N95 Respirators and Surgical Masks

October 19, 2009 by Lisa Brosseau, Sc.D. and Richard Perry Jr.

Bookmark this page for the latest information on NIOSH COVID-19 activities and the NIOSH-approved respirators and Personal Protective Equipment.
Respirator Lists for Respiratory Protection Programs for the most up-to-date information.

With the advent of a novel H1N1 influenza outbreak in spring 2009 and the expansion of a second wave during the 2009-2010 flu season, there has been considerable interest in the use of surgical masks (facemasks) and respirators as infection control measures. Respiratory protection is a critical component of a comprehensive control strategy for influenza and transmission that surgical masks. The amount of exposure reduction offered by respirators and surgical masks differ. The purpose of this blog is to provide information on respirators and surgical masks and their use against influenza. We recommend that you consult with your EHS specialist with a better respirator for the protection of healthcare workers and to consult with patients with H1N1.

Recently, the Institute of Medicine released a report Standards and Guidelines for Pandemic Influenza Preparedness in Healthcare Settings. In September 2009 the Institute of Medicine released a report Respiratory Protection for Healthcare Workers in the Workplace and Beyond. Also, the World Health Organization (WHO) has released a draft guidance document on the use of respirators and masks for influenza. The Centers for Disease Control and Prevention (CDC) has also released guidance. Although these principles apply to all practitioners respirators, the discussion presented in this article is focused on the most frequent hospital and healthcare environment settings. We hope that readers find it useful.

Evolution of Respiratory Protection against Particulate Exposures

Early surgical masks were constructed from cotton layers of gauze. They were first worn by surgeon's staff in the early 1900s to protect patients from the wearer's exhaled breath and droplets. Over the years, the use of surgical masks by other staff masks are worn in a wide range of healthcare settings to protect patients from the wearer's respiratory emissions. A surgical mask is a loose-fitting, single use, disposable device that covers the wearer's nose and mouth. It is cleared by the Food and Drug Administration (FDA) as a medical device. Surgical masks are tested for fluid resistance, particle filtration, flammability, and biocompatibility of the materials that contact the wearer's face. Surgical masks are not designed or intended to be used as personal protective equipment against airborne hazards. Since 2004 consult the Bloodborne Pathogens Standard (29 CFR 1910.1030) or FDA, surgical masks have been cleared by the FDA for use as a barrier to protect the wearer's nose and mouth from splashes or sprays of hazardous or infectious fluids. The FDA clearance is not a NIOSH approval.

The first modern respirators were also developed in the early 1900s. The impetus for their development derived from the need to protect workers from exposure to toxic particulate matter. Cotton was used as the filter material, but was found to be ineffective. In 1919, the U.S. Bureau of Mines published the first respirator performance standards for self-contained breathing apparatus and for air-purifying respirators. The respirators were tested against a "fine" and "coarse" dust. The respirators were tested against a "fine" and "coarse" dust. The respirators were tested against a "fine" and "coarse" dust

P Barth said:
October 26, 2009 at 12:37 am
Dear Colleagues,
This study focuses on the difference in protection between surgical masks and N95 respirators are not statistically significant. What is your response regarding the article? http://www.ncbi.nlm.nih.gov/pubmed/19253835?dopt=Abstract

Respirators are not proved to be better than masks in preventing influenza-like illness in healthcare workers (HCW) in a cluster randomized controlled trial (RCT) conducted during the seasonal epidemic of influenza A (H3N2) virus. This study regarding the difference in protection between surgical masks and N95 was published in Oct 2009. I believe the study is important. Thus, I would like to know your response regarding the article. My feeling is – if hospitals were ready to pay for a respirator, they are willing to pay for the plate and proper fitted N95.

Please respond on the study in question.

Lisa Brosseau and Richard Barry Ann says:
October 26, 2009 at 1:00 pm
Dear P Barth,

JFF Huggins, PA CSP says:
October 26, 2009 at 1:02 pm
Because N95s are in short supply, it is possible for the same nurse to re-use the N95 N-95 JMI made throughout their shift, but it is not possible for the same nurse to re-use a reusable plastic bag respirator or another respirator that would maintain the proper fit.

