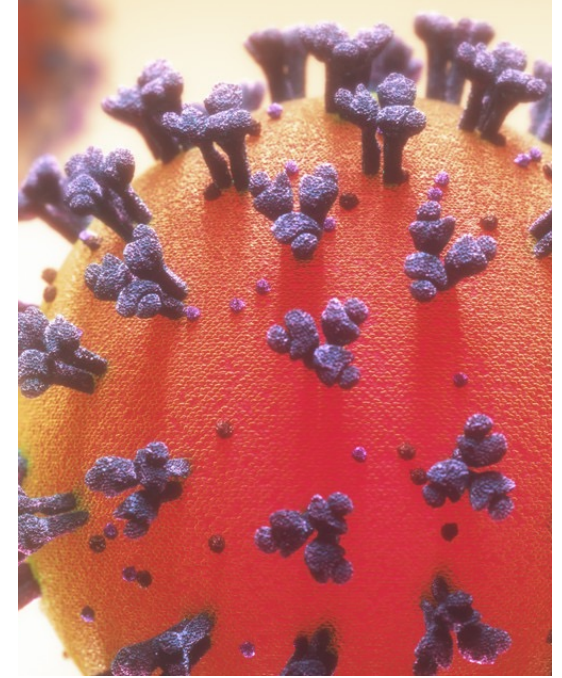


Face mask debris – possible risk to face mask users?

Shiori Echizenya

PI: Dr. Kent E. Pinkerton and Dr. Jenessa Gjeltema

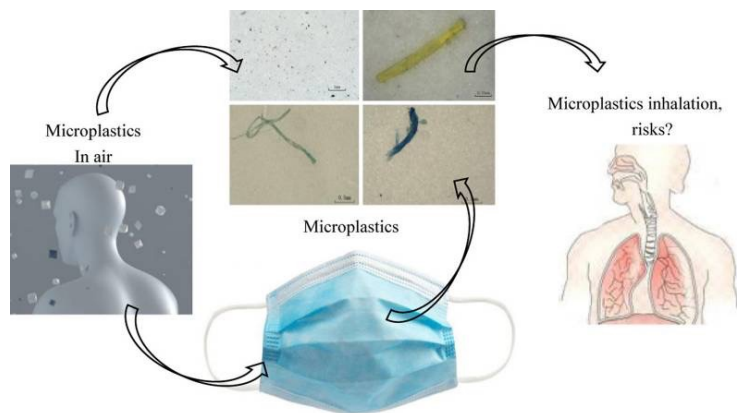


Rationale:
Urgency to continuously update face mask guidelines due to
COVID-19 and California Wildfires



COVID-19: Performance study of microplastic inhalation risk posed by wearing masks

[Lu Li](#),^{a,1} [Xiaoli Zhao](#),^{b,1} [Zhouyang Li](#),^a and [Kang Song](#)^{a,c,*}



Need for assessing the inhalation of micro(nano)plastic debris shed from masks, respirators, and home-made face coverings during the COVID-19 pandemic[☆]

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Department of Environmental Science and Engineering, Xi'an Jiaotong University, Xi'an, 710049, PR China



[Sci Total Environ.](#) 2020 Oct 1; 737: 140279.

PMCID: PMC7297173

Published online 2020 Jun 16. doi: [10.1016/j.scitotenv.2020.140279](https://doi.org/10.1016/j.scitotenv.2020.140279)

PMID: [32563114](https://pubmed.ncbi.nlm.nih.gov/32563114/)

Covid-19 face masks: A potential source of microplastic fibers in the environment

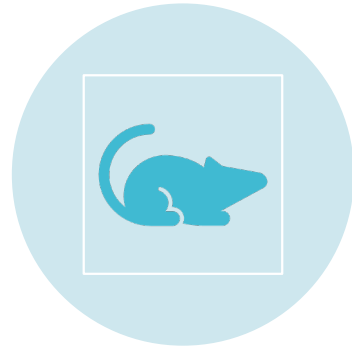
[Oluniyi O. Fadare](#)^{a,b,*} and [Elvis D. Okoffo](#)^c

Specific Aims



1. Determine size and morphology of particles from new and aged N95, surgical, and fabric masks:

Scanning Electron Microscope (SEM) and Raman Spectroscopy



2. Determine biological effects of the particles:

Intranasal instillation in mice, followed by pulmonary function test (PFT) and bronchoalveolar lavage

Inhalable Particles: $<10\ \mu\text{m}$
Respirable Particles: $<2.5\ \mu\text{m}$

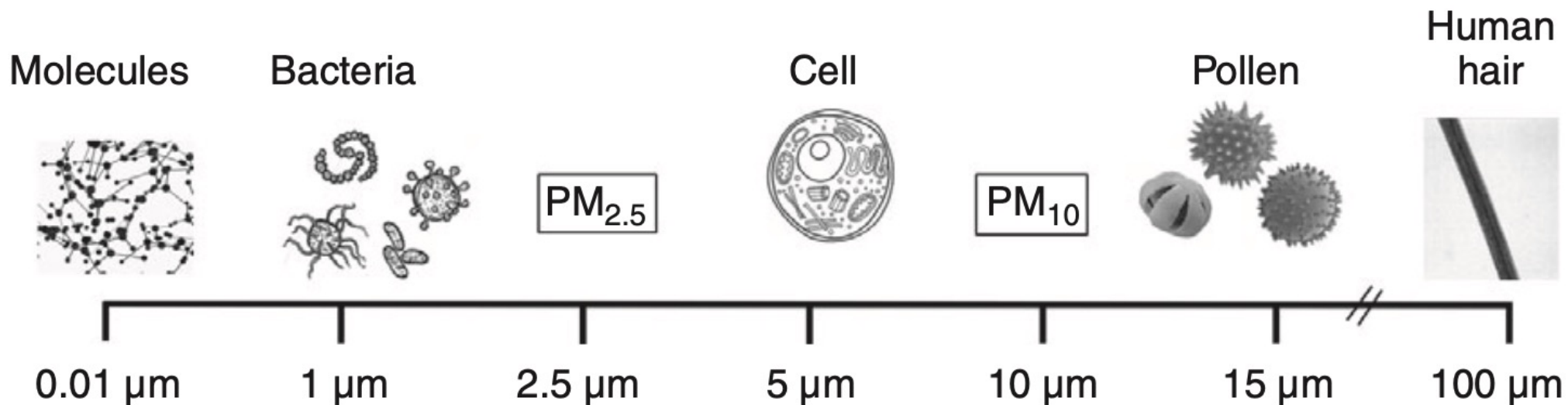


Figure 2 **Comparison of particle size fractions including particulate matter (PM), bioaerosols and reference particles.** Adapted, with permission, from Kaiser J, 2005 (66).

Hypothesis

Face masks have the potential to generate particles with potential health implications.

Aged face masks have the potential to generate more debris.

