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SCHOOL OF MEDICINE

Elastomeric Respirators in Healthcare: Lessons learned and adaptation for COVID-19

NIEHS Worker Training Program
April 15, 2020

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Disclosure/Disclaimer

- I receive research funding to study elastomeric respirator use in healthcare by:
 - CDC NIOSH (1R211OH010868-01, completed)
 - CleanSpace Technology (active)
- The findings and conclusions in this report are those of the author and do not necessarily represent the views of the University of Maryland Medical Center or School of Medicine. Mention of specific products does not imply endorsement.

Familiar Respirator Use Scenarios in Healthcare:

- **Tuberculosis**

- Avian Influenza

- Varicella

- Measles

- Novel pathogens

Certain pathogens



- High Hazard Procedures

- Bronchoscopy

- Intubation

- Sputum induction

- Aerosolized administration of certain meds (Ribavirin, Pentamidine)

N95s



Filtering Facepiece Respirator (FFR)

- Disposable
- Covers the nose and mouth
- Filters out particles such as dust, mist, and fumes
- Select from N, R, P series and 95, 99, 100 efficiency level
- Does NOT provide protection against gases and vapors
- Fit testing required

Powered Air-Purifying Respirator (PAPR)

- Reusable components and replaceable filters or cartridges
- Can be used to protect against gases, vapors, or particles, if equipped with the appropriate cartridge, canister, or filter
- Battery-powered with blower that pulls air through attached filters or cartridges
- Provides eye protection
- Low breathing resistance
- Loose-fitting PAPR does NOT require fit testing and can be used with facial hair
- Tight-fitting PAPR requires fit testing



Elastomeric Half Facepiece Respirator

- Reusable facepiece and replaceable cartridges or filters
- Can be used to protect against gases, vapors, or particles, if equipped with the appropriate cartridge or filter
- Covers the nose and mouth
- Fit testing required

Coronavirus Disease 2019 (COVID-19)

CDC > Coronavirus Disease 2019 (COVID-19) > Healthcare Professionals > Strategies to Optimize PPE & Equipment



Coronavirus Disease 2019 (COVID-19)

How to Prepare +

Symptoms & Testing +

Are You at Higher Risk for Severe Illness? +

If You Are Sick or Caring for Someone +

Frequently Asked Questions

Strategies for Optimizing the Supply of N95 Respirators

Updated February 29, 2020

Conventional Capacity Strategies

Contingency Capacity Strategies

Crisis Alternate Strategies

Elastomeric respirators in use at Univ of Maryland-Baltimore since 2009

- 2009 H1N1 caused N95 shortages
 - Safety Director familiar with elastomerics from general industry
- Workers in Hospital and Ambulatory Practices
 - Inpatient units: i.e. Medicine, MICU, ED, Peds, Radiology
- Duration
 - Practice continued after 2009, transitioned away from late 2016
 - ~25% wanted to remain (NASEM 2017)