Lisa Brosseau and Richard Barry Ann says:
October 26, 2009 at 1:03 pm
Lisa and Richard say:
Dear Colleagues and colleague Scientists may want to consider extending the use of such respirator. There are two resources available for N95 reuse/re-use/re-fit testing. Please see the following: Reuse of Filtering Facepiece Respirators: HCW Influenza Virus Illness Prevention http://www.cdc.gov/niosh/topics/flu/pdf/ucm076150.pdf that address the possibility of extending the use of N95 respirators during influenza pandemics. Also, please see the Centers for Disease Control and Prevention Infection Control Measures for Emerging Infectious Diseases in Healthcare Settings, including Protection of Healthcare Personnel http://www.cdc.gov/ncid/ID/Topic/pandemic/pdf/ucm111080.pdf provides considerations for extending the use of respiratory protection devices during influenza pandemics. Also, please see the Centers for Disease Control and Prevention report, entitled Qualitative Risk Assessment of Artificial Alternatives and Alternative Strategies Regarding Protection for Infection Control Measures for 2009 H1N1 Influenza among Healthcare Personnel http://www.cdc.gov/h1n1flu/guidance/ppe.htm#Qualitative Also, please see the Centers for Disease Control and Prevention report, entitled Qualitative Risk Assessment of Extended and Prolonged Respirator Use http://www.cdc.gov/h1n1flu/guidance/ppe.htm#Qualitative Also, please see the Centers for Disease Control and Prevention compliance safety with respect to infection control, these alternatives should only be considered in the event of significant respirator shortages, and should be used only after all other options have been exhausted. Respirator shortages, leading to extending respirator use and re-use, may be caused by a surge in demand, or by disruptions in the supply chain. Consider the Sandy's infection control experts should be sought in this area. Consider the Sandy's infection control experts should be sought in this area. Consider the Sandy's infection control experts should be sought in this area. Respirator shortages, leading to extending respirator use and re-use, may be caused by a surge in demand, or by disruptions in the supply chain.

The following information comes from the CDC Questions & Answers Regarding Respirators for Infection Control Measures for 2009-H1N1 Influenza among Healthcare Personnel http://www.cdc.gov/h1n1flu/guidance/ppe.htm#Qualitative

If extended use practices are implemented as a means to extend respirator supplies, measures should be taken to reduce cross-contamination, such as:

Discarding disposable N95 respirators following use during aerosol generating procedures.
Discarding disposable N95 respirators following use during aerosol generating procedures or other bodily fluids than patients.
Considering use of a face shield over the disposable N95 respirator to prevent surface contamination.
Considering use of a face shield over the disposable N95 respirator.
If a nurse is forced to wear a respirator to minimize contamination of respiratory protection, the following could be considered to minimize risk of transmission:

Discard disposable N95 respirators following aerosol generating procedures.
Discard disposable N95 respirators contaminated with blood, respiratory or nasal secretions, or other bodily fluids than patients.
Consider use of a face shield over a disposable N95 respirator to prevent surface contamination.
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Consider use of a face shield over a disposable N95 respirator.
Reuse should perform hand hygiene with soap and water or an alcohol-based hand sanitizer after touching a used respirator.

David LaHaste says:
October 26, 2009 at 1:04 pm
Thank you for your website http://www.surgicalmaskrespirator.com/ - wow!

I was at OR some 35 yr. passed, retired, it has always been my understanding that a typical surgical mask boasts no protection against airborne pathogens or moisture. This would seem during coughing, sneezing, etc. Many surgical masks users are convinced a mask maintains its patency under most conditions. Can you clarify?

Lisa Brosseau and Richard Barry Ann says:
October 26, 2009 at 1:04 pm
Lisa and Richard say:
Respirator shortages or shortages in their ability to maintain their protective capabilities when exposed to moisture further from coughing, sneezing, sitting, etc. We are concerned of any disposable products that evaluate the loss in protection over time in either experimental or realistic settings.

Lahta says:
October 26, 2009 at 1:05 pm
I have to disagree with the sentence in your otherwise useful blog entry:

A negative pressure respirator will inherently fit as well as a positive pressure respirator with the same type of facepiece.

This is a misuse of the phrase fit and misleading. The phrase "fit" in respiratory protection is reserved to the mechanical fit, not fit measured in the negative pressure mode only. Tight inward leakage can be affected by positive vs. negative pressure. "Fit" is not.

Lisa Brosseau and Richard Barry Ann says:
October 26, 2009 at 1:06 pm
Thank you for your comments. We have revised the sentence to read: "Negative pressure respirators inherently offer less protection than positive pressure respirators, because inward leakage occurs more easily in the former."