Methods

- 1 • Particle Collection
- 2 • Filter Prescreening
- 3 • Scanning Electron Microscopy
- 4 • Raman Spectroscopy
- 5 • Experimental Animal Test

1. Particle Collection



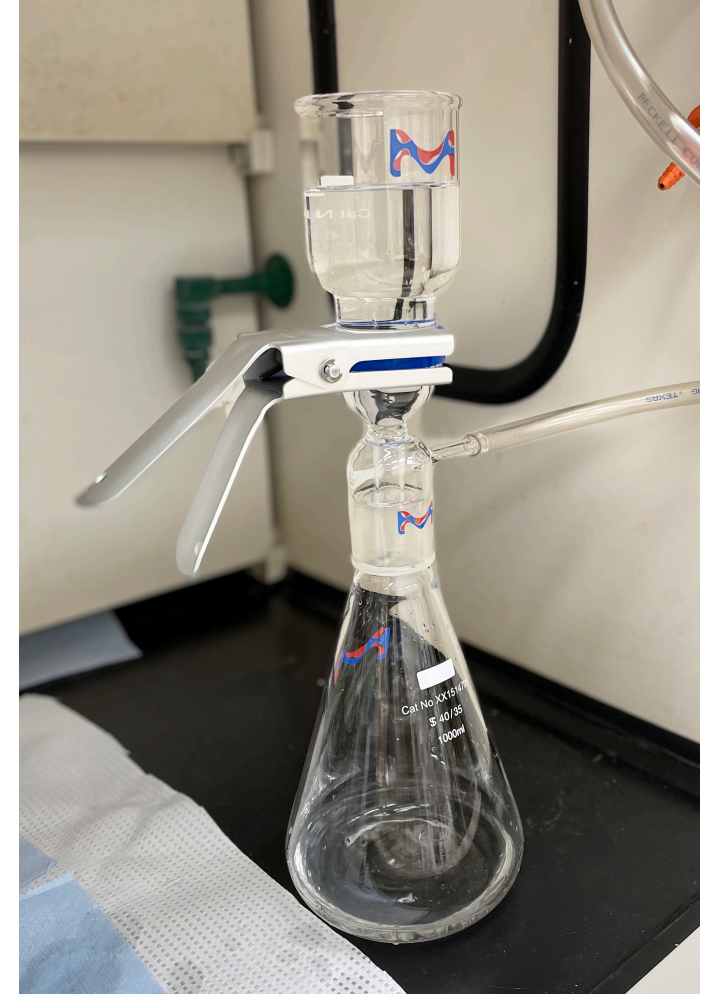
Prefilter DI Water with 0.4-micron filters.



Ultrasonicate masks in prefiltered DI water for 30 minutes.

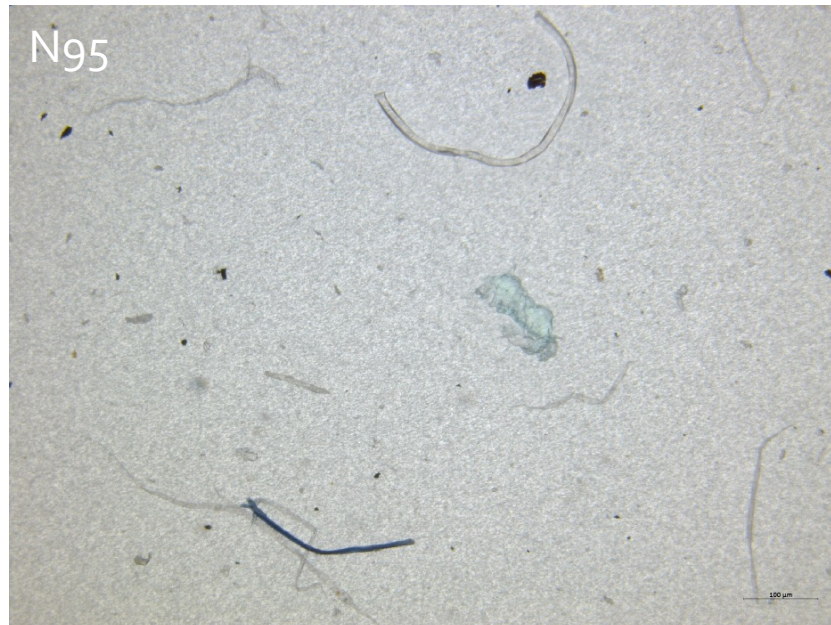
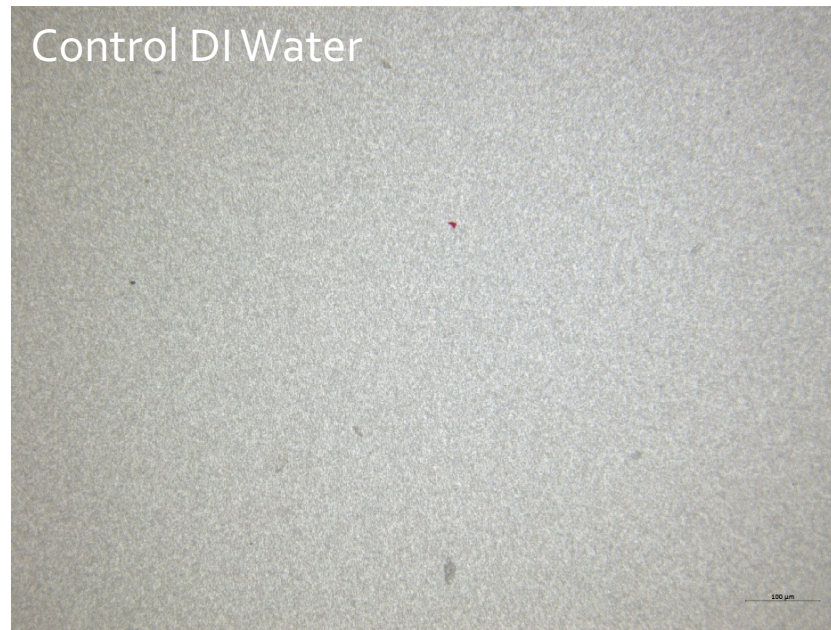


Filter 100mL of the solution onto 0.8-micron filters.



