Coronavirus Disease 2019 (COVID-19)
- Symptoms & Testing +
- Prevent Getting Sick +
- Daily Life & Coping +
- If You Are Sick +
- People Who Need Extra Precautions +
- Frequently Asked Questions
- Travel +
- Cases & Latest Updates +
- Schools, Workplaces & Community Locations +
- **Healthcare Professionals** –
  - Evaluation & Testing
  - Clinical Care +
  - Infection Control +
  - **Optimize PPE Supply** –
    - PPE Burn Rate Calculator
    - Eye Protection
    - Gowns
    - Facemasks
    - **N95 Respirators**
    - Decontamination & Reuse of Filtering Facepiece Respirators
    - Ventilators
    - FAQ About PPE
  - Potential Exposure at Work +
  - First Responder Guidance
  - Preparedness Tools +
  - FAQs
  - Operational Considerations for Non-US Settings +

Strategies for Optimizing the Supply of N95 Respirators

Related Pages

- N95 Respirator Summary
- Stockpiled N95 Respirators

Updated April 3, 2020

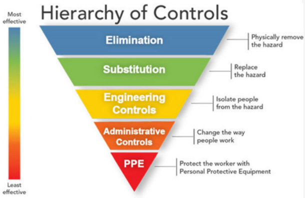
Summary of Updates as of April 2, 2020:

- Conventional capacity strategies
  - Edited the section on use of airborne infection isolation rooms (AIIRs) for aerosol-generating procedures performed on patients with confirmed or suspected COVID-19 patients.
  - Added language on FDA's Emergency Use Authorization (EUA) authorizing the use of certain NIOSH-approved respirator models in healthcare settings to the section on N95 alternatives.
- Contingency capacity strategies
  - Added a section on temporarily suspending annual fit testing following updated guidance from OSHA
  - Added more details in the extended use section.
- Crisis capacity strategies
  - Added language on the use of respirators approved under international standards and updated the tables.
  - Combined sections on limited re-use of N95 respirators for tuberculosis and then COVID-19 patients. Added more details surrounding limited re-use.

Audience: These considerations are intended for use by federal, state, and local public health officials, respiratory protection program managers, leaders in occupational health services and infection prevention and control programs, and other leaders in healthcare settings who are responsible for developing and implementing policies and procedures for preventing pathogen transmission in healthcare settings.

Purpose: This document offers a series of strategies or options to optimize supplies of disposable N95 filtering facepiece respirators (commonly called "N95 respirators") in healthcare settings when there is limited supply. It does not address other aspects of pandemic planning; for those, healthcare facilities can refer to COVID-19 preparedness plans. The strategies are also listed in order of priority and preference in the Checklist for Healthcare Facilities: Strategies for Optimizing the Supply of N95 Respirators during the COVID-19 Response in an easy-to-use format for healthcare facilities.

Controlling exposures to occupational hazards is a fundamental way to protect personnel. Conventionally, a hierarchy has been used to achieve feasible and effective controls. Multiple control strategies can be implemented concurrently and or sequentially. This hierarchy can be represented as follows:


Hierarchy of Controls
Most effective
Least effective
Elimination
Substitution
Engineering Controls
Administrative Controls
PPE
Physically remove the hazard
Replace the hazard
Isolate people from the hazard
Change the way people work
Protect the worker with Personal Protective Equipment

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

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To prevent infectious disease transmission, elimination (physically removing the hazard) and substitution (replacing the hazard) are not typically options for healthcare settings. However, exposures to transmissible respiratory pathogens in healthcare facilities can often be reduced or possibly avoided through engineering and administrative controls and PPE. Prompt detection and effective triage and isolation of potentially infectious patients are essential to prevent unnecessary exposures among patients, healthcare personnel (HCP), and visitors at the facility.

N95 respirators are the PPE most often used to control exposures to infections transmitted via the airborne route, though their effectiveness is highly dependent upon proper fit and use. The optimal way to prevent airborne transmission is to use a combination of interventions from across the hierarchy of controls, not just PPE alone. Applying a combination of controls can provide an additional degree of protection, even if one intervention fails or is not available.

Respirators, when required to protect HCP from airborne contaminants such as some infectious agents, must be used in the context of a comprehensive, written respiratory protection program that meets the requirements of OSHA's Respiratory Protection standard. The program should include medical evaluations, training, and fit testing.

