

DECONTAMINATION AND RE-USE OF N95 RESPIRATORS DURING A PANDEMIC

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Potomac
LOCAL SECTION

Disclaimer

- This presentation represents my views and opinions and not those of Exelon Corporation or the AIHA Potomac Section. Furthermore, in discussing these methods of decontamination I am not making any recommendations as to which devices to purchase or use and I have no financial relationship with these companies.

Objectives

- **Discuss and compare different methods of decontaminating N95 that have been recommended and/or mentioned by CDC, OSHA, and FDA.**
- **Discuss some practical procedures for decontaminating and re-using an N95 respirators.**
- **Other equipment/items that can be decontaminating using these methods.**

Introduction

- **In the United States there was a shortage of N95 filtering facepiece respirators (FFRs).**
- **Predominately for healthcare institutions but also for essential private companies and public services that were trying to remain open.**
- **Demand far exceeded the supply and states and private companies were all scrambling to obtain the same necessary FFR and PPE which caused bidding wars.**
- **Some companies and individuals tried to take advantage of the situation by selling FFRs at a huge mark-up or falsely advertising their products as NIOSH approved N95s.**

March 26, 2020 12:27 PM

Providers in bidding war with states, federal agencies on medical supplies

Associated Press

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Photo: Andrew H. Cooper / Getty Images

The billions of tax dollars headed for hospitals and states as part of the \$2.2 trillion coronavirus response bill won't be the problem facing doctors and nurses: a critical shortage of protective gowns, gloves and masks.

The problem isn't a lack of money, experts say, it's that there's not enough of those supplies available to buy. What's more, the crisis has revealed a fragmented procurement system now descending into chaos just as demand soars. The Associated Press has found.

Hospitals, state governments and the Federal Emergency Management Agency are left bidding against each other and driving up prices.

For more than a week, governors have pushed back against administration assurances that supplies are available now, timely responding to President

Introduction

- Due to the lack of N95 respirators suppliers started selling alternative FFRs such as KN95s (made in China).
- In a 3M Technical Bulletin from January 2020 and later revised they indicated that FFRs approved in other countries “can be expected to function very similarly to one other”.

<https://multimedia.3m.com/mws/media/17915000/comparison-ffp2-kn95-n95-filtering-facepiece-respirator-classes-tb.pdf>

- In my experience, the fit of the KN95 was not equivalent to the N95 and could not pass a quantitative fit-test or qualitative fit-test.
- KN95 and Surgical Masks



Meeting the Demand

April 2020

- CDC Issued a Guidance Document titled “Strategies for Optimizing the Supply of N95 Respirators”.
- <https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html>

Strategies

- use of N95s past their shelf life
- extended use of N95s
- use of other types of respirators
- use of respirators from other countries
- and re-use of respirators, ahead of decontamination of respirators.

Decontamination of N95 Respirators

- CDC issued – “Implementing Filtering Facepiece Respirator (FFR) Reuse, Including Reuse after Decontamination, When There Are Known Shortages of N95 Respirators”

<https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/decontamination-reuse-respirators.html>

- On March 29, 2020, the U.S. Food and Drug Administration (FDA) issued the first Emergency Use Authorization (EUA) for a process to decontaminate, and subsequent EUAs have been issued.

<https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization#covidppe>

- Decontamination of 3M FFR – Considerations

<https://multimedia.3m.com/mws/media/1824869O/decontamination-methods-for-3m-filtering-facepiece-respirators-technical-bulletin.pdf>

Decontaminating N95 Respirators

- NIOSH found that, as of April 2020, there were only three promising methods for decontaminating FFRs.
 - moist heat
 - vaporous hydrogen peroxide
 - ultraviolet germicidal irradiation
- Decontamination - defined as “the use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item.

Decontamination Methods that are Not Recommended

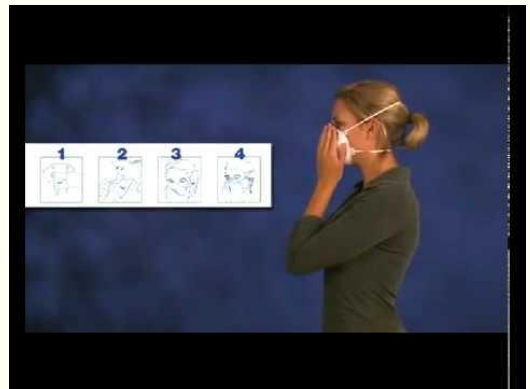
- Ethylene Oxide or formaldehyde for respirator decontamination due to potential for repeat inhalation exposure to residual ethylene oxide or formaldehyde, known human airborne respiratory carcinogens.
- Ionizing Radiation due to degradation in filter performance.
- Microwave due to melting of the respirator near metal components resulting in compromise of fit.
- High Temperatures above 75°C, such as Autoclave or Steam, unless specifically listed in the tables below due to significant filter degradation and fit degradation.
- Methanol, isopropanol, quat solutions, soaps, or detergents due to degradation in filter performance.
- Ozone due to degradation of headband and nosefoam materials.

Guidelines for Decontaminating N95 Respirators

- One single wearer, even when deconned and reused.
- If soiled or visibly damaged do not re-use.
- Thoroughly inspect them before each use for signs of damage or fatigue (headband elasticity, nosefoam compression, pinholes, etc.)
- Perform user seal check.

