

## 2019 Novel Coronavirus

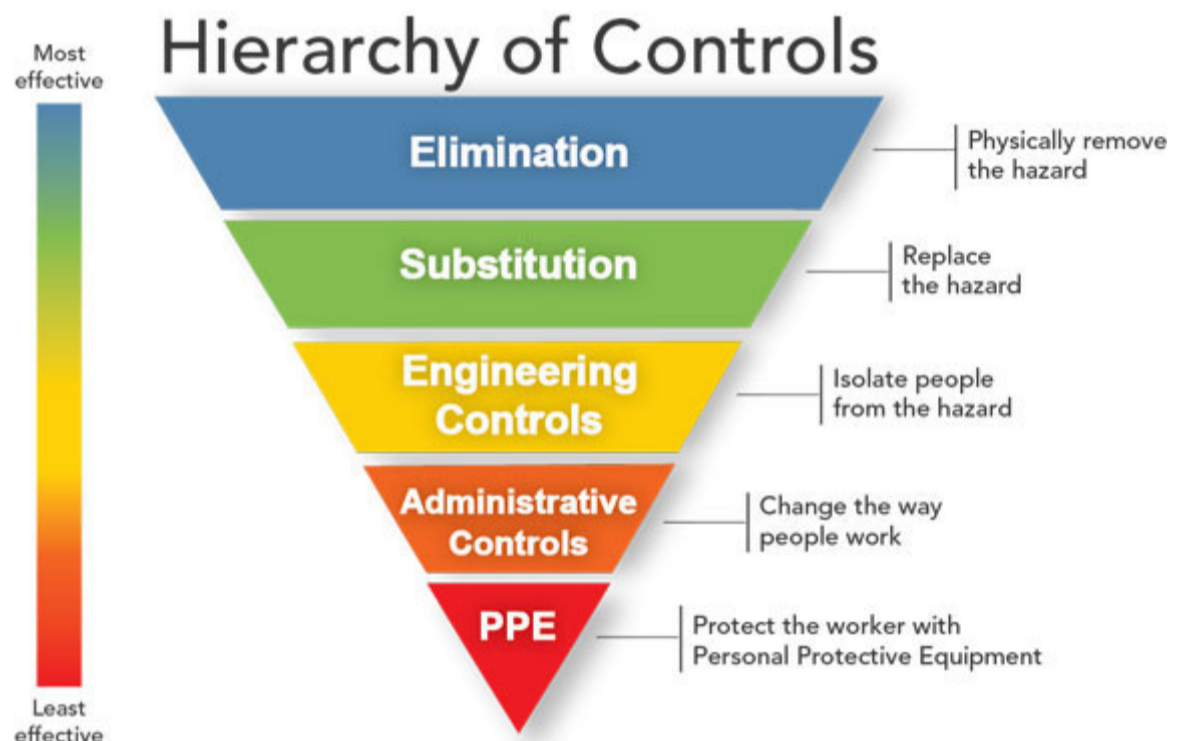
# Strategies for Optimizing the Supply of N95 Respirators

This document offers guidance on how to optimize supplies of N95 filtering facepiece respirators (commonly called “N95 respirators”) in healthcare settings in the face of potential ongoing 2019 Novel Coronavirus (2019-nCoV) transmission in the United States. The recommendations are intended for use by professionals who manage respiratory protection programs, occupational health services, and infection prevention programs in healthcare institutions to protect healthcare personnel (HCP) from job-related risks of exposure to infectious respiratory illnesses.

Controlling exposures to occupational hazards is a fundamental way to protect personnel.

Traditionally, a [hierarchy of controls](#) approach has been used to achieve feasible and effective control. Some of the control measures may fall into multiple categories. It should also be emphasized that multiple control strategies can be implemented concurrently and or sequentially. This hierarchy can be represented as follows:

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



To prevent infectious disease transmission, elimination (physically removing the hazard) and substitution (replacing the hazard) are not typically options for the healthcare setting. 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, 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. It is important to recognize that 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 a degree of protection, even if one intervention fails or is not available.

Respirators, when required to protect HCP from airborne contaminants such as 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, fit testing, and training.