Surge capacity refers to the ability to manage a sudden, unexpected increase in patient volume that would otherwise severely challenge or exceed the present capacity of a facility. While there are no commonly accepted measurements or triggers to distinguish surge capacity from daily patient care capacity, surge capacity is a useful framework to approach a decreased supply of N95 respirators during the COVID-19 response. Three general strata have been used to describe surge capacity and can be used to prioritize measures to conserve N95 respirator supplies along the continuum of care.[1]

- Conventional capacity: measures consist of providing patient care without any change in daily contemporary practices. This set of measures, consisting of engineering, administrative, and PPE controls should already be implemented in general infection prevention and control plans in healthcare settings.
- Contingency capacity: measures may change daily standard practices but may not have any significant impact on the care delivered to the patient or the safety of HCP. These practices may be used temporarily during periods of expected N95 respirator shortages.
- Crisis capacity: strategies that are not commensurate with U.S. standards of care. These measures, or a combination of these measures, may need to be considered during periods of known N95 respirator shortages.

Conventional Capacity Strategies (should be incorporated into everyday practices)

Engineering Controls

Engineering controls reduce exposures for HCP by placing a barrier between the hazard and the HCP. Engineering controls can be very effective as part of a suite of strategies to protect HCP without placing primary responsibility of implementation on them (i.e., they function without HCP having to take an action).

Selective use of airborne infection isolation rooms –

Selective use of airborne infection isolation rooms

Aerosol-generating procedures performed on patients with confirmed or suspected COVID-19 patients should take place in an airborne infection isolation room (AIIR). The AIIR should be constructed and maintained in accordance with current guidelines, as recommended in CDC's COVID-19 interim prevention and control recommendations in healthcare settings. Air from these rooms should be exhausted directly to the outside or be filtered through a high-efficiency particulate air (HEPA) filter directly before recirculation. Air from these rooms should be exhausted directly to the outside or be filtered through a high-efficiency particulate air (HEPA) filter directly before recirculation.

Use of physical barriers –

Use of physical barriers

Barriers such as glass or plastic windows can be an effective solution for reducing exposures among HCP to potentially infectious patients. This approach can be effective in reception areas (e.g., intake desk at emergency department, triage station, information booth, pharmacy drop-off/pick-up windows) where patients may first report upon arrival to a healthcare facility. Other examples include the use of curtains between patients in shared areas and closed suctioning systems for airway suctioning for intubated patients.

Properly maintained ventilation systems

> Another cornerstone of engineering controls are ventilation systems that provide air movement from a clean (HCP workstation or area) to contaminated (sick patient) flow direction (along with appropriate filtration, exchange rate) that are installed and properly maintained.

Administrative Controls

Administrative controls are employer-dictated work practices and policies that reduce or prevent hazardous exposures. Their effectiveness depends on employer commitment and HCP acceptance and consistent use of the strategies.

Limit number of patients going to hospital or outpatient settings

Develop mechanisms to screen patients for acute respiratory illness prior to their healthcare visits, such as through the appointment reminder system. Postpone and reschedule those with signs and symptoms presenting for non-acute visits.

Telemedicine

Nurse advice lines and telemedicine can screen and manage patients with suspected COVID-19 without the need for a face-to-face visit. Promoting the use of these technologies and referral networks can help triage persons to the appropriate level of care, potentially reducing the influx of patients to healthcare facilities and reserving personal protective equipment for when it is needed.

Exclude all HCP not directly involved in patient care

CDC guidance recommends that, for COVID-19, only essential personnel enter the patient care area, and that facilities consider caring for these patients with dedicated HCP. Further limiting the numbers of healthcare personnel and patient contacts to those that are medically essential (e.g., excluding dietary personnel, environmental services) could limit the number of respirators used. The medically essential personnel would assume food delivery and environmental services.

Limit face-to-face HCP encounters with patient

Measures can be explored to limit face-to-face contact encounters between HCP and patients with confirmed or suspected COVID-19. HCP may consider bundling care activities to minimize room entries, and bundling may occur across HCP types (e.g., food trays are delivered by HCP performing other care). Alternative mechanisms for HCP and patient interactions include telephones, video monitoring, and video-call applications on cell phones or tablets.

