Session 5 Opportunities: Improving Existing PPE Access and Feasibility of Use

NASEM workshop: Personal Protective Equipment for Influenza A (H5N1) in High-Risk Farm Settings

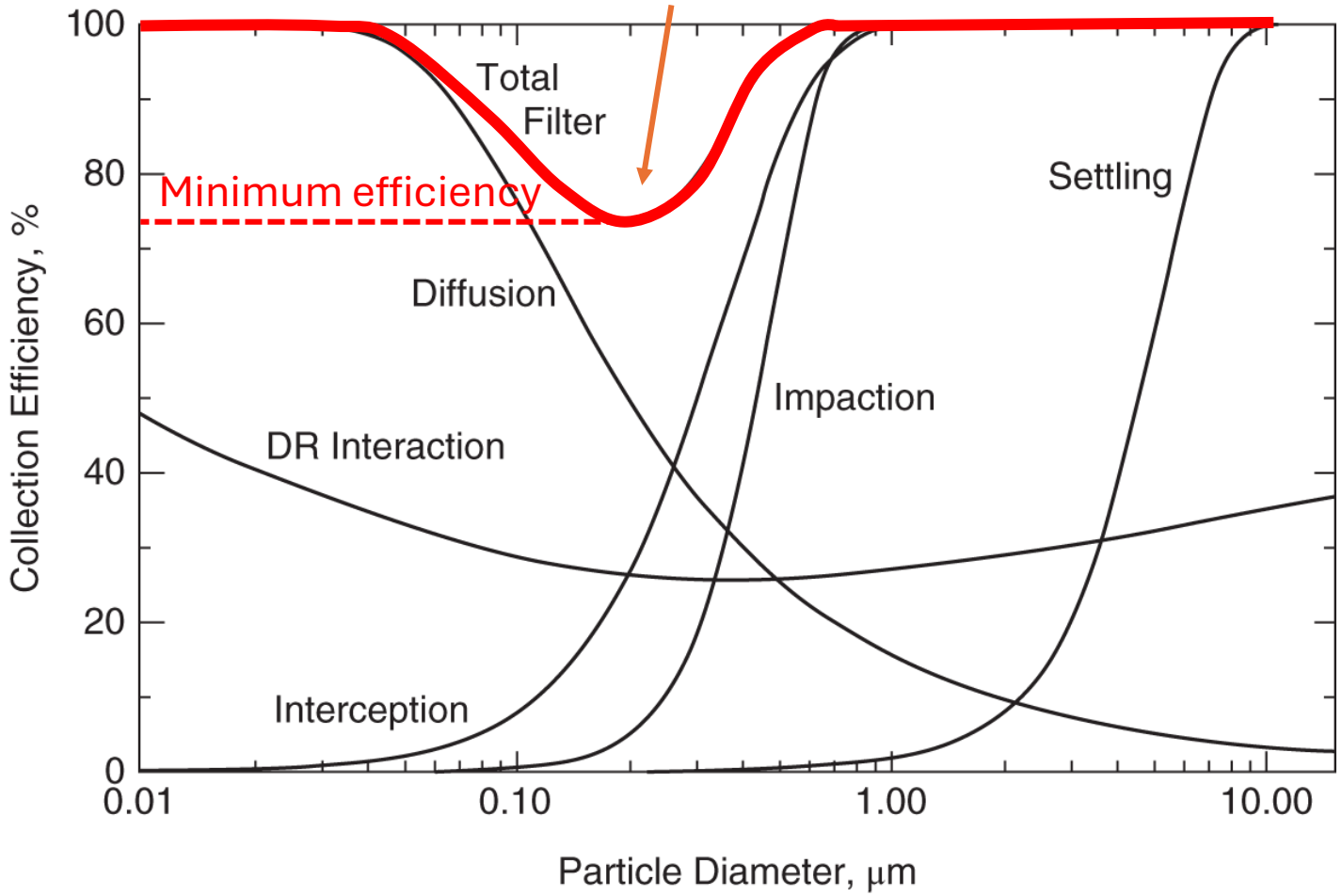
Technologies & research priorities to improve existing PPE accessibility and feasibility of use

Jin Pan
9/30/2025
Assistant professor of Occupational and environmental health
University of Iowa

IOWA

Respirators filter out virus the same way they filter dusts and any other particles.

EX: For N95 respirators, this minimum efficiency should be > 95%



Hinds, W. C., & Zhu, Y. (2022). *Aerosol technology: properties, behavior, and measurement of airborne particles*. John Wiley & Sons.

