Reuse of Masks

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January 20: ZHONG Nanshan

“戴口罩有用。” Masks Can Help.

January 22：National Health Commission

“建议一定戴口罩。提倡口罩文明”

Wear Masks. Civilization of Mask.

http://www.xinhuanet.com/2020-01/22/c_1125493839.htm
Supply and Demand ——Huge Gap

Ministry of Industry and Information Technology
January 23: “8 million masks per day”
February 2: “10 million masks per day, including 600 thousand N95 masks per day.”

Population: 1.4 billion (1400 million)
Working population: 700 million

http://finance.ifeng.com/c/7tJUeYUzri; http://finance.ifeng.com/c/7tBzoKdoFl
Supply and Demand ——Huge Gap

DO NOT COME IN
UNLESS YOU WEAR A MASK

Photo taken in the front of a Bread Shop
How to use masks

- Disposable medical mask
- Surgical mask

How long?
How many times?
Can masks be washed?
How to use masks

How long?
Several hours.

How many times?
Disposable.

Can masks be washed?
No.

Is it necessary when you do not have another one?
How to reuse masks

Three criteria a good decontamination method should satisfy:
1) be effective against the target organism, that is Covid-19 virus;
2) not damage the respirator’s filtration;
3) be safe for the person wearing it.
Effective against Covid-19 virus

Methods to kill Covid-19 virus:
- **56 °C 30 min**, ethyl ether, 75% ethanol, peracetic acid, chloroform, etc.

Our thinking: Convenient for household use
Method—— Soaking used masks in hot water at a temperature >56° (typically 60–80°) for 30 min—— to kill virus

Guidance from the National Health Commission of the People’s Republic of China, February 6, 2020
Three steps for household

**Step One:** Soaking used masks in hot water at a temperature >56° (typically 60–80°) for 30 min. The temperature and timing are based on guidance from the National Health Commission of the People’s Republic of China for killing the Covid-19 coronavirus.

**Step Two:** Essential to restoring the electrostatic charge critical to their filtering function, the masks are dried with a standard—but non-static—hair dryer for 10 min.

**Step Three:** Successful regeneration is confirmed by sprinkling the mask with small scraps of paper—if the paper sticks, the electrostatic charge has been restored.
Reuse of Masks

Engineering

中国工程院院刊
Filterability for 0.1 μm Particles in New and Regenerated Masks After Regeneration Treatment. Tested per China National Standard GB 2626-2006.

<table>
<thead>
<tr>
<th>Mask type (Manufacturer)</th>
<th>Status</th>
<th>Sample size</th>
<th>Filterability for 0.1 μm particles, mean % (range)</th>
<th>Example photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>KF94 (Air Puri)</td>
<td>New</td>
<td>3</td>
<td>98.6 (97.4–99.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regenerated</td>
<td>3</td>
<td>98.1 (97.7–98.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1 cycle)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposable medical (Hubei Lexin)</td>
<td>New</td>
<td>5</td>
<td>46.5 (45.8–46.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regenerated</td>
<td>5</td>
<td>46.0 (44.3–47.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1 cycle)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposable surgical (Henan Yubei)</td>
<td>New</td>
<td>5</td>
<td>76.9 (73.9–78.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regenerated</td>
<td>5</td>
<td>75.5 (74.9–77.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1 cycle)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>regenerated</td>
<td>5</td>
<td>75.4 (73.7–77.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(10 cycles)</td>
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</tbody>
</table>
Steam sterilization by using an autoclave, which most hospitals and many clinics already commonly have on hand to sterilize surgical equipment.

It is well accepted that **30 min of pressurized steam at 121 °C kills almost all pathogens** (recognized by the US Centers for Disease Control and Prevention as the most widely available and dependable method for disinfection and sterilization in healthcare facilities).
Investigations to Clinical Setting

High pressure steam sterilization equipment
Filterability for 0.1 μm particles (%) and airflow resistance of respiration

<table>
<thead>
<tr>
<th>Mask Types</th>
<th>Filterability for 0.1 μm particles (%)</th>
<th>Expiratory resistance (Pa)</th>
<th>Inspiratory resistance (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M 1860 N95 Health Care Particulate Medical mask</td>
<td>new: 99.6%</td>
<td>59</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>regenerated a: 99.2%</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>N95 Specialized Face Mask FFP2</td>
<td>new: 99.7%</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>regenerated b: 99.2%</td>
<td>21</td>
<td>53</td>
</tr>
<tr>
<td>N95 Specialized KF94 Masks</td>
<td>new: 99.9%</td>
<td>35</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>regenerated c: 96.6%</td>
<td>39</td>
<td>59</td>
</tr>
</tbody>
</table>

*a Average of five regenerated masks that were used for 8 hours* by volunteers in Beijing University of Chemical Technology (aged between 32 to 55).

b Average of three regenerated masks.

c Average of three regenerated masks.  
All tested per China National Standard GB 2626-2006.
Summary

1. We developed a specifically designed method for household to reuse masks. Something is better than nothing and we have demonstrated that the regenerated masks is over 95% better than nothing.
2. We are working to optimize the technological parameters of autoclave-based method, with testing—including a qualitative one for fit—to determine how the process may affect other functional and performance requirements for N95 masks.
3. The testing of masks actually used by healthcare personnel is important to demonstrate the method’s effectiveness and suitability for widespread use.

Thank you for your attention and please stay safe!

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