Exclude visitors to patients with known or suspected COVID-19

Restrict visitors from entering the rooms of patients with known COVID-19 or suspected COVID-19, as recommended in CDC's guidance. Alternative mechanisms for patient and visitor interactions, such as video-call applications on cell phones or tablets should be explored. Facilities can consider exceptions based on end-of-life situations or when a visitor is essential for the patient's emotional well-being and care. If visitors must enter the room of a known or suspected COVID-19 patient, facilities should provide instruction, before visitors enter patients' rooms on use of PPE according to current facility policy while in the patient's room.

Source control

Identify and assess patients who may be ill with or who may have been exposed to a person with known COVID-19. Patients with symptoms of suspected COVID-19 or other respiratory infection (e.g., fever, cough) presenting for care should use facemasks for source control until they can be placed in a private room. Instructions should include how to use facemasks. Patients with these symptoms should not wear N95 respirators. If these patients need to leave their room for services in other areas of the hospital (e.g., radiology), they should also wear facemasks for source control.

Cohorting patients

Cohorting is the practice of grouping together patients who are infected with the same organism to confine their care to one area and prevent contact with other patients. Cohorts are created based on clinical diagnosis, microbiologic confirmation when available, epidemiology, and mode of transmission of the infectious agent. Cohorting has been used extensively for managing outbreaks of multidrug resistant organisms including MRSA, VRE, MDR-ESBLs, *Pseudomonas aeruginosa;* methicillin-susceptible *Staphylococcus aureus*, RSV, adenovirus keratoconjunctivitis, rotavirus, and SARS. When single patient rooms are not available, patients with **confirmed** COVID-19 may be placed in the same room. Cohorting patients could minimize respirator use when extended wear of respirators is implemented. For more information on cohorting of patients, refer to 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings .

Cohorting HCP

Assigning designated teams of HCP to provide care for all patients with suspected or confirmed COVID-19 could minimize respirator use when extended wear of respirators is implemented. This strategy can also limit the number of exposed HCP who need to be fit tested.

Training on indications for use of N95 respirators

It is important that HCP be trained on indications for use of N95 respirators. The OSHA Respiratory Protection standard requires employers to provide respirator training to an employee prior to use in the workplace. For example, HCP should be educated on the use of N95 respirators when caring for patients managed with airborne precautions, and other instances for respirator use, such as the performance of aerosol generating procedures.

Training on use of N95 respirators

Training employees on the proper use of respirators, including putting on and removing them, limitations on their use, and maintenance is essential for effective use of respiratory protection. HCP should be thoroughly trained before they are fit tested to ensure they are comfortable donning the respirator and know how to conduct a user seal check. HCP should be trained on the respirator they are expecting to use at work.

Just-in-time fit testing

Just-in-time fit testing refers to the capacity of healthcare facilities to do larger scale evaluation, training, and fit testing of employees when necessary during a pandemic. Facilities may adopt a plan to use the "just-in-time" method for fit testing, which has been incorporated into pandemic plans for many facilities. For large facilities, it may not be feasible to fit test all employees, especially if their job does not typically place them at risk for exposure to airborne infectious diseases such as tuberculosis. If healthcare facilities are expecting to receive COVID-19 patients, they should begin training and start to plan for fit testing now. It is essential to have HCP trained and fit tested prior to receiving patients.

Limiting respirators during training

In order to conserve the supply of N95 respirators, healthcare facilities should understand which of their HCP need to be in a respiratory protection program and thus medically evaluated, trained, and fit tested. If training and fit testing are conducted during two separate steps, it is possible to allow limited re-use of N95 respirators used by individual HCP during training and then fit testing. Employees should be fit tested after they are comfortable donning the respirator and have passed a user seal check. The respirator might also be saved and then used for patient care.

Qualitative fit testing

Respirator fit test methods are classified as either qualitative or quantitative, and there are multiple protocols of each classification that are NIOSH-recommended or meet the requirements of OSHA's Respiratory Protection Standard . A qualitative fit test is a pass/fail test to assess the adequacy of respirator fit that relies on the individual's sensory detection of a test agent. A quantitative fit test numerically measures the effectiveness of the respirator to seal with the wearer's face, without relying on the wearer's voluntary or involuntary response to a test agent. Quantitative fit tests involve adaptation of the respirator to the fit testing equipment, which can involve making holes in the respirator.