Some barriers to existing PPE accessibility and feasibility of use

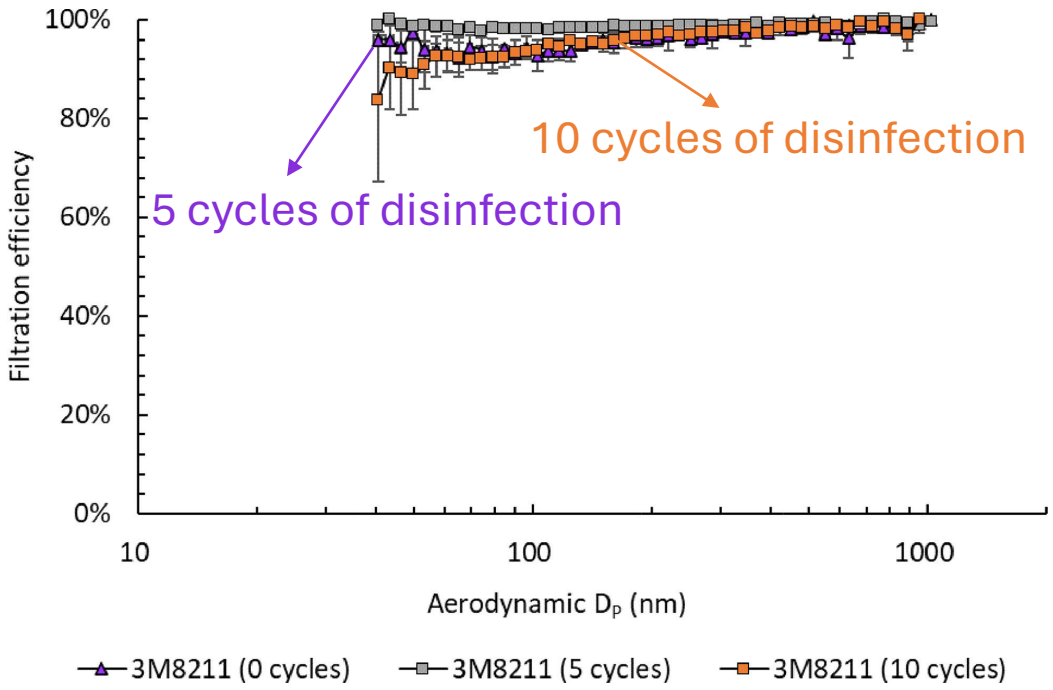
- Cost can be high to use disposable respirators or reusable respirators.
- The comfort level can be low when using highly effective respirators.
- Fit testing is not widely practiced among farm workers.
- Sometimes there can be supply shortages.

These can be potentially improved…

Reduce costs and converse supply: reuse respirators and use expired disposable respirators

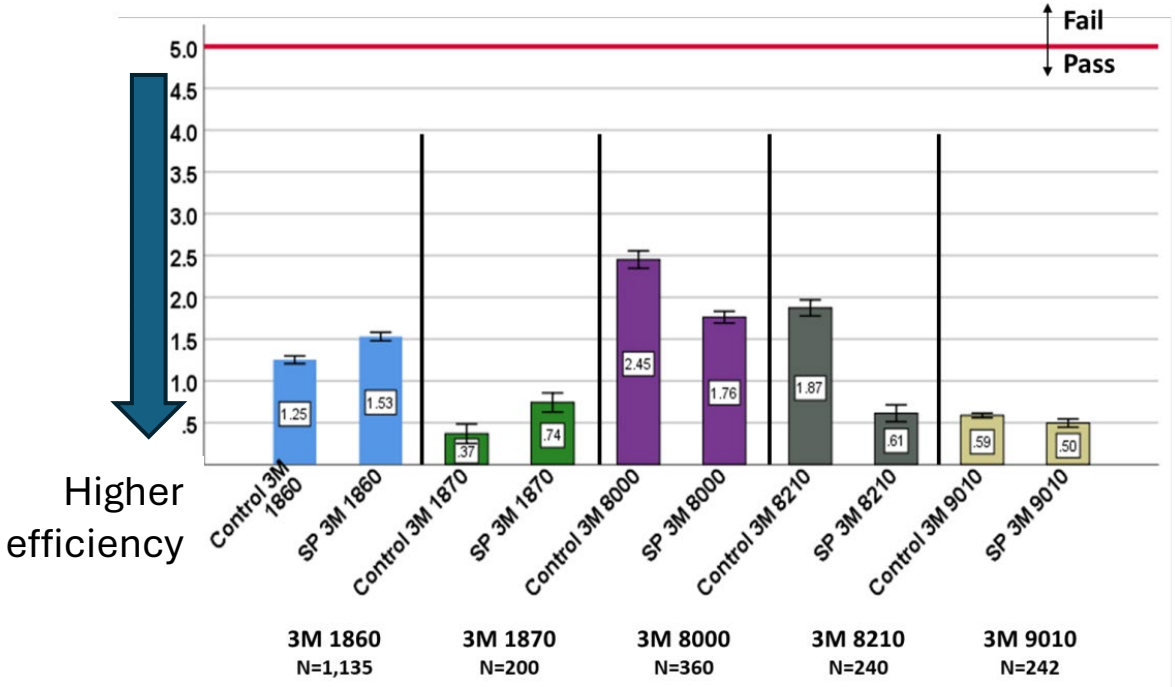
- There are ways to disinfect used disposable respirators without performance degradation
- Expired disposable respirators with proper storage still meet the standards