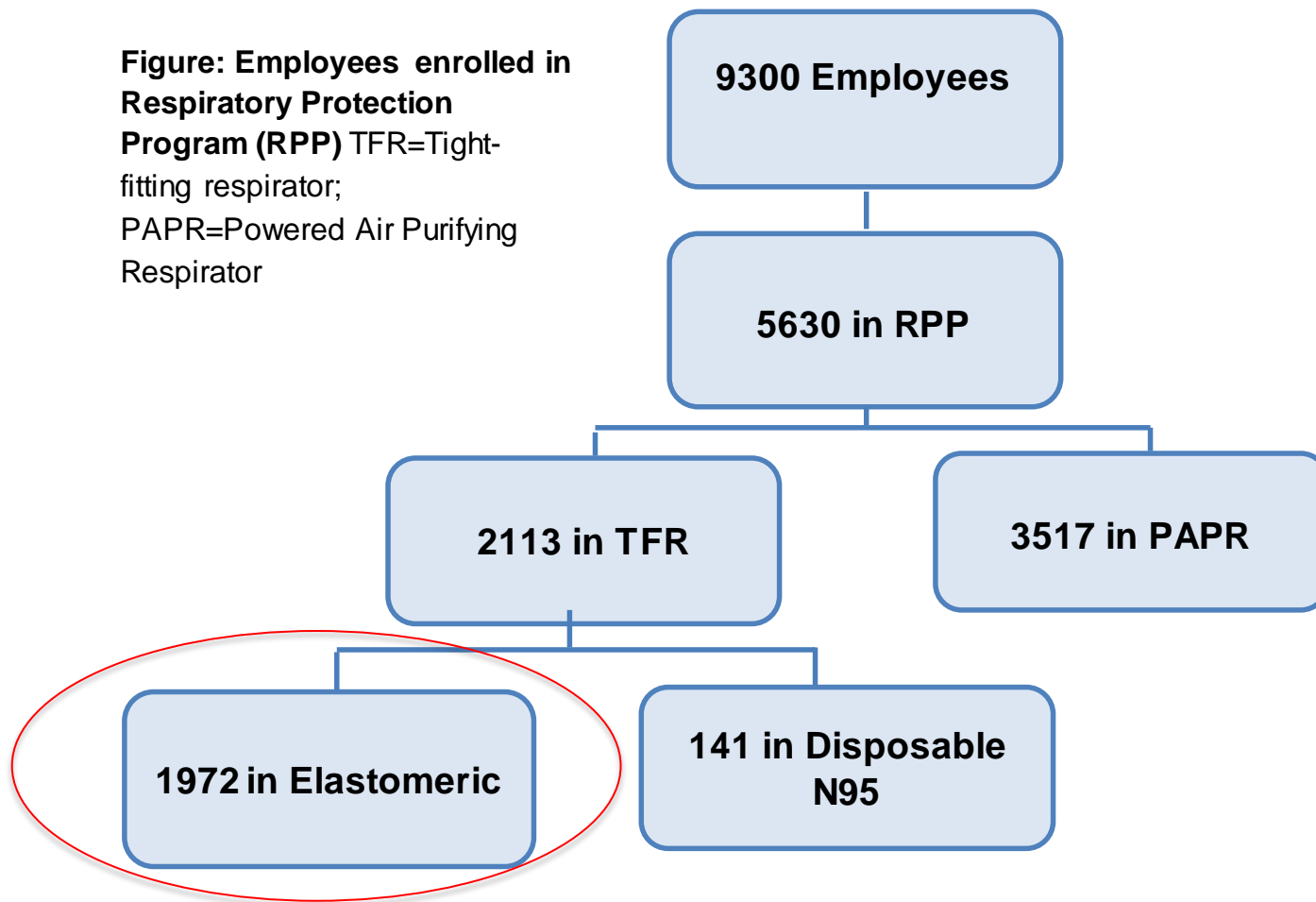
Devices

- 3M 7500 Series Elastomeric Respirators
 - Small, medium, large face masks
- 3M P100 particulate cartridge filters
 - Covered, cleanable



Large, urban US academic medical center, hospital & ambulatory – 6/2014

Figure: Employees enrolled in Respiratory Protection Program (RPP) TFR=Tight-fitting respirator; PAPR=Powered Air Purifying Respirator



2015-2016 Study using
Key Informant interviews, Focus Groups
and Electronic Surveys

Are elastomeric respirators an

- Acceptable (i.e. user acceptability)
- Feasible (logistics – storage, cleaning, supply)

alternative to N95s in healthcare?

- 1152 respondents
- 432 elastomeric respirator users

UMMC respirator study of 1152 participants – User Acceptance

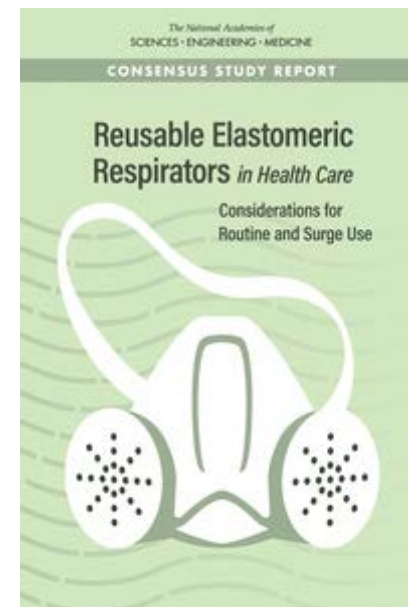
- **Elastomerics** scored highest in **sense of protection** from disease & **confidence** that the respirator will protect.
- *Despite* lower comfort & communication ratings, elastomeric users still **PREFERRED** to use them in certain risk scenarios