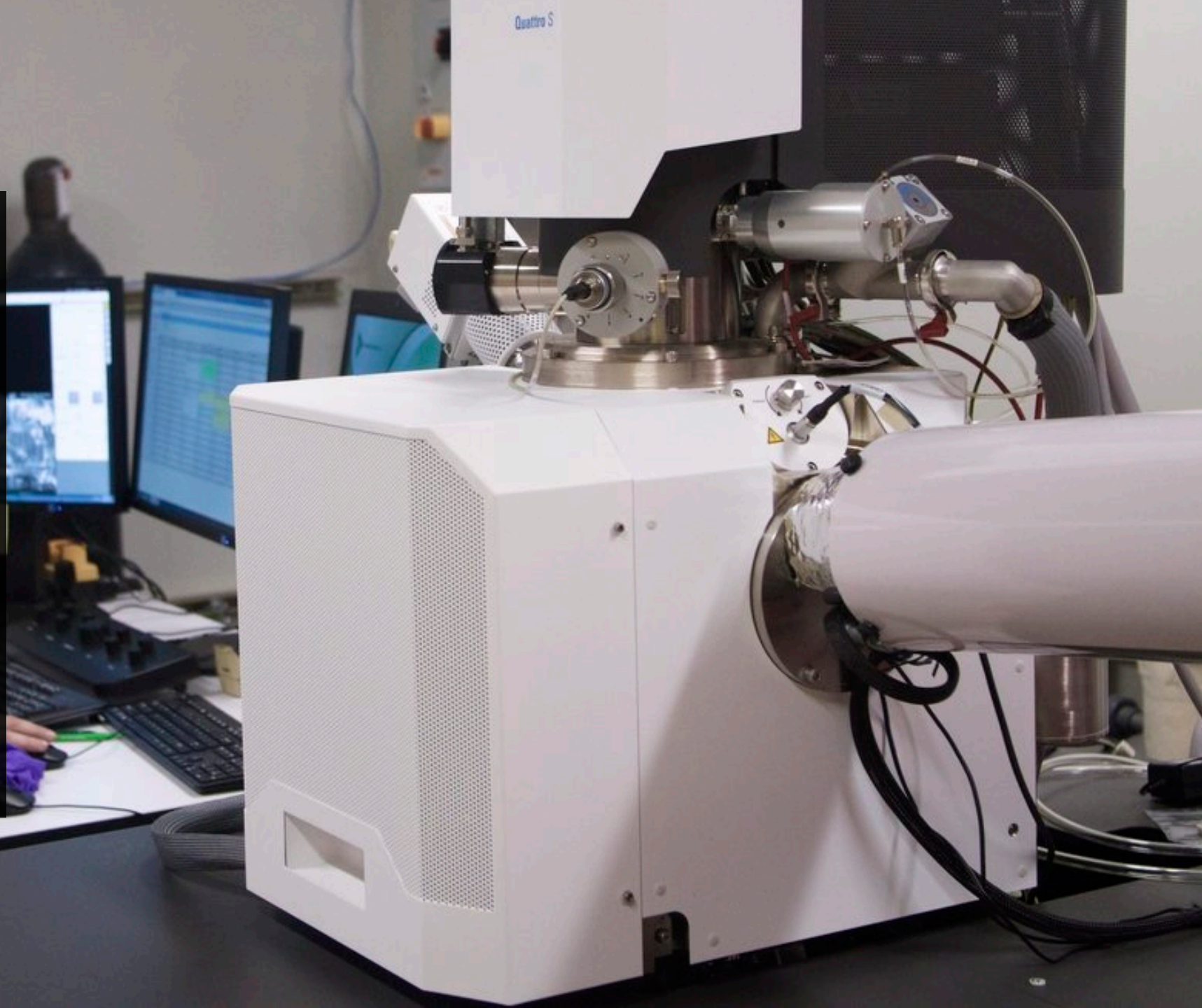
2. Filter Prescreening

Bright Field Microscopy

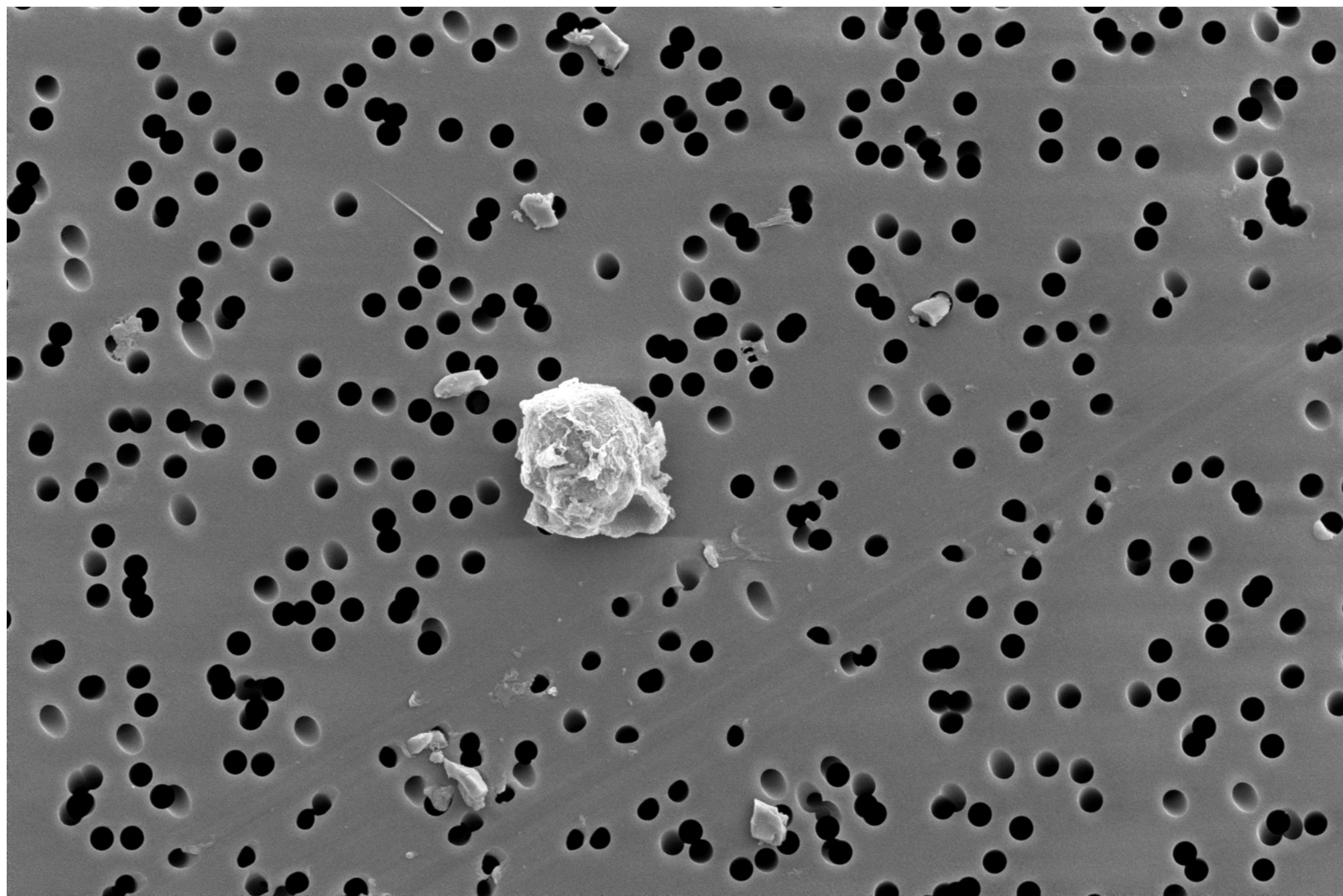



3. SEM Analysis

- Image Capturing
- 100 Particle Count for 3 samples of each mask category



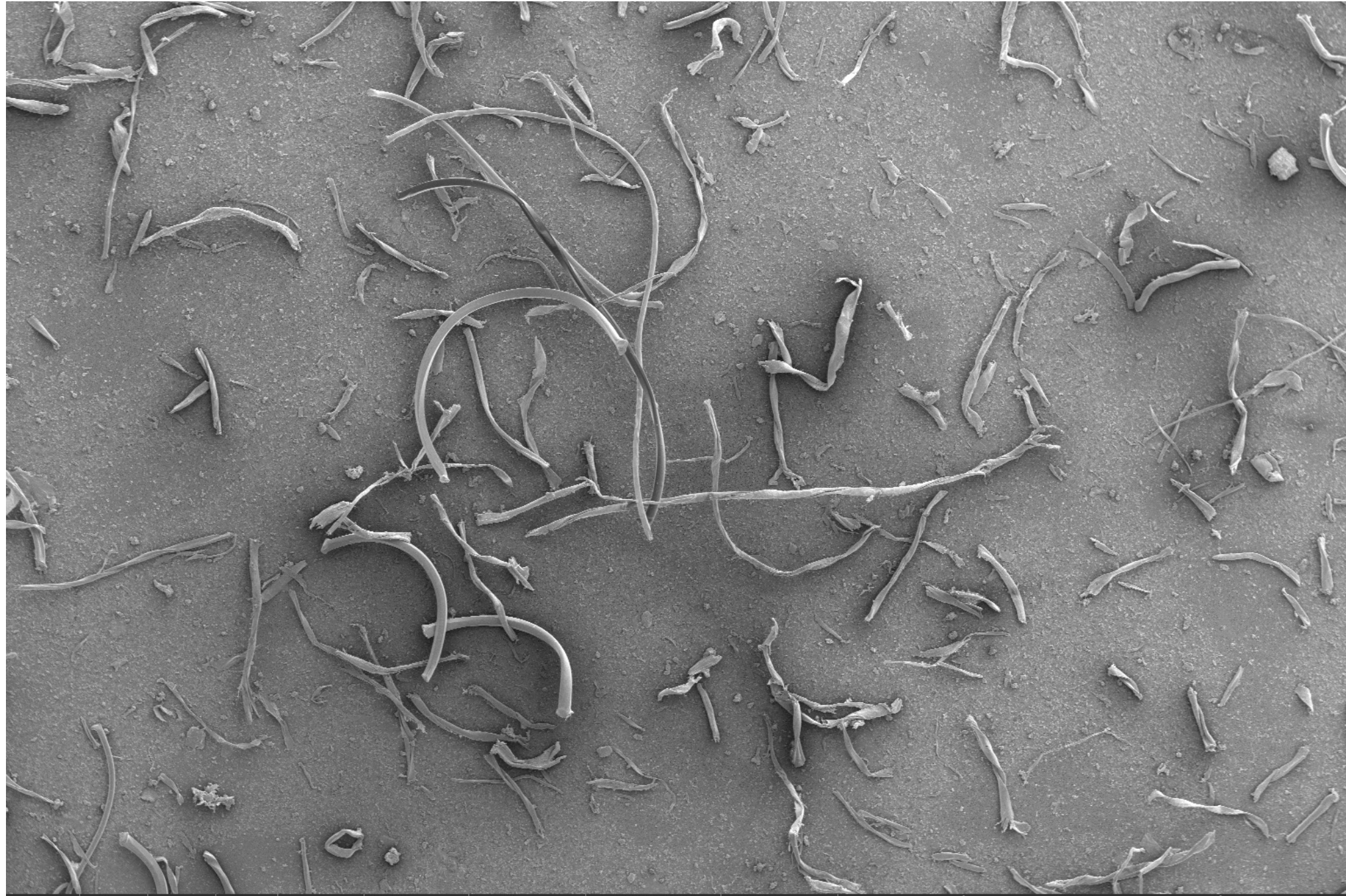
**Control:
Prefiltered
DI Water**



	tilt	spot	det	mag	HV	WD	7/7/2021	HFW