Many healthcare systems already use qualitative fit test methods for fit testing HCP. For those using quantitative fit test methods, considerations can be made to use qualitative fit test methods to minimize the destruction of an N95 respirator used in fit testing and allow for the re-use of the same N95 respirator by the HCP. In March 2020, OSHA recommended healthcare employers consider changing from a quantitative fit testing method to a qualitative fit testing method. Qualitative fit methods may also allow for rapid fit testing of larger numbers of HCP. Any switch in methods should be assessed to ensure proficiency of the fit testers in carrying out the test.

Personal Protective Equipment: Respiratory Protection

While engineering and administrative controls should be considered first when selecting controls, the use of **personal protective equipment** (**PPE)** should also be part of a suite of strategies used to protect personnel. Proper use of respiratory protection by HCP requires a comprehensive program (including medical clearance, training, and fit testing) that complies with OSHA's Respiratory Protection Standard and a high level of HCP involvement and commitment. The program should also include provisions for the cleaning, disinfecting, inspection, repair, and storage of respirators used by HCP on the job according to manufacturer's instructions. Proper storage conditions can maximize shelf life of respirators. The following strategies in this section are traditionally used by some healthcare systems. If not already implemented, these strategies can be considered by healthcare settings in the face of a potential N95 respirator shortage before implementing the contingency strategies that are listed further below.

N95 respirators

N95 respirators include standard and surgical N95 respirators. In the United States, all N95 respirators used in occupational settings are approved by the National Institute for Occupational Safety and Health (NIOSH) and used in accordance with OSHA standards.

A surgical N95 respirator is a NIOSH-approved N95 respirator that has also been cleared by the FDA as a surgical mask. Surgical N95 respirators (sometimes called medical respirators) are recommended only for use by HCP who need protection from both airborne and fluid hazards, such as splashes or sprays. In times of shortage, only HCP who are working in a sterile field or who may be exposed to high-velocity splashes, sprays, or splatters of blood or body fluids should be provided these respirators. Other HCP can use standard N95 respirators. If surgical N95 respirators are not available, and there is a risk that the worker may be exposed to high velocity splashes, sprays, or splatters of blood or body fluids, then a faceshield should be worn over the standard N95 respirator.

Use of alternatives to N95 respirators

Use NIOSH approved alternatives to N95 respirators where feasible. These include other classes of filtering facepiece respirators, elastomeric half-mask and full facepiece air purifying respirators, powered air purifying respirators (PAPRs). All of these alternatives will provide equivalent or higher protection than N95 respirators when properly worn. NIOSH maintains a searchable, online version of the certified equipment list identifying all NIOSH-approved respirators.

Every other NIOSH approved filtering facepiece respirators is at least as protective as the N95. These include N99, N100, P95, P99, P100, R95, R99, and R100. Many filtering facepiece respirators have exhalation valves and should not be used in surgical settings as unfiltered exhaled breath would compromise the sterile field. On March 2, 2020, FDA issued an Emergency Use Authorization (EUA) authorizing the use of certain NIOSH-approved respirator models in healthcare settings.

Elastomeric respirators are half-facepiece, tight-fitting respirators that are made of synthetic or rubber material permitting them to be repeatedly disinfected, cleaned, and reused. They are equipped with replaceable filter cartridges. Similar to N95 respirators, elastomeric respirators require annual fit testing. Elastomeric respirators should not be used in surgical settings due to concerns that air coming out of the exhalation valve may contaminate the sterile field.

PAPRs are reusable respirators that are typically loose-fitting hoods or helmets. These respirators are battery-powered with blower that pulls air through attached filters or cartridges. The filter is typically a high-efficiency particulate air (HEPA) filter. Loose-fitting PAPRs do not require fit-testing and can be worn by people with facial hair. However, PAPRs should not be used in surgical settings due to concerns that the blower exhaust and exhaled air may contaminate the sterile field.

On March 28, 2020, FDA issued an update to address NIOSH-Approved Air Purifying Respirators for Use in Health Care Settings During Response to the COVID-19 Public Health Emergency. Facilities using elastomeric respirators and PAPRs should have up-to-date cleaning/disinfection procedures, which are an essential part of use for protection against infectious agents.