Ex. 59% vaporized hydrogen peroxide



Jatta, M., et al. (2021). *American journal of infection control*, 49(1), 8-14.

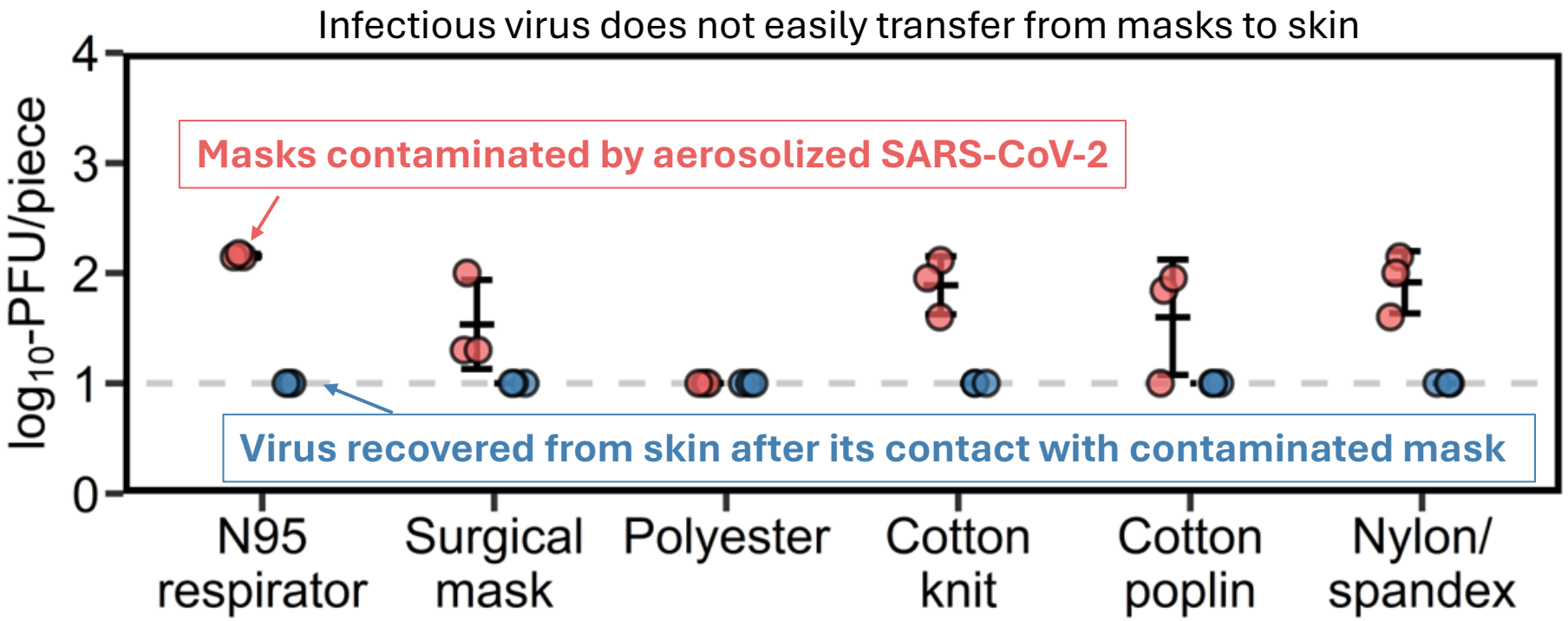
Ex. 98% of stockpiled respirators manufactured between 2003-2013 passed the NIOSH standards in 2017-2019



Lee A. Greenawald, Susan M. Moore, Patrick L. Yorio (NIOSH and NPPTL)
https://www.cdc.gov/niosh/media/pdfs/2024/11/ppe-case-p2020-0111-aggregated-stockpile-study-03252020-508.pdf

Reduce costs and converse supply: reuse respirators

- Contaminated respirators may not transfer infectious virus.