	0.0 °	3.0	ETD	5 006 x	5.00 kV	10.0 mm	2:03:09 PM	41.4 μm

10 μm
UC Davis Quattro


Non-Inhalable Particles



tilt
0.0 °

spot
3.0

det
ETD

mag 
80 x

HV
5.00 kV

WD
10.0 mm

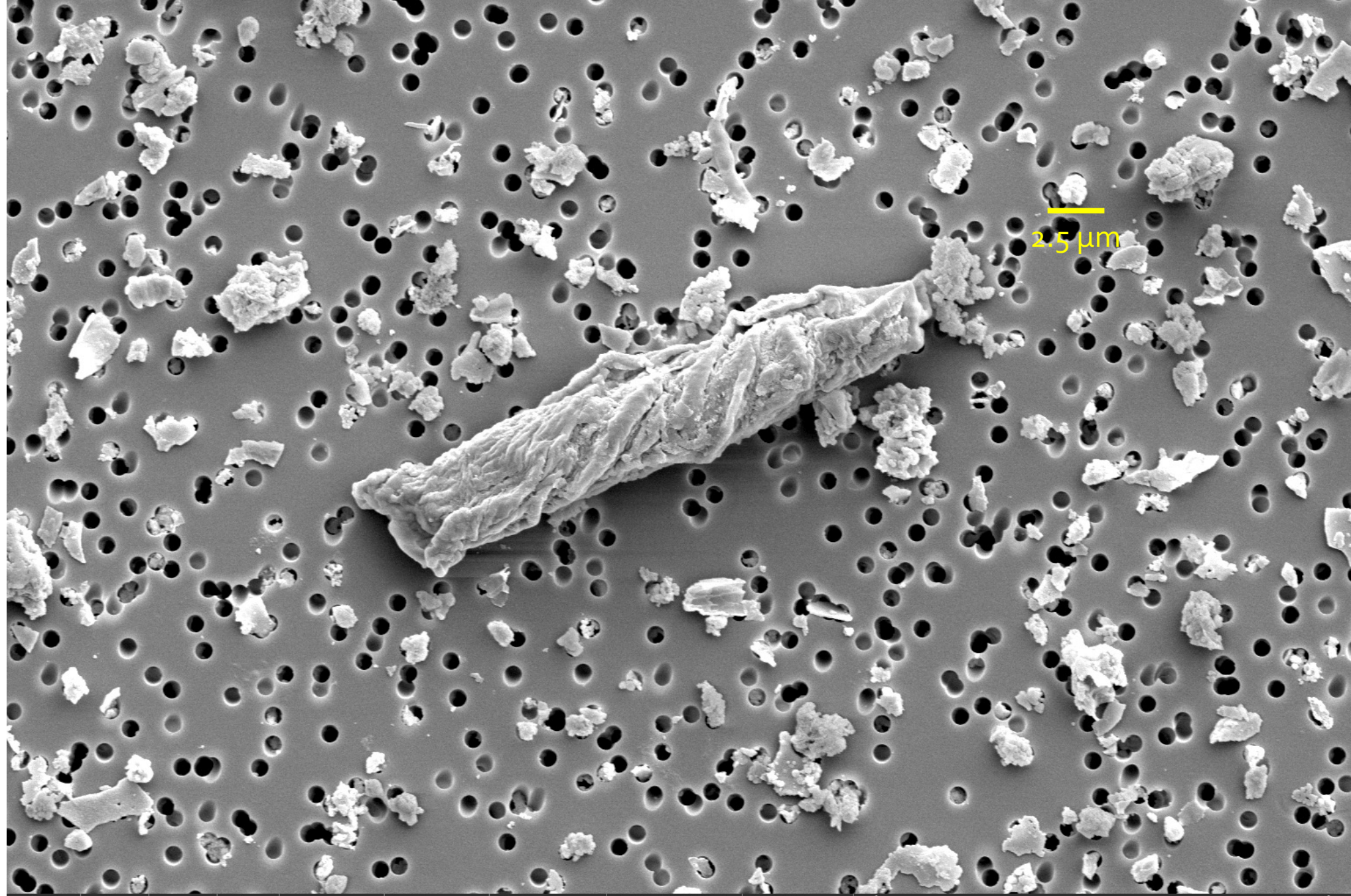
7/7/2021
2:46:15 PM


HFW
2.59 mm

500 μm

UC Davis Quattro

Inhalable Particles



	tilt	spot	det	mag	HV	WD	7/14/2021	HFW
	0.0 °	3.0	ETD	3 500 x	5.00 kV	11.2 mm	2:33:12 PM	59.2 μm