Top of Page

Contingency Capacity Strategies (during expected shortages)

Decisions to implement contingency are based upon these assumptions:

1. Facilities understand their current N95 respirator inventory and supply chain
2. Facilities understand their N95 respirator utilization rate
3. Facilities are in communication with local healthcare coalitions, federal, state, and local public health partners (e.g., public health emergency preparedness and response staff) regarding identification of additional supplies
4. Facilities have already implemented conventional capacity measures
5. Facilities have provided HCP with required education and training, including having them demonstrate competency with donning and doffing, with any PPE ensemble that is used to perform job responsibilities, such as provision of patient care

Administrative Controls

Decrease length of hospital stay for medically stable patients with COVID-19 –

Currently, CDC recommends discharge of patients with confirmed COVID-19 when they are medically stable and have an appropriate home environment to which to return. CDC lists considerations for care at home in: Interim Guidance for Implementing Home Care of People Not Requiring Hospitalization for Coronavirus Disease 2019 (COVID-19). If patients cannot be discharged to home for social rather than medical reasons, public health officials might need to identify alternative non-hospital housing where those patients can convalesce.

Temporarily suspend annual fit testing –

Facilities can consider temporarily suspending annual fit testing of HCP in times of expected shortages. In March 2020, OSHA issued new temporary guidance regarding the enforcement of OSHA’s Respiratory Protection Standard. The guidance gave OSHA field offices enforcement discretion concerning the annual fit testing requirement as long as HCP have undergone an initial fit test with the same model, style, and size. Other conditions include explaining to HCP the importance of conducting a user seal check each time the respirator is put on and conducting a fit test if there are visual changes to the employee’s physical condition.

Personal Protective Equipment: Respiratory Protection

Use of N95 respirators beyond the manufacturer-designated shelf life for training and fit testing

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In times of shortage, consideration can be made to use N95 respirators beyond the manufacturer-designated shelf life. However, expired respirators might not perform to the requirements for which they were certified. Over time, components such as the strap and material may degrade, which can affect the quality of the fit and seal. Because of this, use of expired respirators could be prioritized for situations where HCP are NOT exposed to pathogens, such as training and fit testing. As expired respirators can still serve an important purpose, healthcare facilities should retain and reserve all N95 respirators during the pandemic.

Extended use of N95 respirators

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Practices allowing extended use of N95 respirators, when acceptable, can also be considered. The decision to implement policies that permit extended use of N95 respirators should be made by the professionals who manage the institution's respiratory protection program, in consultation with their occupational health and infection control departments with input from the state/local public health departments. CDC has recommended guidance on implementation of extended use of N95 respirators in healthcare settings. Extended use has been recommended and widely used as an option for conserving respirators during previous respiratory pathogen outbreaks and pandemics.

Extended use refers to the practice of wearing the same N95 respirator for repeated close contact encounters with several different patients, without removing the respirator between patient encounters. Extended use is well suited to situations wherein multiple patients with the same infectious disease diagnosis, whose care requires use of a respirator, are cohorted (e.g., housed on the same hospital unit). It can also be considered to be used for care of patients with tuberculosis, varicella, and measles, other infectious diseases where use of an N95 respirator or higher is recommended. When practicing extended use of N95 respirators, the maximum recommended extended use period is 8–12 hours. Respirators should not be worn for multiple work shifts and should not be reused after extended use. N95 respirators should be removed (doffed) and discarded before activities such as meals and restroom breaks.

Top of Page

Crisis Capacity Strategies (during known shortages)

Decisions to implement crisis strategies are based upon these assumptions:

1. Facilities understand their current N95 respirator inventory and supply chain
2. Facilities understand their N95 respirator utilization rate
3. Facilities are in communication with local healthcare coalitions, federal, state, and local public health partners (e.g., public health emergency preparedness and response staff) regarding identification of additional supplies
4. Facilities have already implemented contingency capacity measures
5. Facilities have provided HCP with required education and training, including having them demonstrate competency with donning and doffing, with any PPE ensemble that is used to perform job responsibilities, such as provision of patient care

When N95 Supplies are Running Low

Personal Protective Equipment: Respiratory Protection and Facemasks

Use of respirators beyond the manufacturer-designated shelf life for healthcare delivery

