

International Engineering Response to COVID-19

Video call with National Academies



Reuse of Masks

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January 20: ZHONG Nanshan





"戴口罩有用。" Masks Can Help.

http://paper.people.com.cn/rmrb/html/2020-01/21/nw.D110000renmrb_20200121_5-06.htm

January 22: National Health Commission



"建议一定戴口罩。提倡口罩文明"

Wear Masks. Civilization of Mask.

国家卫健委:提倡"口罩文明"一定要戴口罩

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2020-022 13:47:52 発達: 能特性"能够现在"的错 国家卫生健康委员会医政医管局负责人集难库22日在国新办当日举行的新闻发布会上提示公众,要做好个人防护和个人的卫 生,尽量减少去人员密集的地方,不管是居家、工作场所,还是学校、要保持室内定期通风的习惯,即便是在北方,在冬季也建议 短时间的开窗通风,建议一生要载口罩,提倡口罩文明,打饭一种要用手捐或者纸脂在口具,戴口罩成是文自己的防护,也是对其他 人的保护,要勤洗手,如果不小心用手捂住自己的口具,打了一个咳嚏之后一定要先洗手,不要打完咳嚏之后续脱端或者接触就做 的部位, (记者屈踪,王重阳) 【特徴】张任领征: 歪曲

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/7tTJUeYUzri; http://finance.ifeng.com/c/7tlBzoKdoFl

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





Guidance from the National Health Commission of the People's Republic of China, February 6, 2020

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 $>56^{\circ}$ (typically 60–80°) for 30 min—— to kill virus

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

Filterability for 0.1 µm Particles in New and Regenerated Masks After Regeneration Treatment. Tested per China National Standard GB 2626-2006.

Mask type (Manufacturer)	Status	Sample size	Filterability for 0.1 µm particles, mean % (range)	Example photograph s
KF94 (Air Puri)	New	3	98.6 (97.4–99.9)	
	Regenerated (1 cycle)	3	98.1 (97.7–98.5)	
Disposable medical (Hubei Lexin)	New	5	46.5 (45.8–46.8)	W -L
	Regenerated (1 cycle)	5	46.0 (44.3–47.2)	K A
Disposable surgical (Henan Yubei)	New	5	76.9 (73.9–78.5)	
	Regenerated (1 cycle)	5	75.5 (74.9–77.0)	
	regenerated (10 cycles)	5	75.4 (73.7–77.9)	

Investigations to Clinical Setting

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







Investigations to Clinical Setting



Filterability for 0.1 µm particles (%) and airflow resistance of respiration

Mask Types		Filterability for 0.1	Expiratory	Inspiratory	
		μm particles (%)	resistance (Pa)	resistance (Pa)	
3M 1860 N95		00 (0/	50	22	
Health Care	new	99.6%	59	82	
Particulate	a concepted a	00.20/	51	50	
Medical mask	regenerated	99.2%			
N95 Specialized	new	99.7%	18	47	
Face Mask		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	10	.,	
FFP2	regenerated ^b	99.2%	21	53	
N95 Specialized KF94 Masks	new	99.9%	35	47	
	regenerated ^c	96.6%	39	59	

^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.

All tested per China National Standard GB 2626-2006.

^c Average of three regenerated masks.

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 autoclavebased 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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