Pan, J., et al. (2023). *Environmental Science & Technology*, 57(28), 10193-10200.

Broaden the choices: alternatives to NIOSH-approved respirators

- Internationally certified respirators can be effective
- Multiple layers of less efficient masks can provide good protection

Results of NIOSH Testing for International respirators

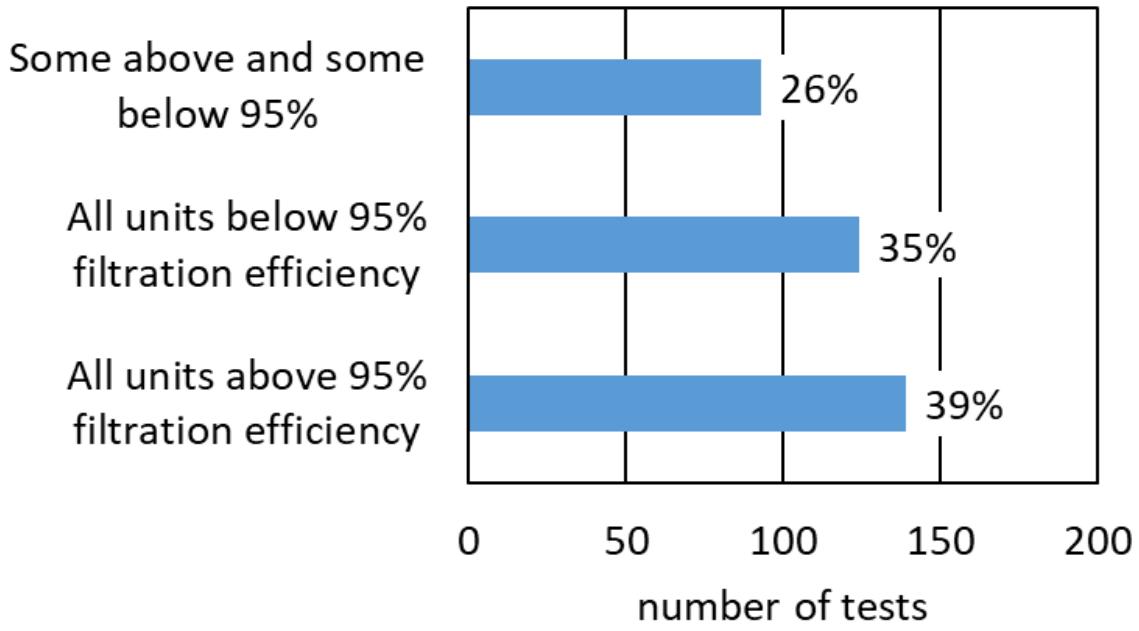
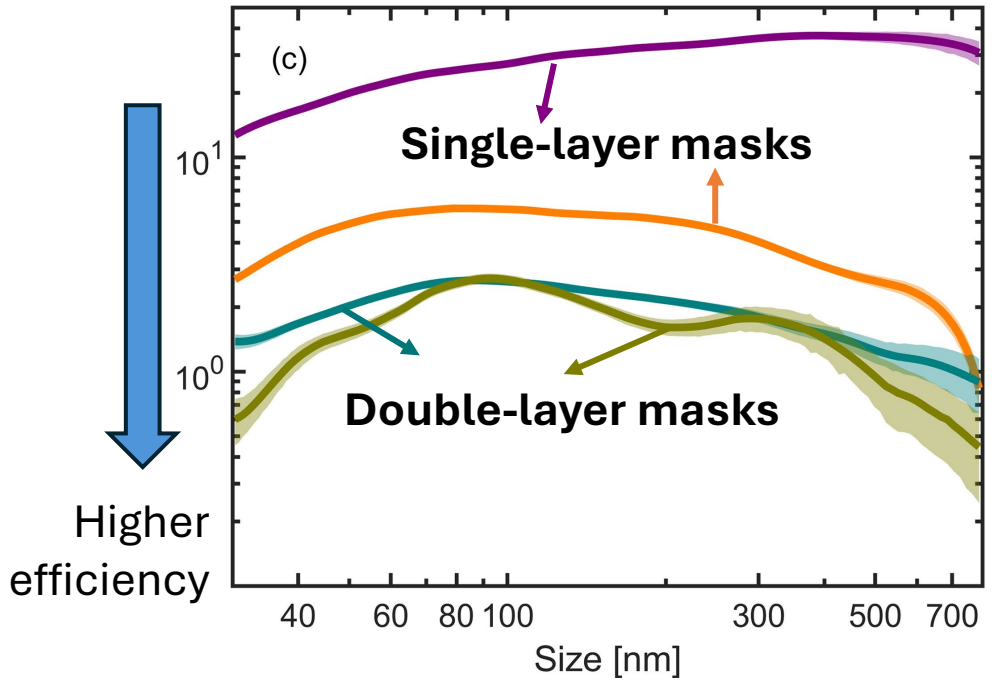