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Consideration can be made to use N95 respirators beyond the manufacturer-designated shelf life for care of patients with COVID-19, tuberculosis, measles, and varicella. However, respirators beyond the manufacturer-designated shelf life may not perform to the requirements for which they were certified. Over time, components such as the straps and nose bridge material may degrade, which can affect the quality of the fit and seal. Many models found in U.S. stockpiles and stockpiles of healthcare facilities have been found to continue to perform in accordance with NIOSH performance standards. However, fluid resistance and flammability were not assessed. Use of the N95 respirators recommended in *Release of Stockpiled N95 Filtering Facepiece Respirators Beyond the Manufacturer-Designated Shelf Life: Considerations for the COVID-19 Response* can be considered. It is optimal to use these respirators in the context of a respiratory protection program that includes medical evaluation, training, and fit testing. If used in healthcare delivery, it is particularly important that HCP perform the expected seal check, prior to entering a patient care area. CDC does not recommend using N95s beyond the manufacturer-designated shelf life in surgical settings. On March 2, 2020, FDA issued an Emergency Use Authorization (EUA) authorizing the use of certain NIOSH-approved respirator models in healthcare settings. This EUA includes respirator units that are past their designated shelf life.

Use of respirators approved under standards used in other countries that are similar to NIOSH-approved respirators

Other countries approve respirators for occupational use according to country-specific standards. These products are evaluated using some methods that are similar to those used by NIOSH. Some methods are different but are expected to provide protection similar to NIOSH-approved filtering facepiece and elastomeric respirators. Devices supplied by current NIOSH-approval holders producing respirators under the standards authorized in the listed countries are expected to provide the protection indicated, given that a proper fit is achieved. Therefore, they are considered to be suitable alternatives to provide protection during the COVID-19 response when supplies are short. Within the following tables, the country, conformity assessment standards, standards and guidance documents, acceptable product classification, and NIOSH classification are provided in alphabetical order. All of these respirators have protection factors of at least 10 in the countries listed below, as outlined in the standards and guidance documents specified. Non-NIOSH approved products developed by manufacturers who are not NIOSH approval holders are expected to meet the performance requirements if they have been issued a certificate of approval by an authorized test laboratory indicating they conform to the standards below. Non-NIOSH-approved products developed by manufacturers who are not NIOSH approval holders, including only products approved by and received from China, should only be used in crisis situations when no other NIOSH-approved N95 respirator (or a listed device from one of the other countries identified within the FDA EAU) is available; they should not be used during aerosol generating medical procedures unless the alternative is a loose-fitting surgical mask or improvised device. On April 3, 2020, FDA issued an update to the Non-NIOSH Approved Respirator Emergency Use Authorization (EUA) concerning non-NIOSH-approved respirators that have been approved in other countries.

Respirators Approved Under Standards Used in Other Countries That Are Similar to NIOSH-Approved N95 Filtering Facepiece Respirators

Country	Performance Standard	Acceptable Product Classification	May Be Used in Lieu of NIOSH-Certified Products Classified as
Australia	AS/NZS 1716:2012	P2	N95
		P3	N99 or lower
Brazil	ABNT/NBR 13698:2011	PFF2	N95
		PFF3	N99 or lower
People's	GB 2626-2006	KN/KP95	N95

Republic of China	GB 2626-2019		
		KN/KP100	N95
Europe	EN 149-2001	P2	N95
		P3	N99 or lower
Japan	JMHLW-2000	DS/DL2	N95
		DS/DL3	N99 or lower
Korea	KMOEL-2017-64	Special 1st	N95
Mexico	NOM-116-2009	N95	N95
		R95	R95 or lower
		P95	P95 or lower
		N99	N99 or lower
		R99	R99 or lower
		P99	P99 or lower
		N100	N100 or lower
		R100	R100 or lower
		P100	P100 or lower

Respirator-Cartridge Units Approved Under Standards Used in Other Countries That Are Similar to NIOSH-Approved Elastomeric Half-Facepiece Respirators

Country	**Performance Standard**	**Acceptable Product Classification**	**May Be Used in Lieu of NIOSH-Certified Products Classified as**
Australia	AS/NZS 1716:2012	P2	N95
		P3	N99 or lower
Brazil	ABNT/NBR 13694:1996; ABNT/NBR 13697:1996	P2	N95
		P3	N99 or lower
People’s Republic of China	GB 2626-2006; GB 2626-2019	KN/KP95	N95
		KN/KP100	N95
Europe	EN140-1999; EN 143-2000	P2	N95
		P3	N99 or lower
Japan	JMHLW-2000	RS/RL2	N95
		RS/RL3	N99 or lower
Korea	KMOEL-2014-46	Special 1st	N95
Mexico	NOM-116-2009	N95	N95
		R95	R95 or lower
		P95	P95 or lower

