3M Personal Safety Division

Design of Filtering Facepiece Respirators

NIOSH Healthcare Stakeholder Meeting

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June 18, 2013

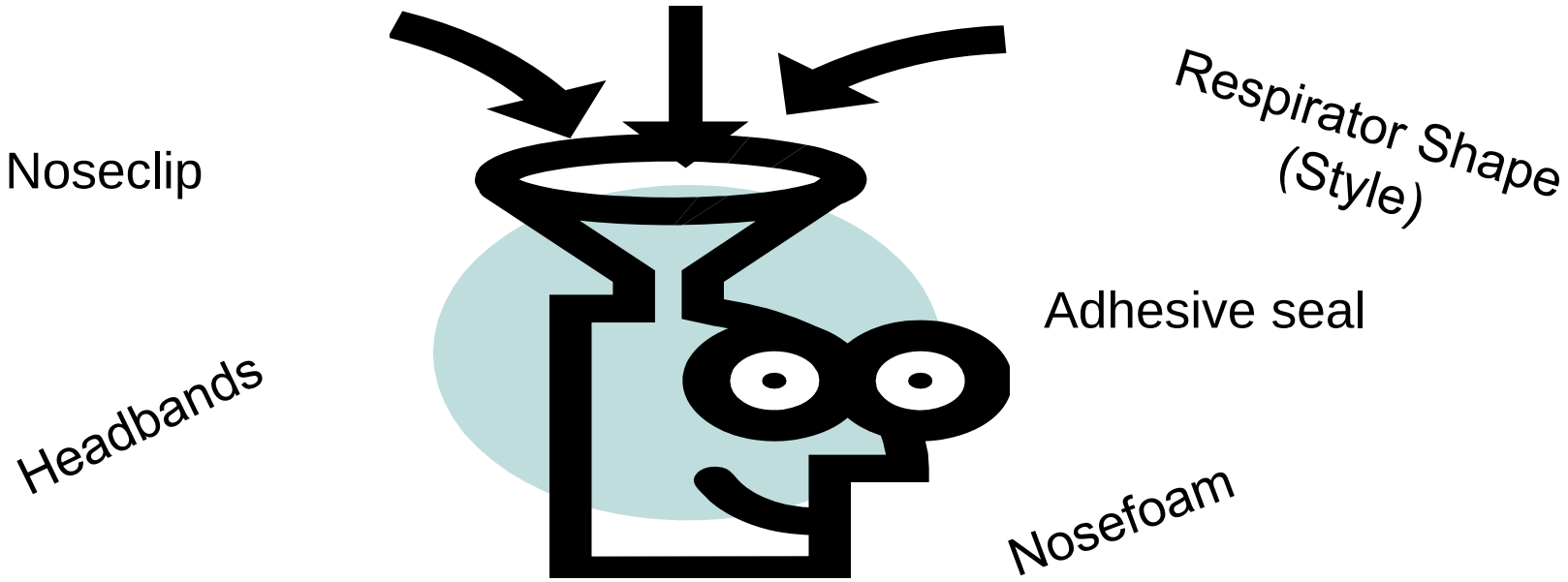
Design of Filtering Facepiece Respirators

- 3M Involvement in Project BREATHE
- 3M Technologies and Testing Capabilities related to development of health care respirators

3M and Project BREATHE

- Kick-off meeting to work with VA and NIOSH March 2012
- 3M Generated Concepts – July 2012

23 Ideas Related To:



Resulting in 12 Concepts Proposed to VA

Concept Evaluation

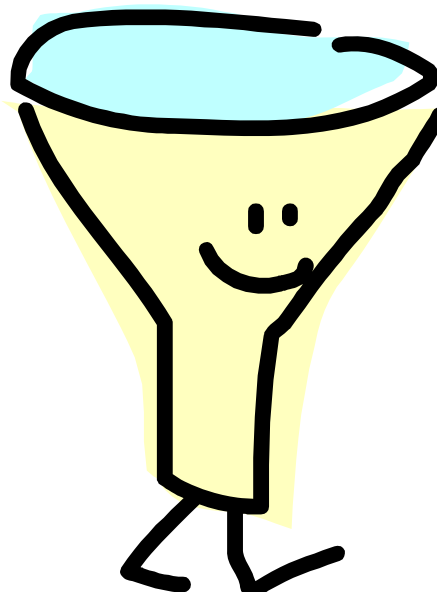
- 12 Concepts to VA for Idea Screening Compared to 3M 1860