Pennsylvania says:
October 26, 2009 at 1:06 pm
Thank you for a long overdue review of a 100A technical seminar, as of August 2009. Date the PHENOLICS forum, 2009.

H1N1 is viewed not as deadly as H5N1, yet general NIOSH consensus. However, the H1N1 flu mirror accounts is commonly viewed the greatest public or business.

The US public is not wearing surgical masks or N95 Filtering Facepiece Respirators (FFR), of a 1700hrs today.

The three (gave or take) reasons are: Social stigma, Not a "sexy" world-wide disease?, Lack of personal protection and daylight (it overshadows large scale pandemic events), Lack of personal protection and daylight (it overshadows large scale pandemic events), Lack of personal protection and daylight (it overshadows large scale pandemic events), Lack of personal protection and daylight (it overshadows large scale pandemic events).

The actions of Health Care Workers (HCW) taking a NIOSH-approved N95 FFR out of its "ready to use package", "impacting it, donning it, wearing it, doffing it and disposing of it" is a major concern. Is there a study that addresses the "impacting" and consequently negating efficacy of an N95, a FFR, or a NIOSH-approved N-95? Contagion outbreaks: Environmental workers, Hospital workers, Home workers, Office workers, Public workers, Transit workers, Airline workers, Cruise ship workers, Transit workers, Airline workers, Cruise ship workers, Transit workers, Airline workers, Cruise ship workers.

NIOSH-approved respirators offering "CBRN protection" have captured years of "best practice science" and can survival "contagion" outbreaks. Respirators offering "CBRN protection" are: N95, N99, N100, R95, R99, R100, P95, P99, P100, Half-face, Full-face, Half-face, Full-face, Half-face, Full-face

information on how to don and remove the mask) because the officers are not employed in a healthcare setting and guidance on proper donning and doffing is not provided in the CDC guidance.

Lisa Brosseau and Roland Berry Ann says:
March 23, 2020 at 10:07 pm
Thank you for providing your perspective on synthetic masks establishing a Respiratory Protection Program and Program Administrator meeting the minimum requirements specified by OSHA in 29 CFR 1910.134(c). This paragraph requires a respiratory protection program be established and maintained in accordance with the respiratory protection standard provided by regulated employers. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the respirator use. Respirator users must receive training in the hazards, the reason for the need for a program and proper use of a respirator prior to respirator use. Training must be provided by a Competent Person. Compliance Guides are available from the Occupational Safety and Health Administration's Office of Publications, Room N-3101, Frances Perkins Building, 200 Constitution Ave., Washington, DC 20210 (202) 219-8615. The website address is: http://www.osha.gov/Publications/OSHA3767.html, see here:

The instructions provided, the specific respirator model training used should be read and followed in the donning, doffing and disinfecting after of the respirator. Additionally, OSHA has produced a video in conjunction with Occupational Safety and Health Administration's Office of Publications, Room N-3101, Frances Perkins Building, 200 Constitution Ave., Washington, DC 20210 (202) 219-8615.

The same guidance and precautions in the "hoarding" of patients in healthcare would apply for the jobs and contractual facilities. The same proper guidance on donning and doffing PPE applies.

Disposable Respirators says:
March 23, 2020 at 10:11 pm
Personal Protection is the consumer factor to be considered in workplaces. Therefore safety awareness and prevention is very important in workplaces. (Company name) believes that a safe workplace environment ensures employee wellness, eliminates waste in the workplace, and helps maintain a productive workforce. Respirators are a personal protection factor.

Gary Keller DDS says:
March 23, 2020 at 10:14 pm
Dental care is a middle ously looking at conservation of oxygen and carbon dioxide inside surgical facemasks/respirators commonly worn by healthcare workers. Testing done using a highly accurate multiga oxygen/carbon dioxide meter shows that the oxygen level drops and the carbon dioxide level rises to a point that it is unacceptable to be breathed back into the lungs of the surgical patient. Our "facing wear down or fading" and "nonadhesive" environment to simulate workplace environments.

Conclusions remain that current OSHA and CDC guidelines.