		N99	N99 or lower
		R99	R99 or lower
		P99	P99 or lower
		N100	N100 or lower
		R100	R100 or lower
		P100	P100 or lower

Limited re-use of N95 respirators

Re-use refers to the practice of using the same N95 respirator by one HCP for multiple encounters with different patients but removing it (i.e. doffing) after each encounter. This practice is often referred to as “limited reuse” because restrictions are in place to limit the number of times the same respirator is reused. It is important to consult with the respirator manufacturer regarding the maximum number of donnings or uses they recommend for the N95 respirator model. If no manufacturer guidance is available, data suggest limiting the number of reuses to no more than five uses per device to ensure an adequate safety margin.[1] N95 and other disposable respirators should not be shared by multiple HCP. CDC has recommended guidance on implementation of limited re-use of N95 respirators in healthcare settings.

For pathogens for which contact transmission is not a concern, routine limited reuse of single-use disposable respirators has been practiced for decades. For example, for tuberculosis prevention, a respirator classified as disposable can be reused by the same provider as long as the respirator maintains its structural and functional integrity. If reuse must be implemented in times of shortages, HCP could be encouraged to reuse their N95 respirators when caring for patients with tuberculosis disease first.

Limited re-use of N95 respirators when caring for patients with COVID-19 might also become necessary. However, it is unknown what the potential contribution of contact transmission is for SARS-CoV-2, and caution should be used. Re-use should be implemented according to CDC guidance. Re-use has been recommended as an option for conserving respirators during previous respiratory pathogen outbreaks and pandemics. It may also be necessary to re-use N95 respirators when caring for patients with varicella or measles, although contact transmission poses a risk to HCP who implement this practice. Ideally, N95 respirators should not be re-used by HCP who care for patients with COVID-19 then care for other patients with varicella, measles, and tuberculosis, and vice versa.

Respirators grossly contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients should be discarded. HCP can consider using a face shield or facemask over the respirator to reduce/prevent contamination of the N95 respirator. HCP re-using an N95 respirators should use a clean pair of gloves when donning or adjusting a previously worn N95 respirator. It is important to discard gloves and perform hand hygiene after the N95 respirator is donned or adjusted.

The surfaces of a properly donned and functioning NIOSH-approved N95 respirator will become contaminated with pathogens while filtering the inhalation air of the wearer during exposures to pathogen laden aerosols. The pathogens on the filter materials of the respirator may be transferred to the wearer upon contact with the respirator during activities such as adjusting the respirator, improper doffing of the respirator, or when performing a user-seal check when redonnng a previously worn respirator. One effective strategy to mitigate the contact transfer of pathogens from the respirator to the wearer could be to issue each HCP who may be exposed to COVID-19 patients a minimum of five respirators. Each respirator will be used on a particular day and stored in a breathable paper bag until the next week. This will result in each worker requiring a minimum of five N95 respirators if they put on, take off, care for them, and store them properly each day. This amount of time in between uses should exceed the 72 hour expected survival time for SARS-CoV2 (the virus that caused COVID-19).[3] HCP should still treat the respirator as though it is still contaminated and follow the precautions outlined in CDC’s re-use recommendations.

Respirator manufacturers may provide guidance for respirator decontamination. At present, there are no generally approved methods for N95 and other disposable respirator decontamination prior to re-use. Additional guidance on potential methods may be found here.

Use of additional respirators beyond the manufacturer-designated shelf life for healthcare delivery that have not been evaluated by NIOSH

Use of additional N95 respirators beyond the manufacturer-designated shelf life for care of patients with COVID-19, tuberculosis, measles, and varicella can be considered. However, respirators beyond the manufacturer-designated shelf life may not perform to the requirements for which they were certified. Over time, components such as the straps and nose bridge material may degrade, which can affect the quality of the fit and seal. Some models have been found NOT to perform in accordance with NIOSH performances standards, and consideration may be given to use these respirators as identified in *Release of Stockpiled N95 Filtering Facepiece Respirators Beyond the Manufacturer-Designated Shelf Life: Considerations for the COVID-19 Response*. In addition, consideration can be given to use N95 respirators that have not been evaluated by NIOSH beyond the manufacturer-designated shelf life. These respirators should ideally be used in the context of a respiratory protection program that includes medical evaluation, training, and fit testing. It is particularly important that HCP perform the expected seal check, prior to entering a patient care area.

