Hospital Elastomeric Respirator Use
Pre- and During COVID-19

Cal/OSHA
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Disclosure/Disclaimer

• I receive research funding to my institution to study elastomeric respirator use in healthcare by:
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• 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.
Elastomeric respirators in use at Univ of Maryland-Baltimore since 2009

- 2009 H1N1 caused N95 shortages
  - Safety Director familiar with elastomeric 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 7093 P100 particulate cartridge filters
  – Covered, cleanable
Figure: Employees enrolled in Respiratory Protection Program (RPP) TFR=Tight-fitting respirator; PAPR=Powered Air Purifying Respirator

- 9300 Employees
  - 5630 in RPP
    - 2113 in TFR
    - 3517 in PAPR
    - 1972 in Elastomeric
    - 141 in Disposable N95
2015-2016 Study using Key Informant interviews, Focus Groups and Electronic Surveys

*Are elastomeric respirators an alternative to N95s in healthcare?*

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

*alternative to N95s in healthcare?*

- 1152 respondents
- 432 elastomeric respirator users
2016 UMMC respirator study of 1152 participants – User Acceptance

- **Elastomeric**s 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

Hines et al, AJIC 2019
Availability

<table>
<thead>
<tr>
<th>Availability</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>2%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>0%</td>
</tr>
<tr>
<td>About half the time</td>
<td>2%</td>
</tr>
<tr>
<td>Usually</td>
<td>19%</td>
</tr>
<tr>
<td>Always</td>
<td>75%</td>
</tr>
</tbody>
</table>

Hines et al., Health Security, 2019
Storage location

<table>
<thead>
<tr>
<th>Storage Location</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>In a drawer near the patient’s room</td>
<td>5</td>
</tr>
<tr>
<td>Somewhere in the patient care area nearby (like a locker)</td>
<td>60</td>
</tr>
<tr>
<td>Somewhere on campus</td>
<td>9</td>
</tr>
<tr>
<td>In my car/at home/don’t know</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>19</td>
</tr>
</tbody>
</table>

*Inconvenient storage location more often reported in non-compliant elastomeric users*

Logistics - Decontamination

<table>
<thead>
<tr>
<th>I wipe my respirator with an alcohol pad or disinfectant wipe after each use.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>4</td>
</tr>
<tr>
<td>Sometimes</td>
<td>11</td>
</tr>
<tr>
<td>Half the time</td>
<td>6</td>
</tr>
<tr>
<td>Usually</td>
<td>21</td>
</tr>
<tr>
<td>Always</td>
<td>58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I remove the filters and wash inside of my respirator with soap and water</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rarely/never</td>
<td>69</td>
</tr>
<tr>
<td>Yearly</td>
<td>11</td>
</tr>
<tr>
<td>Monthly</td>
<td>9</td>
</tr>
<tr>
<td>Weekly</td>
<td>3</td>
</tr>
<tr>
<td>After each shift</td>
<td>8</td>
</tr>
</tbody>
</table>

No difference in reporting between compliant vs non-compliant elastomeric users.

Hines et al, Workplace Health & Safety 2020
2016 Study Findings

- User acceptance is **not** a critical barrier \((Hines \ et \ al, \ AJIC \ 2019)\)
- Storage & assuring availability are barriers to expected use \((Hines \ et \ al., \ Health \ Security \ 2019)\)
- Disinfection NOT a barrier to expected use, but inadequate compliance with expected cleaning practice when left to the individual \((Hines \ et \ al., \ Workplace \ Health \ and \ Safety \ 2020)\)
  - Probably can be taught
  - Strategies to centralize would bypass this
Storage & Availability Options

• Central Cache vs. individual-based
  – TCID – backpacks (NASEM 2018)
  – WorkSafe BC (Ciconte & Danyluk, 2013)
  – Allegheny Health (Chalikonda 2020)

• 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
Published protocols for manual elastomeric respirator reprocessing

• Protocols described in:

• 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)
Automated Reprocessing

• Limits on upper temperature limits for elastomeric materials

• 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
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
    cleaning alone vs.
    cleaning + disinfection

• Durability
  – Manual
    • Passed all tests (150 cycles)
  – Automated
    • Passed all durability tests in 4 of 5 models (100 cycles)

Do you have to wash in soap & water or just disinfect with a wipe?

- Halo ARC Study (Hines et al., JISRP 2020)
  - Facial contaminants – yes
  - Need to also get disinfectant residue off
  - Viral contaminants – yes, at some interval
Filter cartridges

• Cleaning/Disinfection
  – Cleaning alone equivalent to Cleaning + Disinfection
    • Neutral detergent
    • SaniCloth Wipe
  – Removed all virus
  – Passed all tests afterwards
• Change the filters......if they become wet or damaged

Current CoVID19 Respirator Program at University of Maryland

- Ambulatory practices
  
  *(Run by Employee Health)*
  
  – Elastomerics main form of respiratory protection
    
    • Individually-assigned
    
    • Practices expected to clean & maintain
    
    • Policies, protocols and videos available to public on website

Current CoVID19 Respirator Program at University of Maryland

• Hospital *(run by Safety)*
  – Elastomerics part of pandemic plan
  – Disinfect with *wipes* after each use
  – *End of Shift* Cleaning in Central Sterile Processing
    • Bessesen/Lawrence protocol
  – Shared supply

https://www.n95decon.org/implementation#other-ppe
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 some N95 shortage burden
What is an Elastomeric Respirator?

Elastomeric respirators are reusable air purifying respirators with replaceable filters that filter 95-100% of airborne particles, depending on filter type. They can cover the nose and mouth (half face respirators) or the entire face (full face respirators). Many elastomeric respirators allow unfiltered exhaust of the user's exhaled breath.

Facemask: A conformable face mask is held in place by adjustable straps.

Elastomeric Seal: Air is pulled through the filters into the breathing zone due to a tight seal between the mask and the face. Fit-testing is required.

Filters: Replaceable filters are attached to the facemask. Filters covered by a plastic casing can be repeatedly reused, provided they are not soiled, damaged, or become difficult to breathe through.

Exhalation port: Most elastomeric respirators have an unfiltered exhalation port for easier breathing. Those with unfiltered exhalation ports are not recommended for use in sterile procedures where barrier face masks are required, such as surgery. The presence of infectious particles in exhaled breath has not been studied. It may be possible to filter exhausted air.

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https://www.n95decon.org/publications