My findings show a very consistent and reasonable problem with facemask oxygen and carbon dioxide levels for the healthcare worker and the surgical patient. Based on the current CDC and OSHA guidelines, I would suggest "Tailing" down or fading the "Oxygen and the Carbon Dioxide" levels in the surgical mask/respirator. I would suggest "forcibly" tailing of carbon dioxide levels in the 20,000ppm range "forcibly" oxygen levels were in the 17%-18% range. Tailing down the oxygen and carbon dioxide levels would be a reasonable and safe approach. Tailing down the oxygen and carbon dioxide levels would be a reasonable and separate consideration. All within the confines of the current guidelines based on current published OSHA and CDC breathing air standards.

Tailing down the oxygen and carbon dioxide levels in the respirator is obviously needed. I would suggest "Respirator" standards with levels of treatment with oxygen/carbon dioxide exposure times (logarithmic) based on the current published OSHA and CDC breathing air standards. Respirator Manufacturers.

Just a healthcare worker and I spend the same amount of time myself and of the other healthcare consumers/firefighters/military that wear facemasks. A better product would be nice also…one that meets safe air standards.

Roland Berry Ann says:
March 23, 2020 at 10:17 pm
NIOSH approval requirements for respirator types including self-contained breathing apparatus (SCBA), SWPs air purifying respirators (SWPs APR) and CBRN air purifying escape respirators (CBRN APRs) include a maximum average concentration of carbon dioxide and other specified limits.

In addition, two recently published peer-reviewed the process by which the scientific community establishes the science behind a specific issue, the results of two studies that have been published in the scientific literature show that the NIOSH respirator maximum allowable concentrations of CO2 do not cause any adverse consequences in the respiratory system of respirators. While the measured CO2 concentrations were reduced and CO2 concentrations were increased compared to the respirator without the valve, the results showed that the CO2 levels in the respirator were well below the NIOSH limit.

1.Bolanos G, Sun H, Lu J, Weaver M, Fenton M, Fisher E, Thomas G, Rosenberg D, Emanuel P. Carbon Dioxide Buildup in Respirators: Effect of Exhalation Valves. Journal of Occupational and Environmental Hygiene 2010 Dec; 7(12): 685-691. PMID: 21058-10-9 doi: 10.1080/15459624.2010.524-0-0 Epub 2010 Oct 29 Epub ahead of print.

2.Bolanos G, Sun H, Williams RW, Powell JB, Fashner D. Physiological impact of the NIOSH filtering facepiece respirator with exhalation valve. J Occup Med Toxicol (Lond) 2010 Jun 29; 5:14. PMID: 20-5-5-0-0 doi: 10.1186/1745-6673-5-14

We encourage the publication of respirator use in healthcare environments such as scientific and technical journals in order for others to the scientific knowledge on this important subject.

Gary Keller DDS says:
March 23, 2020 at 2:05 pm
Oxygen and carbon dioxide and carbon dioxide levels for bradycardia or otherwise the above posting of 21-17.-18 is Carbon Dioxide 20,000ppm Oxygen 17%-18% Carbon Dioxide 20,000ppm Oxygen 17%-18% Carbon Dioxide 20,000ppm Oxygen 17%-18%

Are all N95 respirators the same? No. Respirators are not all the same. Respirators are made of different materials and have different shapes and sizes. Respirators are designed to protect against airborne particles, but they do not address the practical issue of having to determine in which situations public health representatives should recommend mask or respirator use.

Thank you for this blog.

Roland Berry Ann and Lisa Brosseau says:
October 21, 2020 at 2:00 PM
CDC does not have any recommendations, either existing or anticipated, for mask use specific to K-1 - 12 schools for the general public. Masks are not required for students in K-12 schools because they are not at high occupational exposure risk and are not in the proper sized adjustable and fitted respirator protocols required for workers who are at risk. Another common sense measure would be for school occupants with suspected or confirmed influenza, whether students or teachers and staff, to stay home. People who are sick should stay home and the home is treated and the office is cleaned, resulting, to avoid exposing others.

Masks are recommended for students in school settings are limited and mixed. One study with universally residential half boarding students in a boarding school in Germany showed influenza-like illness rates were lower when the use of masks was practiced, in comparison to controls (Kwik et al, 2019). A second study the following year did not find significant differences in rate of influenza-like illness in residents wearing masks in a boarding school in comparison to controls (Kwik et al, 2020).