Best Practice

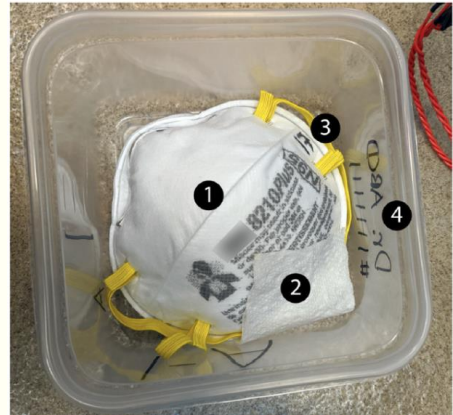
- Write a detailed written procedure.
- Train a selective group of individuals to decon.
- Wear gloves and mask.



Low Temperature Moist Heat

- Place N95 in hard walled polypropylene container.
- Add a wet two-ply paper towel to the container and seal it.
- Place in convection oven and heat for 40 minutes at ~160°F.
- Remove from oven. Take the top off and rotate it 45 degrees to allow air to get in.
- Dry in about 5 minutes.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0234851>



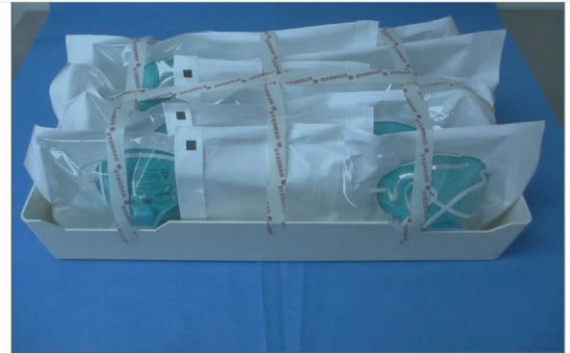
Vaporous Hydrogen Peroxide (VHP)

- March 29, 2020, Batelle Memorial Institute received the first EUA.
- April 11, 2020, ASP Sterrad received EUA. *This is the system we explored but there are others that have received EUA.
- Originally designed to sterilize medical devices and surgical instruments.
- Diffuses hydrogen peroxide vapor into the chamber and then electromagnetically exciting the hydrogen peroxide molecules into a low-temperature plasma state.



Vaporous Hydrogen Peroxide (VHP)

- Place respirators into individual Tyvek pouches and seal (tape).
- Load pouches into the sterilizer.
- Turn it on and run for ~30 minutes.
- Remove and aerate for an hour before giving it back for use.



Vaporous Hydrogen Peroxide (VHP)

- Can set up anywhere.
- Masks must be cellulose free
- 10 masks per batch
- Reprocess the masks two (2) times
- Cost = ~\$65,000
- Consumables = ~ \$3/mask
 - Hydrogen Peroxide
 - Pouches
 - Tape
 - Chemical Indicator Strip



Ultraviolet Germicidal Irradiation (UVGI)

- UV has been used since the mid 20th Century. UV disinfecting devices are devices that use UVA or UVC light to produce a germicidal effect.
- UV Methods do not have FDA EUA; however they are recommended by CDC and OSHA.
- The University of Nebraska developed a procedure for decontaminating and reusing N95 respirators using the ClorDiSys Torch UVGI device.

<https://www.nebraskamed.com/sites/default/files/documents/covid-19/n-95-decon-process.pdf>

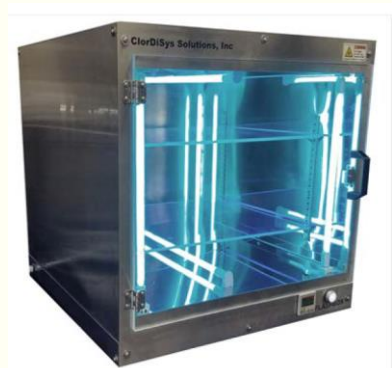
- UVC Cabinets are also available.



Ultraviolet Germicidal Irradiation (UVGI)

Procedure using the ClorDiSys Flashbox

- Print name on mask and place used mask into paper bag and print name on bag.
- Tally number on each mask with permanent marker.
- Position masks on shelf so that they do not overlap, and it appears as though all surfaces will be exposed to the UV-C light.
- Set timer for one (1) minute, press start button.
 - 60mj/cm²
- Lights will turn off when finished, open door and place mask into clean paper bag with user's name.



Ultraviolet Germicidal Irradiation (UVGI)

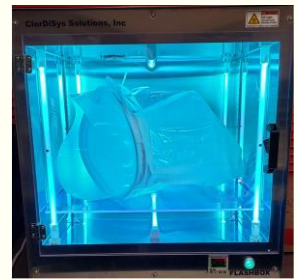
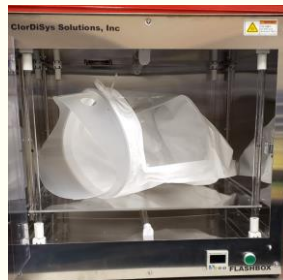
- Can set up anywhere on a sturdy table and plugged into a 115 VAC outlet.
- Not for KN95 or surgical mask.
- 10 - 20 masks per batch
- Reprocess the masks up to five (5) times
- Cost - Tower = ~\$25,000
Cabinet = ~\$7,500
- Consumables
 - UVC Lamps (16,000 hrs., \$75)
 - Paper bags



Ultraviolet Germicidal Irradiation (UVGI)

Other Uses

- Electronic equipment – cell phones, tablets, keyboards, two-way radios.
- Hand tools
- Qualitative fit-test hoods



Further Reading – Studies

- **Toxicology and Industrial Health Journal, September 2020:** “A critical review of methods for decontaminating filtering facepiece respirators”
- **Journal of the American Association for Laboratory Animal Science, January 2018:** “Evaluation of 6 Methods for Aerobic Bacterial Sanitization of Smartphones”
- **Nature Research Journal, Scientific Reports, September 2020:** “Efficacy of masks and face coverings in controlling outward aerosol particle emission from expiratory activities”

QUESTIONS & ANSWERS