Figure reproduced from Andrews, A. S., et al. (2021). *Health security*, *19*(4), 379-385.

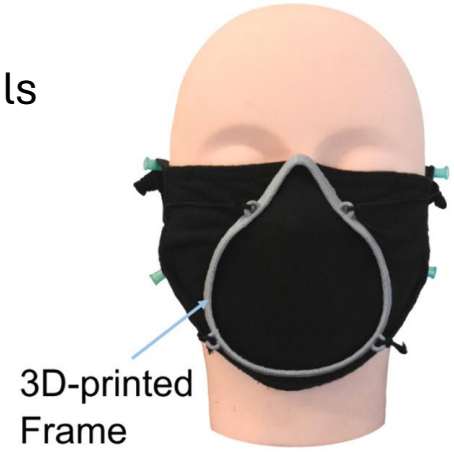
Ex: double masking of cotton masks



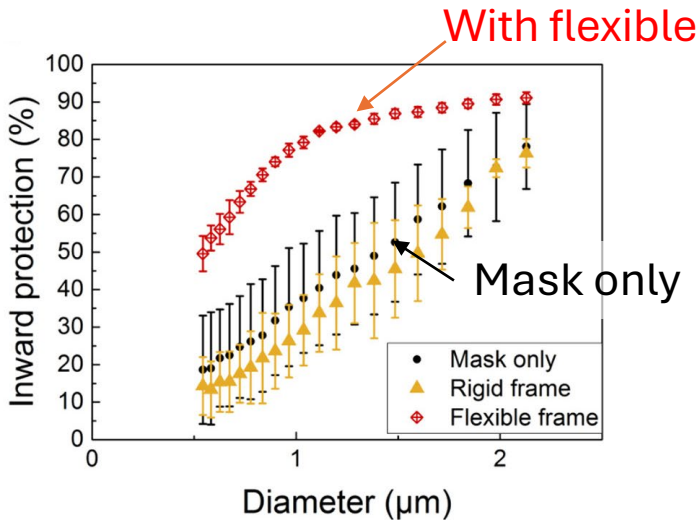
Chea, P. H. et al., (2024). *Aerosol Science and Technology*, 58(9), 965-977.

Design non-proprietary respirators: 3D-printed respirator frames

- Allow wider selections of filter materials
- Lower costs and non-proprietary
- Can be adaptable to individuals
- Improve fit