Study Findings

- User acceptance is **not** a critical barrier (*Hines et al, AJIC 2019*)
- Storage & assuring availability are significant barriers to assigned use (*Hines et al., Health Security 2019*)
- Decontamination NOT a barrier to assigned use, but inadequate compliance with expected decontamination practice when left to the individual (*Hines et al., under review*)
 - Probably can be taught
 - Strategies to centralize would bypass this

Storage & Availability Options

- Central vs. individual responsibility
 - TCID – backpacks (NASEM 2018)
 - WorkSafe BC (Ciconte & Danyluk, 2013)
 - Failed because dedicated staff had not been identified to transport respirators to/from units to cleaning area
- Take home:
 - Central cache: identify staff in advance, assure job duties
 - Individual maintenance: Provide means of readiness (bag)



Cleaning & Disinfection Options

- Cleaning = removal of soiling agents (dirt)
- Disinfection = removal of microbial agents (virus)
- Strategies
 - Individually based
 - Centrally based
 - Need dedicated staff, resource, time

Effectiveness of Common Healthcare Disinfectants against H1N1 Influenza Virus on Reusable Elastomeric Respirators

Shobha S. Subhash, MS, MPH;¹ Maria Cavaiuolo;² Lewis J. Radonovich Jr, MD;^{1,3} Aaron Eagan, RN, BSN;¹ Martin L. Lee, PhD;⁴ Sheldon Campbell, MD, PhD;^{2,5} Richard A. Martinello, MD^{6,7}

Disinfection of reusable elastomeric respirators by health care workers: A feasibility study and development of standard operating procedures

Mary T. Bessesen MD^{a,b,*}, Jill C. Adams BSN^a, Lewis Radonovich MD^{c,d}, Judith Anderson MD^a

Assessment of half-mask elastomeric respirator and powered air-purifying respirator reprocessing for an influenza pandemic

Caryn Lawrence BS^a, Delbert A. Harnish MS^{a,*}, Megan Sandoval-Powers BS^a, Devin Mills BS^a, Michael Bergman MS^b, Brian K. Heimbuch MS^a



Published protocols for manual elastomeric respirator reprocessing

- Protocols described in:
 - Bessesen et al, AJIC 2015,
 - Lawrence et al., AJIC 2015,
 - Heimbuch & Harnish, 2019.
- Cleaning
 - Remove filters
 - Use neutral detergent (dish soap) & warm water, sponge/soft brush
- Disinfection
 - Dilute bleach (<0.1%)
 - Rinse
- Time: 16-23 minutes; Up to 6 hours for drying (straps)

Photo: Bessesen et al, 2015.



Photo #2

Automated Reprocessing

- Upper temperature limits for elastomerics
- ARA 2019 Report: 5 elastomeric models contaminated with influenza
- Hospital Washer-Disinfectors
 - Performed at **50° C** (122° F) – *normally these machines operate at >90° C*
 - Used Miele® G7899 washer-disinfector



ARA 2019: Mitigate a Shortage of Respiratory Protection Devices HHSF223201400158C

Evidence of Effect

- Virus Removal (influenza)
 - Manual
 - Virus eliminated from all surfaces
 - Fabric surfaces harder to test
 - Automated
 - No detectable viable virus
 - No difference between only cleaning vs. cleaning + disinfection
- Durability
 - Manual
 - Passed all tests (**150 cycles**)
 - Automated
 - Passed all durability tests in 4 of 5 models (**100 cycles**)

Filter cartridges

- Cleaning/Disinfection
 - Cleaning equivalent to Cleaning + Disinfection
 - Neutral detergent
 - SaniCloth Wipe
 - Removed all virus
 - Passed all tests after 150 cycles
- Change the filters if they become wet or damaged



Current local plans for CoVID19

- Ambulatory practices
 - Elastomerics main form of respiratory protection
- Hospital
 - Elastomerics part of pandemic plan
 - Disinfect with 4 wipes after each use
 - End of Shift Centralized Cleaning
 - Bessesen/Lawrence protocol
 - Shared supply



Summary

- Elastomeric respirators have been used in healthcare, prior to COVID19.
- Facilities must have plans for assuring storage, availability, cleaning & disinfection.
- Cleaning & Disinfecting protocols exist & can be adapted for local use
- Elastomeric respirators can alleviate N95 shortage burdens on respiratory protection options

Key References

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Thank
You

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a-d: Doctors wearing 3M 7500 series with P100 cartridge filters: e: Doctor wearing CleanSpace Halo hybrid elastomeric/PAPR