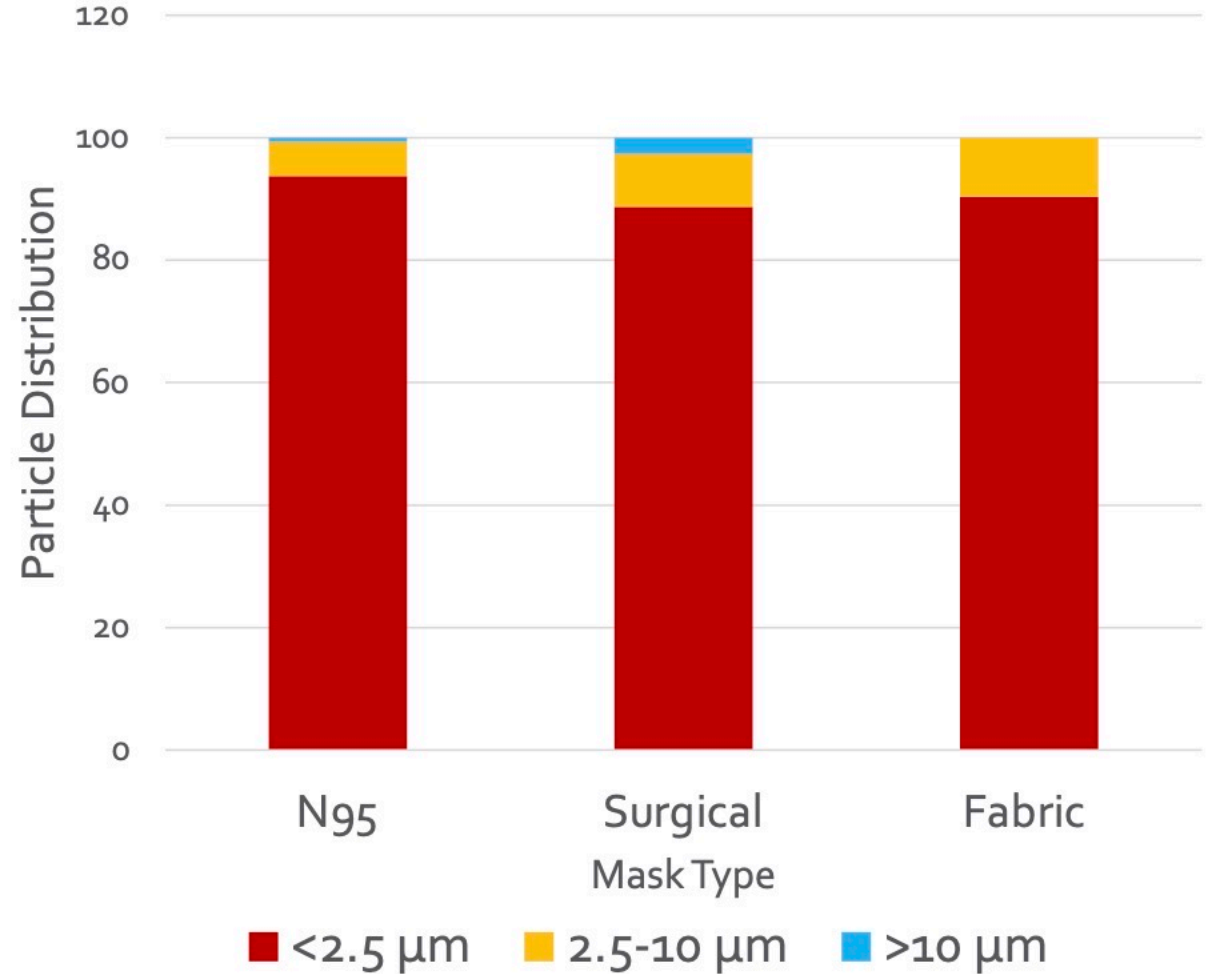
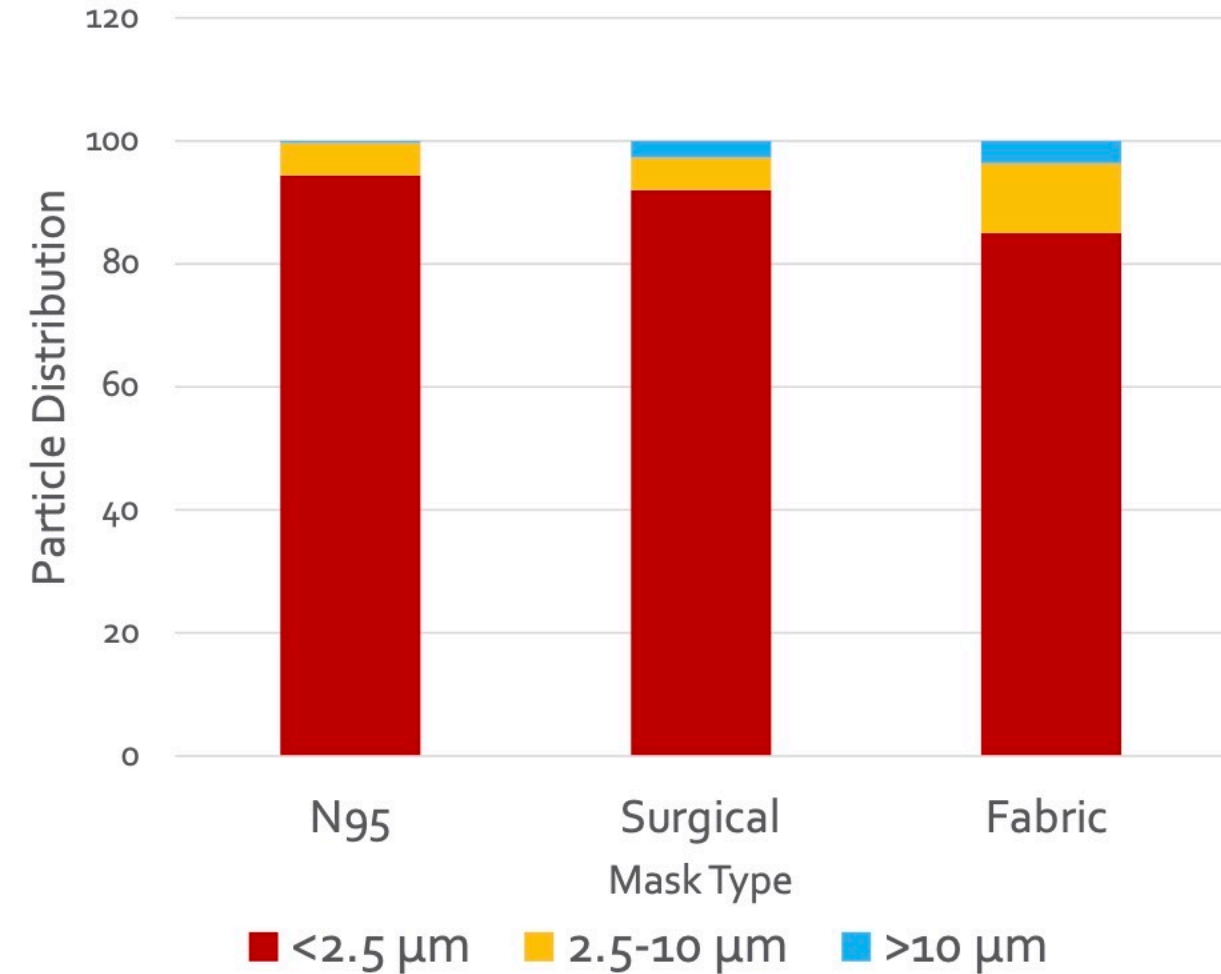
20 μm