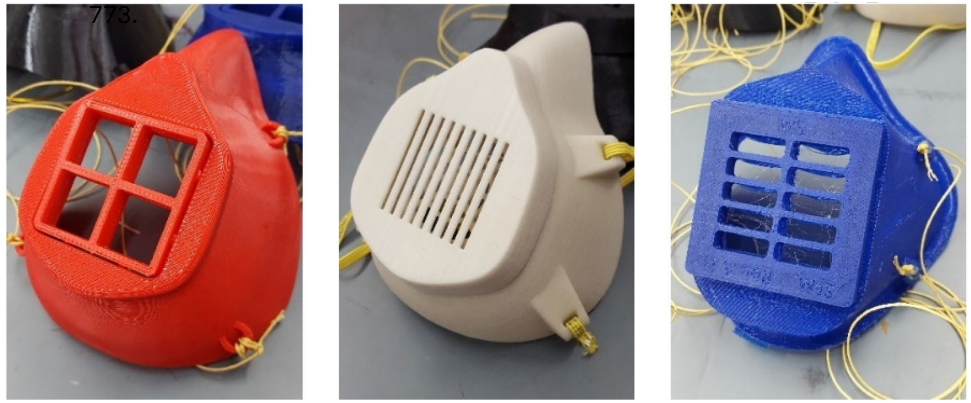


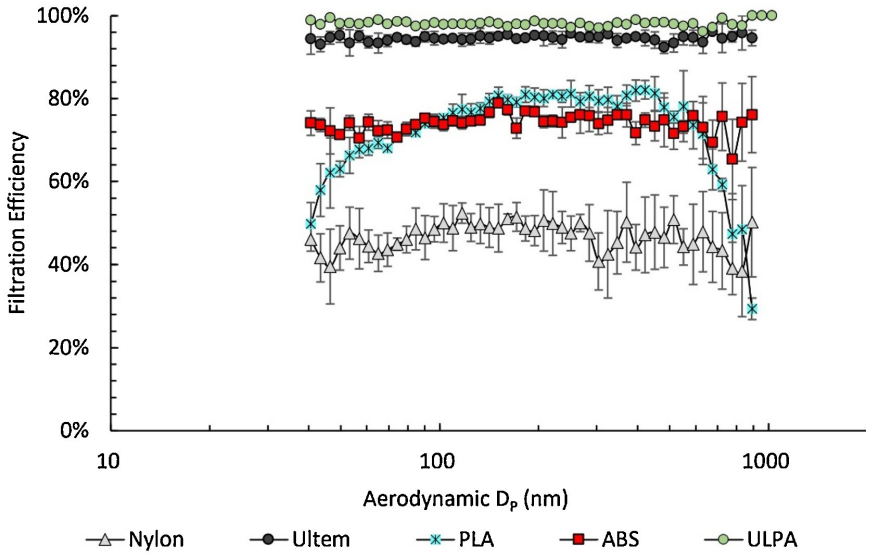
Elastomer filaments



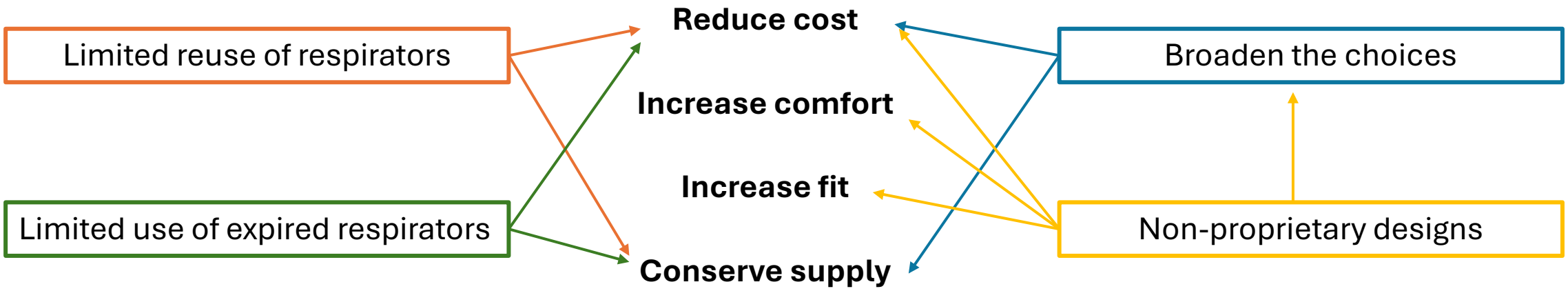
Tong, Y., et al. (2021). *ACS ES&T Engineering*, *1*(6), 1000-1008.

Bezek, L. B., et al. (2021). *Journal of manufacturing systems*, 60, 762-773.





Research priorities to improve existing PPE accessibility and feasibility of use



Acknowledgement

Dr. Linsey Marr

Dr. Nisha Duggal

Dr. Peter Vikesland

Carilion clinic members
Dr. Anthony Baffoe-Bonnie, MD
Maimuna Jatta, MSN
Carolyn Kiefer, BSN
Dr. Harsh Patolia, ND

Virgina Tech members
Dr. Charbel Harb
Dr. David Kormos
Dr. Weinan Leng
Seth Hawks

Dr. Christopher Williams and lab members
Dr. Lindsey Bezek
Dr. Yuxin Tong
Dr. Blake Johnson and lab members

Dr. Abby Whittington
Selma Gmati
Bryce Roper

VT ENGINEERING VIRGINIA TECH™

ICTAS INSTITUTE for CRITICAL TECHNOLOGY and APPLIED SCIENCE Virginia Tech

BIOTRANS

IOWA