

Best practice is to use new N95s. Decontamination does not solve the PPE shortage crisis, and is an emergency practice to be considered during the COVID-19 pandemic. Efficacy and safety of N95 decontamination has not been fully characterized.

# COVID-19 N95 DECON & REUSE



# HEAT & HUMIDITY

See Technical Report at  
[n95decon.org/heat](https://www.n95decon.org/heat)

## CORONAVIRUS INACTIVATION

- +** 70°C dry heat for 60min inactivated\* SARS-CoV-2 on N95 under lab conditions<sup>1</sup>
- 50-85% humidity enhances inactivation of flu virus (non-CoV) on N95 and metal<sup>2-4</sup>
- ?** Real-world conditions (e.g. saliva, mucus droplets) may require higher temperature, humidity, or longer time.
- SARS-CoV-2 NOT inactivated by 70°C dry heat for 30min (on N95) and 60min (on metal)<sup>1</sup>
- Method does NOT inactivate all bacterial or mold spores on N95<sup>5</sup>

\* ≥ 3-log inactivation

## KEY CONSIDERATIONS

- Temperature and humidity must be calibrated and monitored; heating devices can be highly variable
- N95 must be isolated and returned to original user
- User seal check must be performed before each reuse
- Each don/doff can reduce N95 fit; some models fit unacceptably after 5 don/doff cycles<sup>12</sup>

## N95 MASK INTEGRITY

- +** Several 3M N95 models (1860, 8210, 8210+) keep fit and filtration for multiple 30min cycles at 70-85°C and >50% humidity<sup>6,7</sup>
- Many models (e.g., 3M 8200, 3M 8511) keep fit performance for multiple 30min cycles at 75°C dry heat<sup>8,9</sup>
- ?** Each N95 model responds differently to heat; many have not been tested with the heating conditions above<sup>1,10</sup>
- Repeated thermal cycles may damage N95 fit and filtration<sup>1,10,11</sup>

## RISKS

- Heat inactivation is **highly sensitive** to temperature, humidity, time, surface, and co-contaminants
- N95 fit and filtration may be damaged if the temperature is too high or after multiple cycles
- N95 will NOT be sterilized by the heat & humidity treatments listed above

## IMPLEMENTATION

- +** CDC released guidance on heat+humidity for N95 decontamination<sup>13</sup>
- Many devices can maintain 70-80°C, 50-85% humidity (warming cabinets, water baths, autoclaves, ovens)

## CONCLUSION

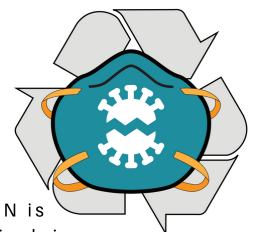
- ?** Method has not been validated in an FDA-approved process

Heat and humidity for N95 decontamination requires further investigation for inactivation of SARS-CoV-2. Its use should be evaluated by relevant authorities. This is a low-cost technique that could be easy to implement in a wide range of settings. However, excessive heating or multiple thermal cycles may damage N95 fit and filtration. Moreover, this approach will NOT protect against all bacterial and mold co-infection risks. If risks are mitigated, this protocol merits future FDA feasibility studies.

### SUPPORTING RESEARCH \*\* = not peer-reviewed

[1\*\*] Fischer et al., 2020; [2] Bergman et al., 2010; [3] Lore et al. 2012; [4] McDevitt et al., 2010; [5] Rodriguez-Palacios & LeJeune, 2011; [6\*\*] Anderegg et al., 2020; [7\*\*] Massey et al., 2020; [8\*\*] Price et al., 2020; [9] Viscusi et al., 2009; [10] Viscusi et al., 2011; [11\*\*] 3M, 2020; [12] Bergman et al., 2012; [13] CDC, 2020

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# HEAT RELATED CONCERNS

## UNPROVEN METHODS

### ? Autoclave

- Standard autoclave cycle (121°C steam, 15 min) inactivates SARS-CoV-2 on N95<sup>1</sup>
- Autoclave is an accepted means of sterilization in hospital setting
- Many pleated N95 models (3M 1870, 1804S, 1862+, 9211; Aearo 1054S) pass quantitative fit test for 5 autoclave cycles<sup>1,2</sup>
- Common molded N95 models (3M 1860, 8210, 8000) known to fail after 1-2 cycles of autoclave treatment<sup>1,3</sup>
- There are few studies on N95 filtration efficiency after autoclave treatment<sup>2,4</sup>
- Different N95 models may respond differently to autoclave cycle<sup>1</sup>

### ? Microwave-Generated Steam

- 2 minutes above water reservoir in 1250 W microwave inactivates H1N1 and H5N1 flu (non-coronavirus) on N95<sup>3,5</sup>
- No data on MGS inactivation of coronaviruses on N95
- Most common N95 models shown to withstand at least one 2-min MGS treatment, several models withstand up to 3 cycles<sup>6-9</sup>
- Possibility of N95 damage beyond three cycles<sup>10</sup>
- Few studies on N95 durability under more than one repeated decontamination cycle
- Some N95 models destroyed by 2-min microwave without steam<sup>11</sup>
- Metal components of N95 may present sparking hazard

## UNSUITABLE METHODS

### ✗ Home Oven

- Bringing potentially biohazardous materials home is highly dangerous and carries significant contamination risk

### SUPPORTING RESEARCH \*\* = not peer-reviewed

[1\*\*] Kumar et al., 2020; [2] van Straten et al., 2020; [3] Heimbuch et al., 2011; [4] Viscusi et al., 2007; [5] Lore et al., 2012; [6] Bergman et al., 2010; [7] Bergman et al., 2011; [8] Viscusi et al., 2011; [9] Fisher et al., 2011; [10\*\*] Liao et al., 2020; [11] Viscusi et al., 2009

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