Elastomeric Respirators: Infection Control Perspective

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Respirator Use in Health Care

- **N95 filtering facepiece respirator**
  - Single-Use, Disposable
  - Requires fit testing, initial training and annual fit test
  - Extended use requires administrative and engineering controls to limit surface contamination

- **Elastomeric Half-Facepiece Respirators**
  - Reusable
  - Requires medical surveillance, initial training and annual review
  - Requires cleaning and disinfection after use
  - Usage: minor spill control (e.g. formaldehyde (Histology Lab))
    - Emergency Preparedness Decon Response Team
    - Alternative for fit test failure with N95 respirator (e.g. PAPR)
Common Disinfectants in Health Care for cleaning patient care equipment

- Alcohol
- Quaternary Ammonium Compounds
- Sporicidal agents (e.g. bleach, peracetic acid, hydrogen peroxide)

<table>
<thead>
<tr>
<th>Disinfectant wipes</th>
<th>Use to clean Electronic Devices (computer screens) Contact time: 3 min</th>
<th>Use to Clean Patient Care Equipment Contact time: 2 min</th>
<th>Use to clean Patient Care Equipment in high risk areas endemic with <em>Clostridium difficile</em>, <em>Norovirus</em> and <em>Candida auris</em>. Contact time: 4 min.</th>
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<tbody>
<tr>
<td>Quaternary ammonia compound disinfectant (no alcohol)</td>
<td>Quaternary ammonia compound disinfectant with isopropryl alcohol</td>
<td>Sodium hypochlorite</td>
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Elastomeric Respirators

Cleaning and Disinfection:  Follow Manufacturer’s IFU

- Disassemble the respirator, removing any filters, canisters or cartridges
- Wash the facepiece and associated parts in mild detergent with warm water
- Rinse in clean warm water, preferably running water and drain
- Use a disinfecting agent (i.e. bleach or iodine solution or commercially available disinfectant)
- Rinse components thoroughly in clean warm water, preferably running water and drain. *Important step to avoid contact dermatitis with residual chemical on facepiece*
- Dry with clean cloth or air dry
- Re-assemble respirator
- Test to ensure all components work properly

PAPRs - Powered Air Purifying Respirators

Donning the apparatus to enter the patient room:

1. Wash hands.
2. Remove the airflow indicator and connect the breathing tube to the hood/visor assembly.
3. Remove paper cover from clear Acetate visor on the hood/visor assembly.
4. Strap air filter unit around waist over outer gown and turn unit on.
5. Pull hood/visor assembly on over head and assure an airtight fit.

Post procedure:

1. Wash hands. Exit patient room
2. Remove hood/visor assembly from head.
3. Disconnect hood/visor assembly from hose.
4. Mark hood with your name in permanent marker. Using gloves, disinfect hood with alcohol and store in your locker for reuse. If hood becomes damaged, replace hood.
5. Unstrap PAPR unit from around.
6. Wipe down the PAPR unit and tubing with disinfectant wipes.*
7. Remove gown and wash hands.

*Contact pathogens (i.e. *Clostridium difficile*, *Candida auris*, other MDROs) require bleach disinfectant wipes.
Transmission Based Precautions

Respirator Personal Protective Equipment required for:

- Airborne Isolation
  - Tuberculosis
  - Measles
- Airborne and Contact Isolation
  - Chickenpox, Disseminated Zoster
  - Monkey pox, Smallpox
  - SARS- CoV
  - Viral Hemorrhagic Fever (i.e. Ebola, Marburg)
  - Novel Respiratory Viruses (i.e. Influenza A (H1N1) 2009)
    - Resuscitation (emergency intubation, CPR and endotracheal intubation)
    - Open suctioning of airway secretions
    - Bronchoscopy
    - Collection of nasopharyngeal specimens
Study reported observed variation in N95 respirator use by nurses demonstrating isolation care. University of Nebraska.

- Identified need for consistent strap placement and seal check to prevent migration of mask on the face while in the room.
- Education focus on contaminated areas of N95 mask and reinforce safe practices for removal and use.

Disinfection of reusable elastomeric respirators by HCWs

- Study reported reusable facial protective equipment may be disinfected by HCWs with minimal training when using SOPs (Standard Operating Procedures). University of Colorado.
  - This study provides SOPs that can be used for deployment in health care settings using readily available supplies.
  - Applied human factors principles to pandemic preparations
  - Designed and tested SOPs for rapid deployment in event of an airborne infectious disease outbreak
  - Results showed significantly fewer errors when HCWs followed specific developed SOPS versus using manufacturer’s instructions
  - Challenges and limitation during pandemic include:
    - Shortage of bleach. Hospital supply vendors (5.25% - 6%) vs Retail (8.25%)
    - Chlorine off-gassing minimized if air dried overnight
    - Average respirator disinfection time 16 minutes. Utility room and sink availability issue.
    - Other considerations: Washer-sterilizers, ultraviolet light disinfection for clean respirators

Assessment of elastomeric respirator reprocessing for an influenza pandemic

- NIOSH study demonstrated that elastomeric respirators and PAPRs can be effectively disinfected when challenged with a pandemic influenza strain.
  - Of 41 surfaces tested, only 1 showed recoverable viable virus after cleaning and disinfection.
  - This study used detailed cleaning and disinfection methods for both half-mask elastomeric respirators and PAPRs, with demonstrated effectiveness. Potential adoption of SOPs for the industry.
  - Cleaning alone was shown to be similarly as effective for most surfaces as cleaning and disinfection.

- Challenges and limitation during pandemic include:
  - Logistics and time required for cleaning and disinfection in healthcare facility
  - SOPs need to be clear and specify appropriate PPE to wear
  - Manufacturers may have separate IFUS for each component of PAPR
  - Average respirator disinfection time 15 minutes, not including drying time
  - Cleaning alone may be necessary if disinfectant (e.g. bleach) not available

Elastomeric Respirators: Challenges in Health Care during Epidemic

- **Education**
  - Just in time training (e.g. SOPs and validation)
  - Patient education - address anxiety, feelings of isolation, fear

- **Storage**
  - During work shift and between shifts

- **Cleaning and disinfection**
  - Centralized area (e.g., Central Processing Department) vs Soiled utility room
  - In between patient care: usage of disinfectant wipes
  - Number of patient care encounters: “Healthcare providers might need to clean their hands as many as 100 times per 12-hour shift, depending on the number of patients and intensity of care.” (CDC)

- **Allocation algorithm for particular service lines based on risk assessment**
  - Assignment of respirator to individual
  - Visual field may be limited; clarity of speech may be impeded
  - Fit testing, medical surveillance
  - Independent Practitioners

- **Shortage of cleaning/disinfectant supplies**
Remembering the 1918 Influenza Pandemic

- In a list of 12 rules to prevent the disease’s spread, the Army’s surgeon general wrote that people should “avoid needless crowding,” open windows and “breathe deeply” when the air is “pure” and “wash your hands before eating.”
- One slogan was, “Cover up each cough and sneeze. If you don’t, you’ll spread the disease.”
- Those who were healthy wore masks when venturing outside. People who were known to be infected were threatened with a $50 fine if they were seen in public. Sardo remembers people throwing buckets of water with disinfectant on their sidewalks to wash away germs from people spitting on the street.

NBC News.com. “Survivors remember 1918 global flu pandemic”