Perhaps more relevant to the K-12 setting, surveys of teachers and parents about their attitudes toward the use of non-pharmaceutical interventions by adults and children showed that respondents were in support of basic hygiene measures, such as hand washing, and in favor of school closures, but were not in favor of other non-pharmaceutical gloves (Stebbins et al, 2020). Given these results, in conversation with training in hand and respiratory hygiene or encouragement to use hand sanitizer in 3 elementary schools (compared to 3 control schools) showed significantly decreased rates of influenza-like illnesses (ILIs) and ILIs fewer absences, but had no effect on self-confirmed influenza infection (Jefferson et al, 2011).

Muhammad Akram says:
February 24, 2019 at 6:22 PM
Respirator fit testing is part of an N95 filter should be satisfying ample for all particle size encountered in healthcare settings. There is no requirement to use a respirator later than an N95 filter. The latter will increase greater airwaves resistance and may be more uncomfortable to wear. However, to ensure leakage together in the midst of the respirator and the face is not necessary, it is important to use a respirator that has been properly fit tested, regardless of the filter efficiency.

Johan Hatter says:
April 9, 2020 at 4:32 am
Respirators are used in the workplace is very important and something which is often taken for granted. Making sure there is a proper policy in place is a bulk employer's responsibility to confirm they may face dangerous health hazards occurring without a correct policy or personal protection which may affect their work.

Israel Alan Solomon says:
July 17, 2020 at 10:06 am
Thanks for this article. Recall reading about Practical issues such as compliance and supply being part of the argument for use of surgical masks rather than N95 respirators in most clinical settings.

AnnOlliges says:
July 28, 2020 at 5:26 am
My office claims that no fit test for the N95 respirator is required. Is this true?

Lisa Brosseau and Roland Berry Ann says:
July 28, 2020 at 12:53 am
All NIOSH-certified filtering facepiece respirators require fit testing. This includes an initial fit testing and training in the respirators use and fit testing at least annually after that.

The OSHA Respiratory Protection Standard includes more details about the types of fit testing required for different types of respirators.

Tom Harris says:
November 5, 2019 at 3:01 am
What are the recommendations for the storage of individual respirators that staff use for their shift after placing them in a plastic bag. Are it sealed when they are stored, and how?

Marine Jensen says:
April 9, 2020 at 4:32 pm
As an OH professional I am asked to the difference is the fit and quality of effectiveness between surgical masks and N95 filtering facepiece. The technology is fantastic and I enjoy impacting the research that is available.

However I am very disappointed with the aspect of requiring actual qualitative fit testing for each healthcare worker wearing N95 PPE. The actual fitting of the mask, is in my opinion the best effective aspect of a respiratory program that deals with N95's.

Lisa Brosseau says:
January 15, 2021 at 5:22 am
In the United States employers are required by OSHA to conduct annual respirator fit testing for every employee who wears a tight-fitting respirator. Fit testing is a key component of a respiratory protection program for workers who are at qualifying exposures such as N95 filtering facepiece respirators. Without a fit test, it is impossible to know whether a particular manufacturer, model and size will fit a particular person. Past NIOSH research (see citation below) has shown that a fit test is a very important feature of a respiratory protection program.
Coffey CC, Lawrence RB, Campbell DL, Zhuang Z, Calvert CA, Jensen PA. 2004. Fitting characteristics of fifteen N95 Filtering Facepiece Respirators. J Occup Environ Hyg 1(265-271).

Shondra Pavlina says:
April 9, 2020 at 4:32 pm
very nice post. I just found this website, keep up!

C. Derrick says:
March 13, 2019 at 10:27 am
Interesting data. Not surprised, sadly, but yesterday by happening that a lot of the so-called positive pressure masks are quite unpalatable in terms of pressure against the face and difficulty with exhaling the breath against the respirator (ouch!) and I was shocked when grasped the specs of those components. Normally those specifications are used for air-purifying elastomeric half-mask respirators, not for disposable N95 filtering facepiece respirators. Do you have any more of this information in the appropriate place on where to find such specs? Supplementary you should be able to know whether a particular manufacturer, model and size will fit a particular person. Past NIOSH research (see citation below) has shown that a fit test is a very important feature of a respiratory protection program.
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Comparison Specialist says:
July 29, 2020 at 11:20 am
What I see is, changes those things affects was the issue for me, moreover, getting one to last 2 hrs, fold dirt, infiltrating, and breathing. Is there any other way to get the same? Or, is there any other way to get the same?
Don't sure, or maybe, we can state, we are not sure, but, we are sure, that, we are not sure, that, we are not sure, that, we are not