UC Davis Quattro

Particle Size

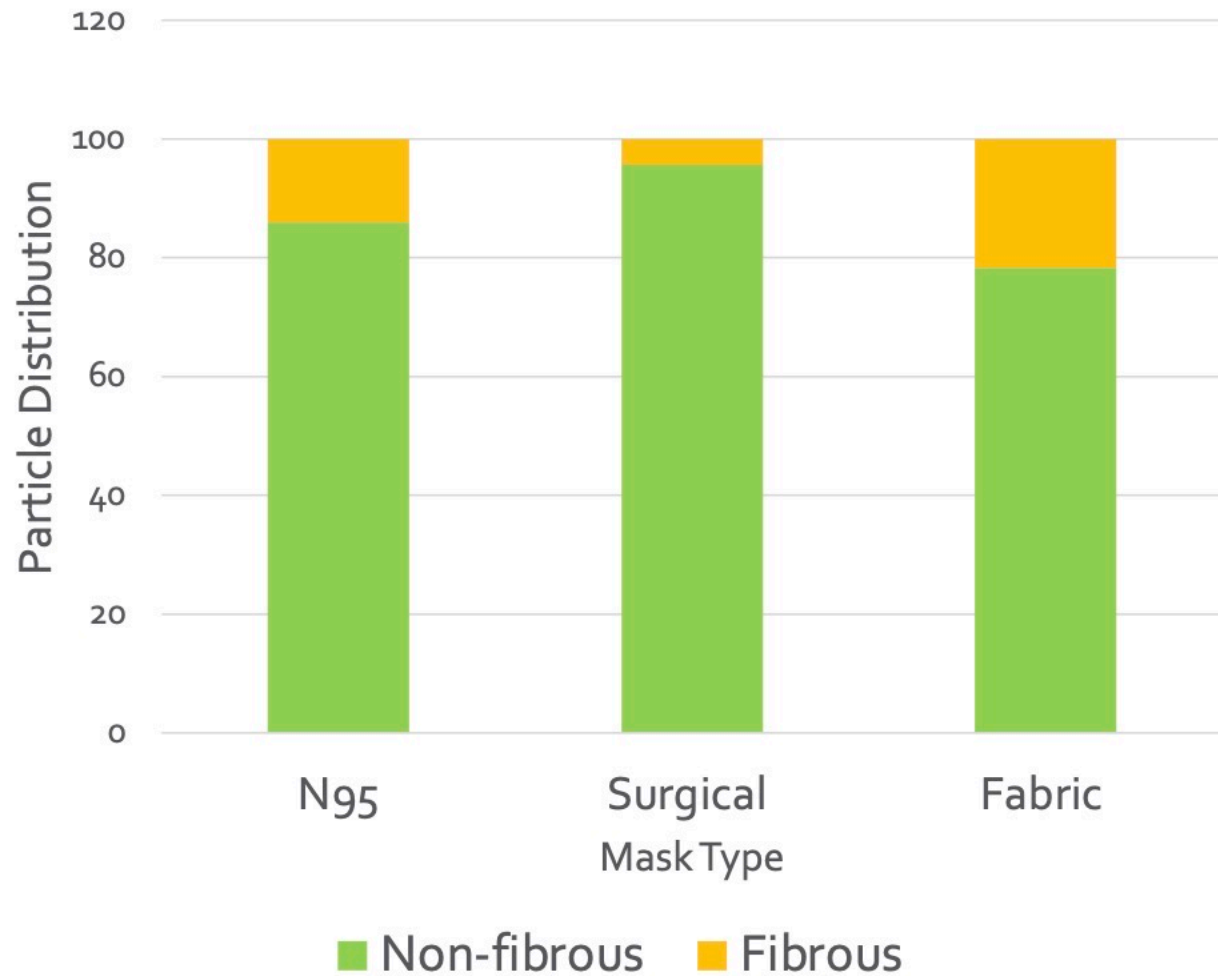
New Masks

Aged Masks

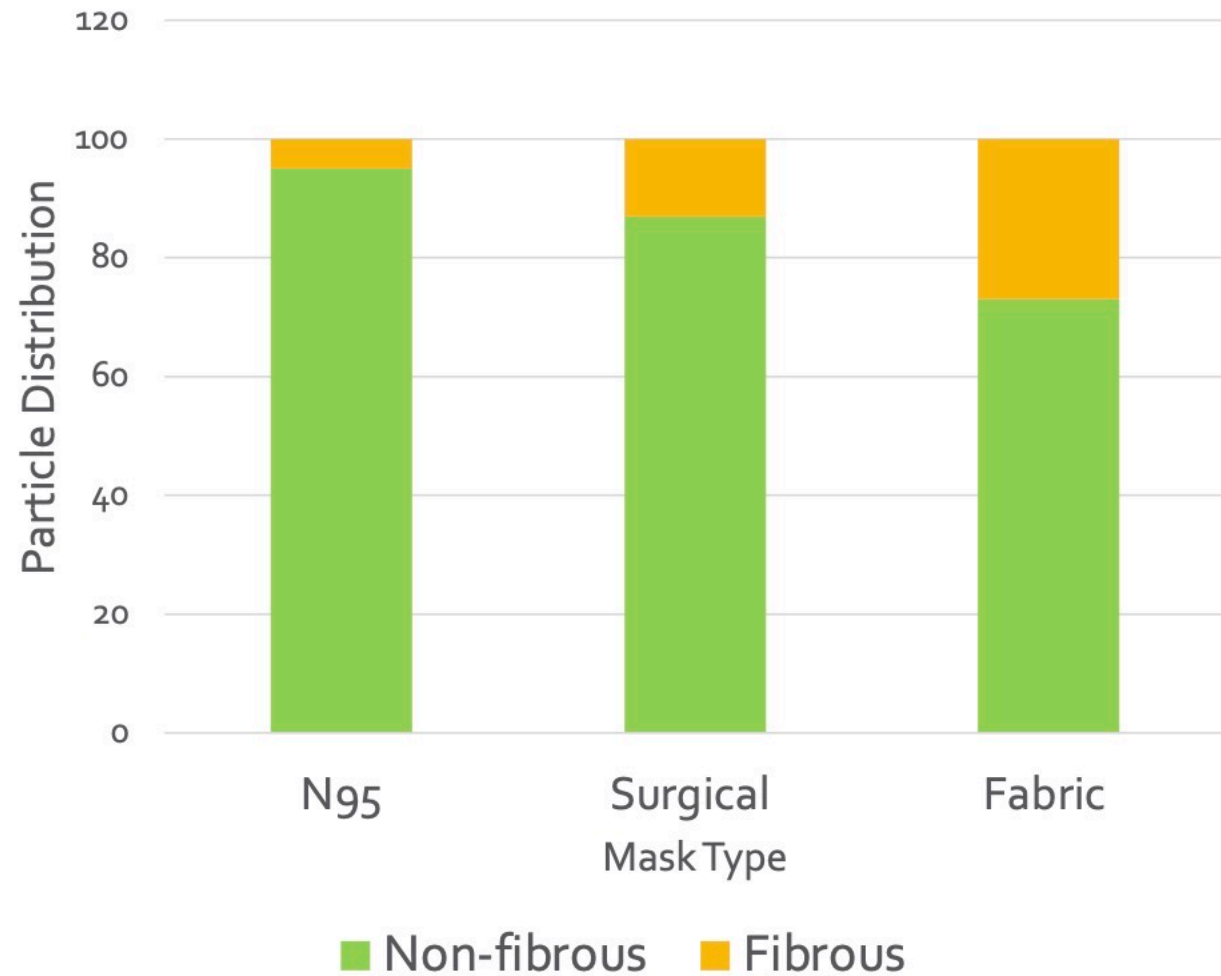


Particle Morphology

New Masks

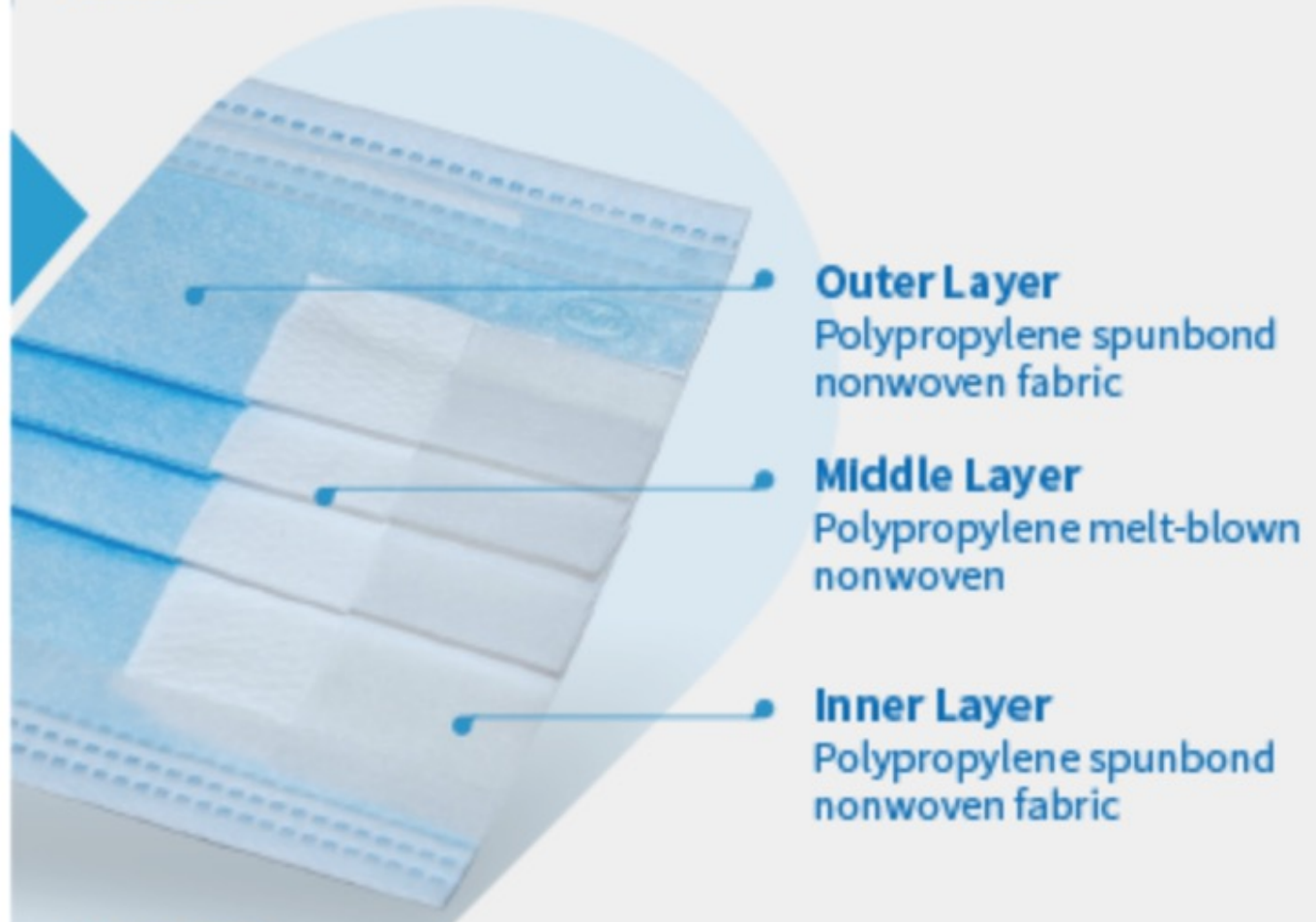


Aged Masks

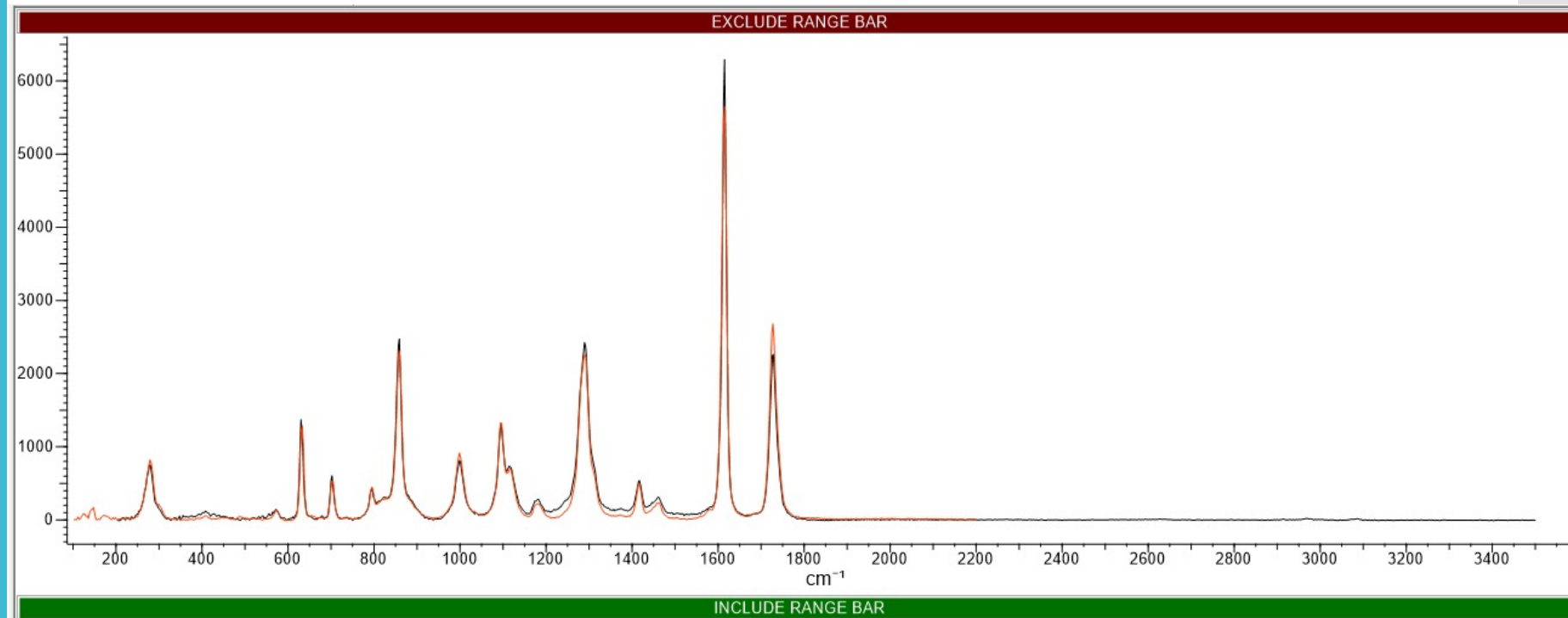


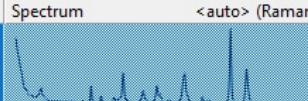

4. Raman Spectroscopy

BYD Single-use Surgical Mask consists of three layers of nonwoven material:



4. Raman Spectroscopy

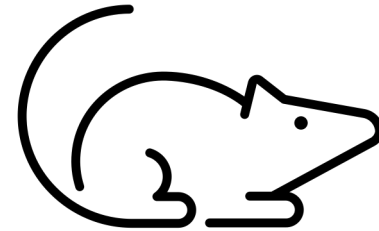


1-Component Results		Peak Results	Functional Groups					
Score	Tag	Name	Classification	Spectrum	<auto> (Raman)	Chemical Structure	Formula	Info
98.35		Polyester 6. White Fiber	N.A.				N.A.	

5. Experimental Animal Test

Experimental Groups

- Strain: C57 mice
- Age: 8-10 weeks
- Sample Size: 5 mice per each group = 25 total
- Groups:
 - Control DI Water
 - N-95
 - Surgical Mask
 - Fabric Mask



Pulmonary Function & Lavage

Procedure

Intranasal Instillation

25 μL of $1\mu\text{g}/1\mu\text{L}$ particle + saline solution
every 24 hours for 3 days prior to PFT