Question	Much Worse	Worse	The Same	Better	Much Better
Overall, **my opinion** is the Prototype Respirator compared to 1860 is:					
Overall, **the comfort** of the Prototype Respirator compared to 1860 is:					
Ease of donning (putting on) of Prototype compared to 1860 is:					
Ease of doffing (removing) of Prototype compared to 1860 is:					
Comfort of Prototype respirator (facial heat) compared to 1860 is:					
Comfort in the nose area of Prototype respirator compared to 1860 is:					
Comfort on face (scratching, itching) of prototype compared to 1860:					
The ease of breathing through prototype respirator compared to 1860:					
How well does this prototype hold its shape compared to 1860					
Weight of the prototype on the face compared to 1860					
How do headbands of prototype respirator compare to 1860? Explain in comment area below in detail.					
Field of view of prototype respirator compared to 1860 is:					

Concept to Prototype

- Idea Screening by VA Participants (Office Setting)

12 Concepts



Comfort on Nose

Ease of Breathing

Shape Retention

Facial Heat

Opinion of Headbands

Overall Opinion

Resulting in 2 Prototypes –
1 Cup Style, 1 Flat Fold

Next Steps -

- 3M will provide 2 prototypes
- VA will conduct Simulated Workplace Study
  - Evaluate Fit and Comfort
  - Tasks to Represent Patient Care Activities

3M Technologies and Testing Capabilities

- Respirator Fit and Comfort
  - Fit Testing
  - Thermal Imaging
- Filtration Technology
- Biological aerosol interaction with respirators
- Fluid Resistance

Respirator Fit

- Consensus 4: Respirator Fit
- Consensus 9: Gauging Fit
- 3M has internal fit testing capabilities
- We have an ongoing technology program to develop test methods to evaluate respirator fit and comfort