Prioritize the use of N95 respirators and facemasks by activity type

The number of infectious particles required to cause an infection (infectious dose) is often uncertain or unknown for respiratory pathogens. Further, there is often uncertainty about the influence of factors such as exposure duration and nature of clinical symptoms on the likelihood of infection transmission from person-to-person. When facemasks must be used by HCP entering a patient care area, source control (i.e. masking of symptomatic patients) and maintaining distance from the patient are particularly important to reduce the risk of transmission.

This prioritization approach to conservation is intended to be used when N95 respirators are so limited that routinely practiced standards of care for all HCP wearing N95 respirators when caring for a COVID-19 patient are no longer possible. N95 respirators beyond their manufacture-designated shelf life, when available, are preferable to use of facemasks. The use of N95s or elastomeric respirators or PAPRs should be prioritized for HCP with the highest potential exposures including being present in the room during aerosol generating procedures performed on symptomatic persons.

Suggested facemask or respirator use, based upon distance from a patient with suspected or known COVID-19 and use of source control*

HCP planned proximity to the case patient during encounter	Facemask or respirator determination	
	Patient masked for entire encounter (i.e., with source control)	**Unmasked patient or mask needs to be removed for any period of time during the patient encounter**
HCP will remain at greater than 6 feet from symptomatic patient	If HCP must enter the patient care area: no facemask or respirator. However, HCP should consider not entering the patient care area.	If HCP must enter the patient care area: no facemask or respirator. However, HCP should consider not entering the patient care area.
HCP will be within 6 feet of symptomatic patient, including providing direct patient care	Facemask	Any NIOSH-approved N95 respirator/ elastomeric /PAPR, based on availability or facemask if respirator unavailable
HCP will be present in the room during aerosol generating procedures performed on symptomatic persons	Any NIOSH-approved N95 respirator/ elastomeric /PAPR, based on availability	Any NIOSH-approved N95 respirator/ elastomeric /PAPR, based on availability

*Based on availability, organizations may require and/or individuals may voluntarily choose to utilize higher levels of protection

When No Respirators are Left

Administrative Controls

Exclude HCP at higher risk for severe illness from COVID-19 from contact with known or suspected COVID-19 patients

During severe resource limitations, consider excluding HCP who may be at higher risk for severe illness from COVID-19, such as those of older age, those with chronic medical conditions, or those who may be pregnant, from caring for patients with confirmed or suspected COVID-19 infection.

Designate convalescent HCP for provision of care to known or suspected COVID-19 patients

It may be possible to designate HCP who have clinically recovered from COVID-19 to preferentially provide care for additional patients with COVID-19. Individuals who have recovered from COVID-19 infection may have developed some protective immunity, but this has not yet been proven.

Engineering Controls

Expedient patient isolation rooms for risk-reduction

Portable fan devices with high-efficiency particulate air (HEPA) filtration that are carefully placed can increase the effective air changes per hour of clean air to the patient room, reducing risk to individuals entering the room without respiratory protection. NIOSH has developed guidance for using portable HEPA filtration systems to create expedient patient isolation rooms. The expedient patient isolation room approach involves establishing a high-ventilation-rate, negative pressure, inner isolation zone that sits within a “clean” larger ventilated zone. In the absence of any remaining supply of N95 respirators, it may be possible to use this technology in conjunction with HCP wearing facemasks.

Ventilated Headboards

NIOSH has developed the ventilated headboard that draws exhaled air from a patient in bed into a HEPA filter, decreasing risk of HCP exposure to patient-generated aerosol. This technology consists of lightweight, sturdy, and adjustable aluminum framing with a retractable plastic canopy. The ventilated headboard can be deployed in combination with HEPA fan/filter units to provide surge isolation capacity within a variety of environments, from traditional patient rooms to triage stations, and emergency medical shelters. In the absence of any remaining supply of N95 respirators, it may be possible to use this technology in conjunction with HCP and/or patients wearing facemasks.

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Top of Page

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