,21] Best practices should be explored and shared regarding cleaning and disinfecting programs as well as filter reuse, handling, and storage.

PPE shortages highlighted the role and importance of supply chain and materials management staff. Facilities struggling to maintain adequate supplies of PPE looked to their supply chain staff to provide finely tuned data necessary to calculate their "burn rates". Pre-pandemic, many facilities relied on "just-in-time" inventory management systems to minimize the space and costs associated with storing materials. There is a need to re-visit and adjust this approach when it comes to PPE. To maintain an ongoing adequate supply of respirators, facilities need to periodically review detailed data on burn rates under varied conventional, contingency, and crisis capacity guidance.[3] The application of a robust inventory management structure is needed, to maintain and rotate a stockpile that will help ensure a consistent state of readiness to meet demand. Such structures would also need to identify, validate, and maintain relationships with multiple suppliers and distributors.

4. Efficient and Innovative Strategies to Effectively Communicate Evolving Regulations and Recommendations as Well as Deliver Appropriate Training are Needed. Facilities Should Look to the Respirator Manufacturer to Help Educate on Model-Specific Use Instructions and to Help Identify Current Implementation and Use Guidelines and Regulations

During rapidly changing guidance or practice considerations, the panel recommends that communication should be disseminated consistently, be kept simple and brief, be applicable and practical, and be derived from a centralized source. Through advisory panel consensus, a communication framework (Figure 1) was developed to help provide direction when communicating guidance, policy, education, and any important complex information out to a large volume of people within health care: Simple, Accountable, Accessible, Repeatable, Actionable (SAARA).

Education and training on respiratory devices should ideally be conducted in the working environment and incorporate the realities unique to the work being conducted. Education and training should be performed as shifts change for the day. Where possible, information should be provided utilizing the "Rule of Seven" to communicate the message using seven different modalities.[21] This can include flyers, fact sheets, QR code postings, etc. Training on the use of respirators should be ongoing and

include the importance of conducting a seal check with each donning. There should be an ongoing monitoring of "in the field" donning and doffing of respirators to address potential "relaxing" of proper use. If needed, non-essential service workers should also be trained to monitor and deliver on-site education on the proper use of respirators.

Respirator manufacturers are knowledgeable on updated regulations related to respiratory protection, as they are responsible for ensuring products meet applicable regulatory requirements and many provide educational materials and training on proper use of their specific respiratory protection products. Due to the rapid cycling of respirator products not typically worn by health-care staff, such as FFR intended for use in an industrial setting or reusable respirators, many facilities relied on communication with manufacturers to support proper model-specific respirator use and to help locate and identify applicable regulatory requirements for implementation.

There may be nuances to wearing different respirator types and styles. One respirator may require different donning, doffing, or use procedures. Facilities should look to the manufacturer to help educate on current implementation and use recommendations.

5. Additional Research is Necessary on Filtering Facepiece Respiratory Protection Usage to Balance Infection Prevention Best Practices with a Sustainable Process

Unprecedented supply challenges resulted in fundamental shifts in the selection and use of respirators in clinical practice. Recommendations shifted early in the pandemic from single use of FFRs for each patient encounter to utilization of crisis and contingency strategies based on CDC guidance,[3] including extended use and reuse of FFRs. Challenges with the implementation of these strategies included potential for discomfort with long-term wear, concern about fit, and potential for cross-contamination with multiple donning and doffing cycles. This also raised questions about wear duration and how to reuse FFRs effectively and safely, given scant evidence examining these practices in health care to guide decision-making.

The panelists' strategies to address these challenges were supported by existing evidence. This included the OSHA requirement of conducting user seal checks when donning respirators and infection prevention best practices such as strict attention to hand hygiene after every contact with a respirator.[10] Practical guidance from end users also included the ability for staff to choose their preferred respirator for comfort (RR vs FFR vs PAPR) and periodic removal of tight-fitting respirators on a pre-determined basis to help reduce the potential risk of discomfort.

Stabilization of the supply of FFRs led to an examination of the historic practice of FFR single use for each patient encounter after recognizing the utility of RR and the potential for reduced consumption and waste. However, concerns about the safety of extended use and reuse of FFRs remain, due to a lack of robust scientific evidence available to support a change in practice. Some studies have been conducted to evaluate the extended use and reuse of FFRs.[22–25] However, these data are limited by study design, small sample sizes,[22,24,25] and not being reflective of real-world practice.[24] Additionally, studies did not control for repeated donning/doffing[22,23] or duration of wear[23] and only included a small number of FFR models.[23,24] Therefore, additional research and real-world data on FFR extended use and reuse – and further sharing of best practices and successes in developing and implementing reusable respirator programs in health care – are needed to inform the balance between infection prevention best practice, with sustainable respirator supply conservation efforts and waste reduction, and to make clinical recommendations related to practice.

Panelist recommendations for areas for future research include:

1. Acceptability of extended use in real practice in which filtration and fit are maintained.
   - Awareness of simple and effective ways to check fit in the field.
   - Increased seal check recognition and education.

2. Differences in re-use and extended use based on clinical setting and practice setting.
   - Hospital vs Community settings.
   - Emergency Department vs General Unit vs Intensive Care Unit.

3. Frequency of donning and doffing cycles before replacement.

Conclusion

The onset of the COVID-19 pandemic resulted in unprecedented challenges to health-care systems and health-care professionals around the world. The authors discussed recommendations for the selection of respiratory protection, education, and communication on the use of respirators, stockpiling/storage of respiratory protection for future public health emergencies. These considerations may offer guidance and identify areas for research on preparedness, communication, education, and training to better prepare health-care facilities for future unexpected events.

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Disclosure

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