3M Fit Testing Laboratory

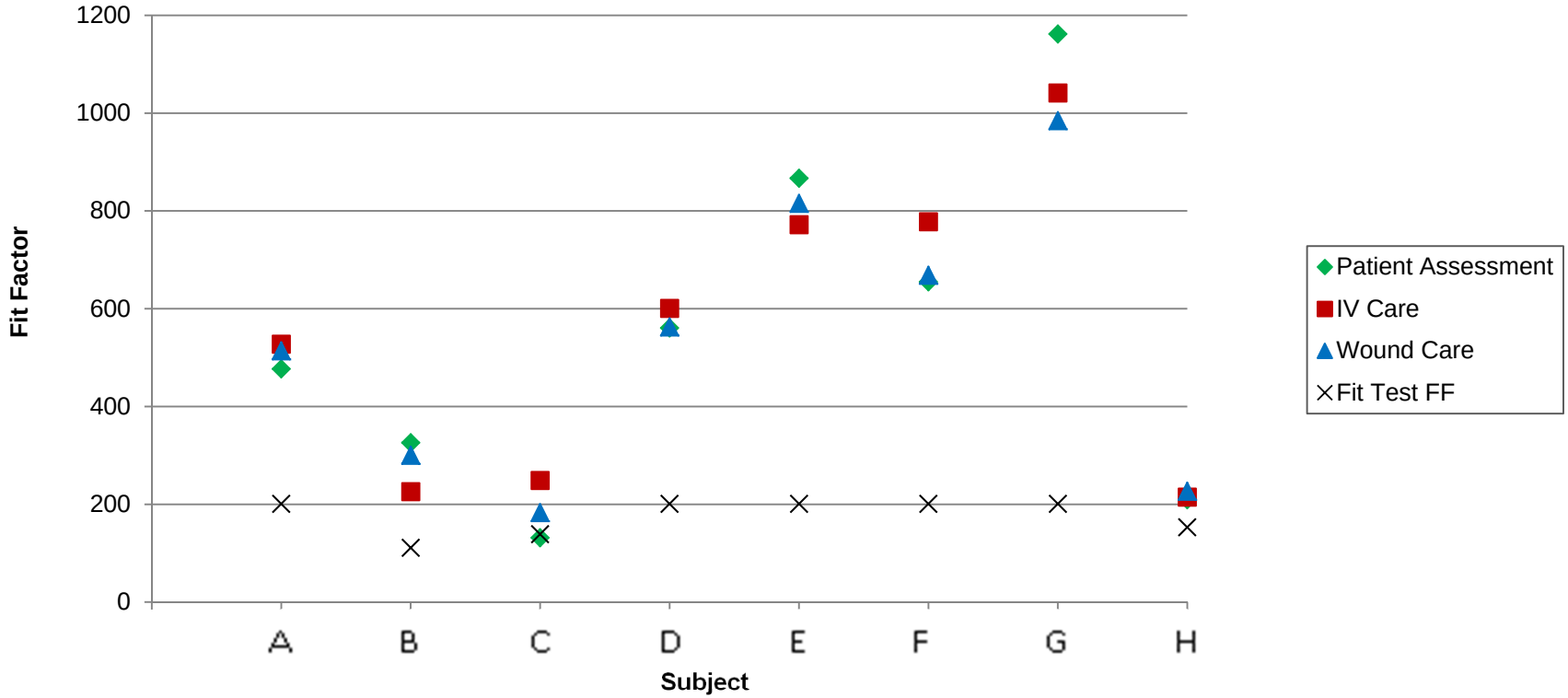
- Multiple fit test chambers

Simulated Workplace Study in Health Care Setting

- Collaborative project with Professor Lisa Brosseau (University of Minnesota, School of Public Health)
- Objective:
  - To measure simulated workplace fit factors for filtering facepiece respirators during typical patient care tasks (e.g. patient assessment, IV care, wound care) conducted by healthcare workers in a simulated healthcare environment using facilities at the Interprofessional Education and Research Center (IERC), University of Minnesota

Subjects: 8 registered nurses
Respirators: 1860 and 1860S
Continuous fit monitoring to calculate SWFF

Scenario Geometric Mean SWFF and FF by Subject



- Simulated Workplace Fit Factor (SWFF) highly dependent on the individual subject.
- Overall, SWFF is higher than Fit Test calculated Fit Factor (FF).

Jessica Hauge, Marc Roe, Lisa M. Brosseau & Craig Colton (2012): Real-Time Fit of a Respirator during Simulated Health Care Tasks, Journal of Occupational and Environmental Hygiene, 9:10, 563-571

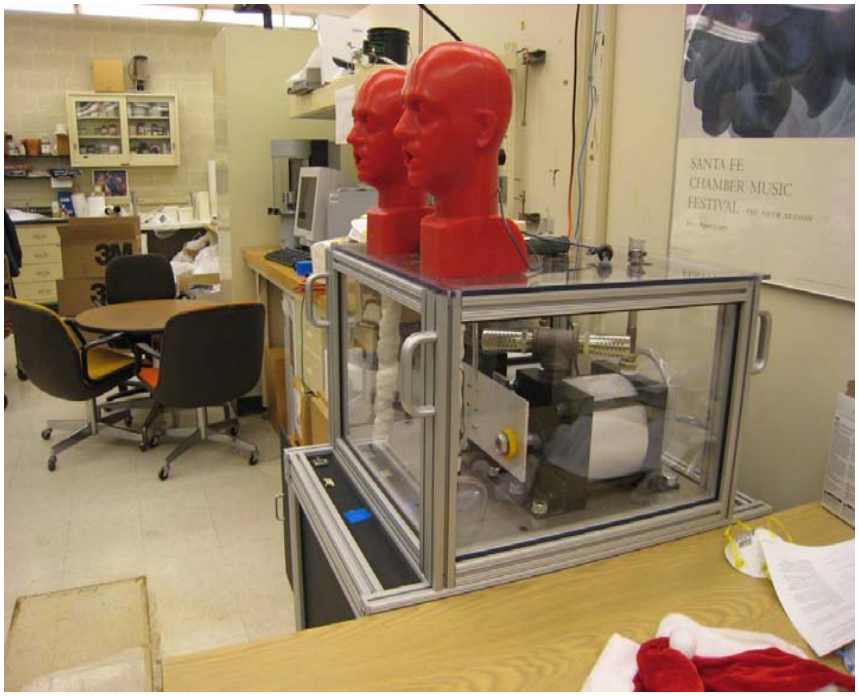
Respirator Comfort

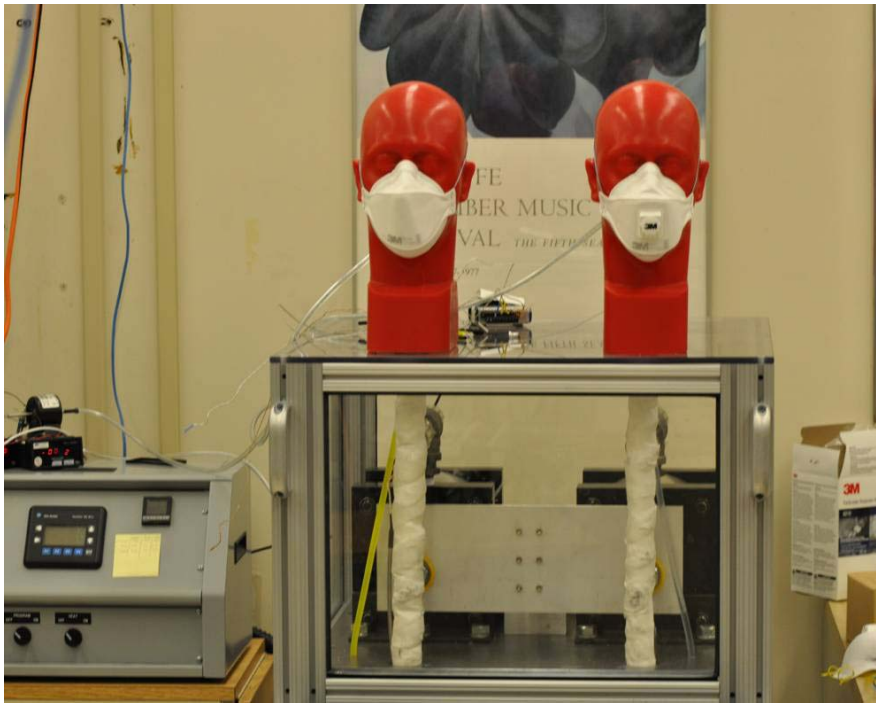
- Consensus 19: Facial Heat
- 3M developed real-time thermal imaging methods to identify effect of respirator design on heat build up