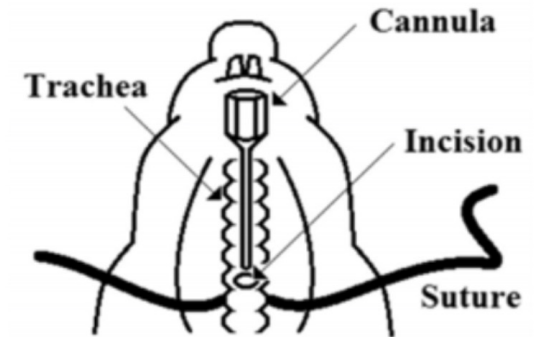
PFT

Methacholine Challenge



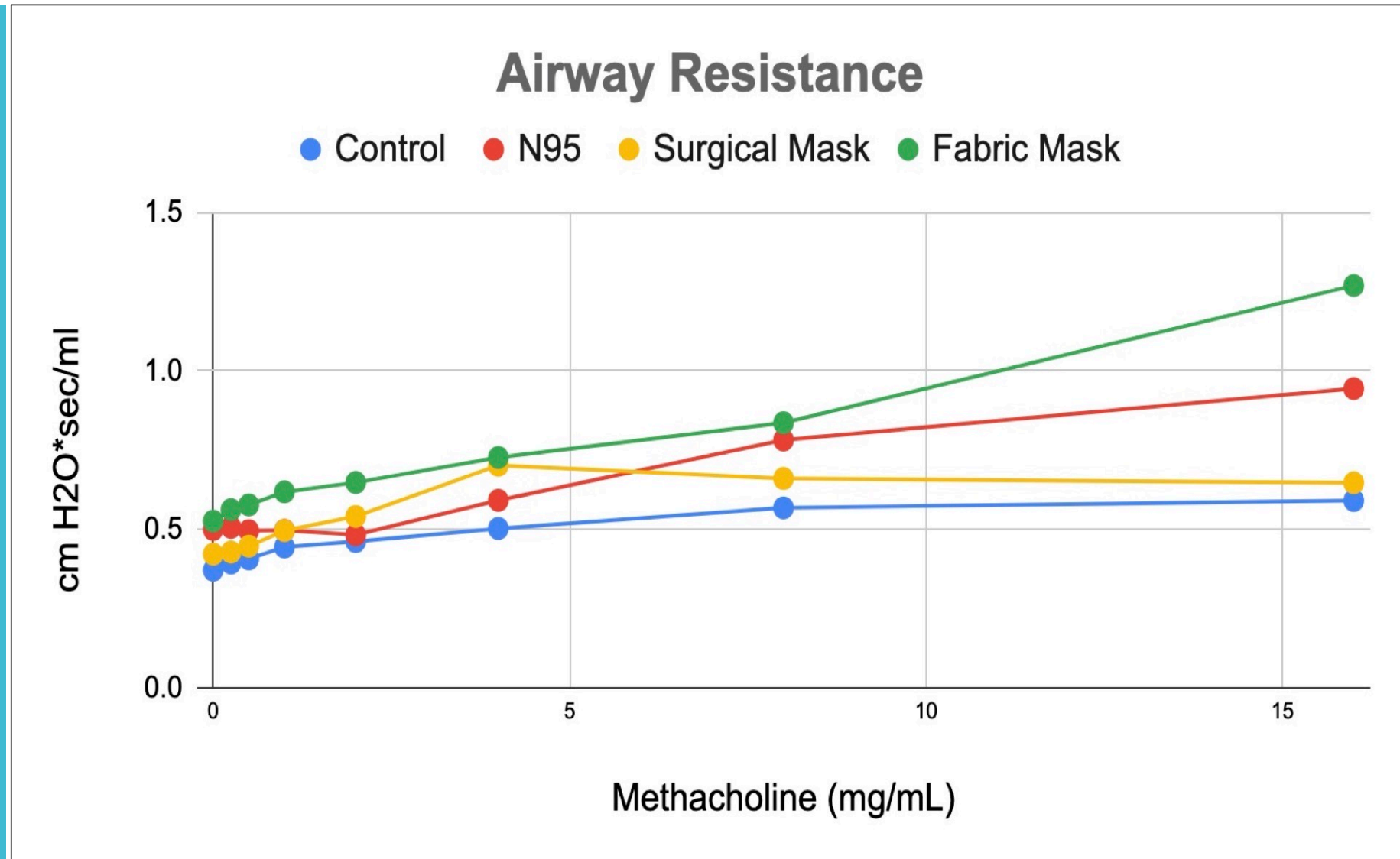
Bronchoalveolar Lavage Fluid (BALF)

Cell Differentials and Total Cell Count

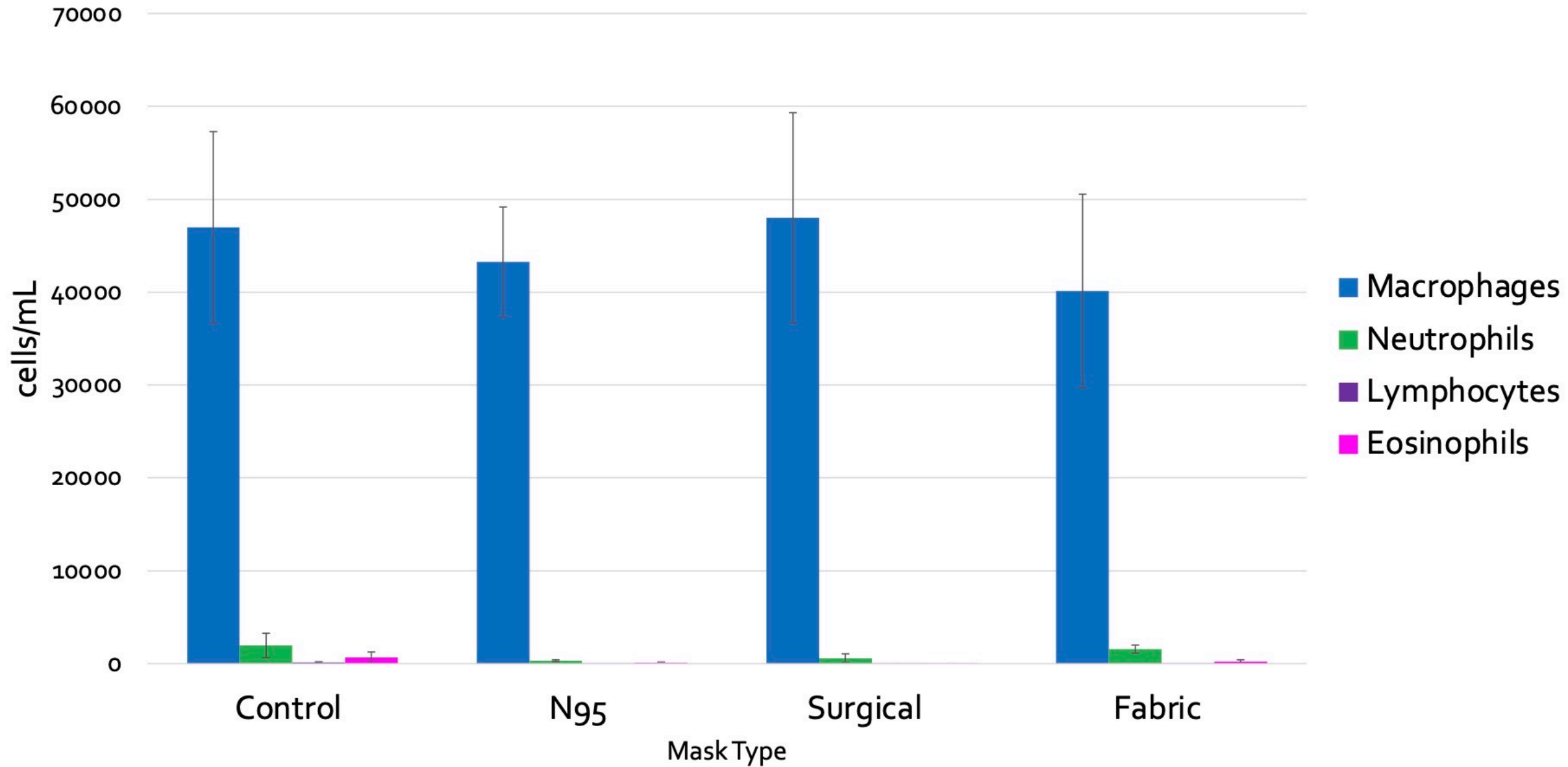


Methacholine Challenge

Bronchoconstrictive agent administered at increasing doses to measure changes in airway resistance



Cell Differential



Conclusion

- Particles under $2.5\mu\text{m}$
 - New Masks: N95 > Surgical > Fabric
 - Aged Masks: N95 > Fabric > Surgical
- Fibrous particles
 - New Masks: Fabric > N95 > Surgical
 - Aged Masks: Fabric > Surgical > N95
- Particle instillation in mice did NOT cause
 - Airway sensitivity
 - Inflammatory changes

Acknowledgements

- Dr. Kent Pinkerton
 - Dr. Jenessa Gjeltrema
 - Dr. Andrew Thron
 - Amanda Burns
-
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