Supplies of N95 respirators can become depleted during pandemics or when otherwise in high demand. [Existing CDC guidelines](#) recommend a combination of approaches to conserve supplies while safeguarding HCP in such circumstances. These existing guidelines recommend that healthcare facilities:

- Minimize the number of HCP who need to use respiratory protection through the preferential use of engineering and administrative controls;
- Use alternatives to N95 respirators (e.g., other classes of filtering facepiece respirators, elastomeric half-mask and full facepiece air-purifying respirators, powered air-purifying respirators) where feasible;
- Implement practices allowing extended use and/or limited reuse of N95 respirators, when acceptable; and
- Prioritize the use of N95 respirators for those HCP at the [highest risk of acquiring infection](#) or experiencing complications of infection.

## 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). This set of controls should already be implemented in healthcare settings. In the continuum of surge capacity and standards of care, these measures can be categorized as conventional capacity, which consists of providing patient care without any change in daily practices.

Patients with known or suspected 2019-nCoV (i.e., [person under investigation \[PUI\]](#)) should be placed in an airborne infection isolation room (AIIR) that has been constructed and maintained in accordance with current guidelines, as recommended in the [Interim infection prevention and control recommendations for patients with confirmed 2019 novel coronavirus or persons under investigation for 2019 nCoV in Healthcare Settings](#).

Barriers such as glass/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.

Another cornerstone of engineering controls are ventilation systems that provide air movement in 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

The term **administrative controls** refers to 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. Regular training, monitoring and reinforcement are necessary to ensure that policies and procedures are followed consistently. Many of these strategies should already be incorporated into existing infection prevention and control policies in healthcare settings. In the continuum of surge capacity and standards of care, the following administrative control measures can be categorized as conventional capacity, which consists of providing patient care without any change in daily practices.

### Limit number of patients going to hospital or outpatient settings

Consider developing mechanisms to screen patients for acute respiratory illness prior to their non-urgent care or elective visits or procedures, such as through the appointment reminder system. Postpone and reschedule those with signs and symptoms presenting for these non-acute visits.

### Exclude HCP not directly involved in patient care

Limit the number of HCP who enter the patient's room to only those providing direct patient care. Implement staffing policies to minimize the number of HCP who enter the room and consider excluding staff such as dietary and housekeeping employees.

### 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 2019-nCoV. 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 2019-nCoV patients (i.e., PUI)


Restrict visitors from entering the room of known or suspected 2019-nCoV patients (i.e., PUI), as recommended in the [Interim infection prevention and control recommendations for patients with confirmed 2019 novel coronavirus or persons under investigation for 2019 nCoV in Healthcare Settings](#). Alternative mechanisms for patient and visitor interactions, such as video

[Investigation for 2019-nCoV in Healthcare Settings](#). 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 2019-nCoV 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 patient with known 2019-nCoV. Patients with symptoms of suspected 2019-nCoV or other respiratory infection (e.g., fever, cough) presenting to care should [use facemasks](#)  for source control until they can be placed in an airborne infection isolation room or a private room. Instructions should include how to use facemasks. Patients with these symptoms should not use 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 2019-nCoV may be placed in the same room. Cohorting patients could minimize respirator use when extended wear of RPDs 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 2019-nCoV could minimize respirator use when extended wear of RPDs is implemented. This strategy can also limit the number of HCP exposed to 2019-nCoV and limit the number of HCP who need to be fit tested.

## Telemedicine

Nurse advice lines and telemedicine can screen and manage patients who may be infected with 2019-nCoV without the need for the HCP to use RPDs. 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 seeking evaluation.

## Training on indications for use of N95 respirators

It is also important that HCP be trained on indications for use of N95 respirators. The OSHA Respiratory Protection standard requires employers to provide respirator training prior to requiring an employee to use a respirator in the workplace. For example, HCP should use N95 respirators when caring for patients under airborne precautions for infectious diseases including 2019-nCoV, tuberculosis, measles, and varicella. HCP should generally not need to use N95 respirators when caring for patients under droplet precautions for infectious diseases except under certain circumstances (e.g., aerosol-generating procedures for influenza).

## 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. HCPs should be trained on the respirator they are expecting to use at work.

## Just in time fit testing

Facilities may also 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. These hospitals have the

capacity to do larger scale training and fit testing of employees when necessary during a pandemic. If healthcare facilities are expecting to receive 2019 n-CoV 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 be clear on which of their HCP do and do not 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 may be possible to allow limited re-use of N95 respirators used by individual HCP during both steps. Employees should be fit tested after they are comfortable donning the respirator and have passed a user seal check. Employees should be trained on the respirator they are expecting to use at work. The respirator can be saved and used for fit testing and 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. 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 and Respiratory Protection

While engineering and administrative controls should be considered first when selecting controls, the use of 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 workers on the job. Proper storage conditions can maximize shelf life of respirators. The following strategies are additional strategies that can be considered by healthcare settings in the face of a potential N95 respirator shortage.

## Conventional Capacity Strategies

The following two strategies may already be incorporated into existing infection prevention and control policies in healthcare settings. In the continuum of surge capacity and standards of care, the following two measures can be categorized as conventional capacity, which consists of providing patient care without any change in daily practices.

### Surgical N95 respirators

Surgical N95 respirators (also referred as a medical respirator) are recommended only for use by HCP who need protection from both airborne and fluid hazards (e.g., splashes, sprays). These respirators are not used or needed outside of healthcare settings. 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 [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) where feasible. All of these alternatives will provide equivalent or higher protection than N95 respirators.

NIOSH approves other filtering facepiece respirators that are at least as protective as the N95. These include [N99, N100, P95, P99, P100, R95, R99, and R100](#).

Elastomeric respirators are sometimes referred to as reusable respirators because the facepiece is cleaned and reused but the filter cartridges are discarded and replaced when they become unsuitable for further use. 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 used 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.

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.

## Contingency Capacity Strategies

In the continuum of surge capacity and standards of care, the following two measures can be categorized as contingency capacity, which may change daily practices but may not have any significant impact on the care delivered to the patient or the safety of the HCP. The following measures may be considered in the setting of a potential impending shortage of N95 respirators.

### Use of respirators after their intended shelf life

In times of increased demand and decreased supply, consideration can be made to use N95 respirators past their intended shelf life. However, the potential exists that the respirator will not perform to the requirements for which it was certified. Over time, components such as the strap and material may degrade, which can affect the quality of the fit and seal. Prior to use of N95 respirators, the HCP should inspect the respirator and perform a seal check. Additionally, expired respirators may potentially no longer meet the certification requirements set by NIOSH.

### Extended use and limited reuse

In the setting of a potential N95 respirator shortage, consider implementing practices allowing extended use and/or limited reuse of N95 respirators, when acceptable. The decision to implement policies that permit extended use or limited reuse 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 and limited reuse of N95 respirators in healthcare settings.

The decision to implement these practices should be made on a case by case basis taking into account known characteristics of the 2019-nCoV and local conditions (e.g., number of disposable N95 respirators available, current respirator usage rate, success of other respirator conservation strategies, etc.) Both Extended use and limited reuse have 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 may be implemented when multiple patients are infected with the same respiratory pathogen and patients are placed together in dedicated waiting rooms or hospital wards.

**Reuse** 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. N95 and other disposable respirators should not be shared by multiple workers. The respirator is stored in between encounters to be put on again (i.e. donned) prior to the next encounter with a patient. For pathogens for which contact transmission (e.g., contact with fomites) is not a concern (e.g., tuberculosis), non-

emergency reuse has been practiced for decades. For example, for tuberculosis prevention, CDC recommends that a respirator classified as disposable can generally be reused by the same worker as long as it remains functional and is used in accordance with local infection control procedures. Therefore, to extend the supply of N95 respirators during an anticipated dwindling supply, HCP could be encouraged to practice limited reuse of their N95 respirators when caring for patients with tuberculosis disease.

Even when N95 respirator reuse is practiced or recommended, restrictions are in place which limit the number of times the same respirator is reused. Thus, N95 respirator reuse is often referred to as "limited reuse." To maintain the integrity of the respirator, it is important for HCP to hang used respirators in a designated storage area or keep them in a clean, breathable container such as a paper bag between uses. It is prohibited to modify the N95 respirator by placing any material within the respirator or over the respirator. Modification may negatively affect the performance of the respirator and could void the NIOSH approval.

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