Improving Respirator Comfort – Valve Performance

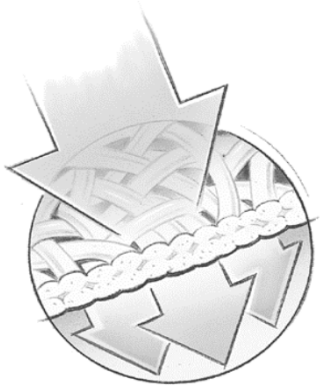
Test method developed to identify effect of valve on heat build up in respirator

- Red heads are supplied with humidified, body temperature breathing air
- External temperature measured using thermal imaging camera
- Temperature inside the respirator and flow resistance measured using sensors embedded in the red head





Filtration Technology

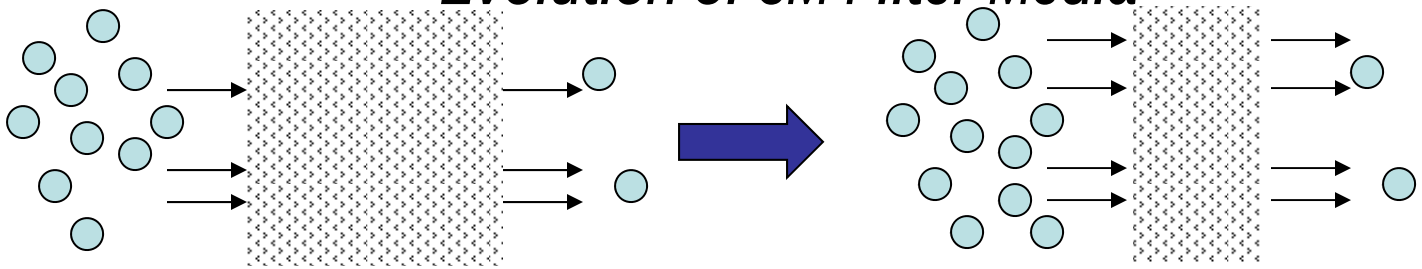


- Electrostatic Filter Media Technology
- Consensus 15: Breathing Resistance

3M Electret Technology Development

- Objective:
  - To develop respirators with high filter performance by advancing the materials and processing of our nonwoven electret technology.
- Benefit:
  - Higher performance filter media will help allow us to reduce respirator thickness, weight, and pressure drop; increase comfort; service life; and expand our design options.

Evolution of 3M Filter Media



Yesterday Today

Bioaerosol Interaction with Respirators

- Consensus 1: Safety and Effectiveness
- Consensus 2: Self-Contamination
- Consensus 3: Fomite Transmission
- Consensus 7: Repeated Disinfection Durability

3M Bioaerosol Generating Equipment

Equipment used to evaluate efficacy of antimicrobial treated respirators and compared to *in vitro* test methods

Bioaerosol Test Method Comparison

Conclusions:

- Antimicrobial treatment evaluated on respirator did not appear to reduce the viability of pathogens on the respirator compared to control respirator without antimicrobial treatment
- This was contrary to the outcome with the standard *in vitro* test method

Ylitalo, C., Stepanova, N., Laingen E., Sebastian J., Viner A. Bioaerosol Interaction with Respirators: The Efficacy of Antimicrobial Treatment as tested by a Standard *in vitro* test method and by a bioaerosol test method. Paper presented at American Industrial Hygiene Conference & Expo Session, May 18, 2011

Bioaerosol Filtration

- University of Nebraska Medical Center, Department of Pathology & Microbiology, Bioaerosol Research Laboratory
- 3M Company, Personal Safety Division, St. Paul, MN
- This research was supported by a grant from the Air Force Research Laboratory.

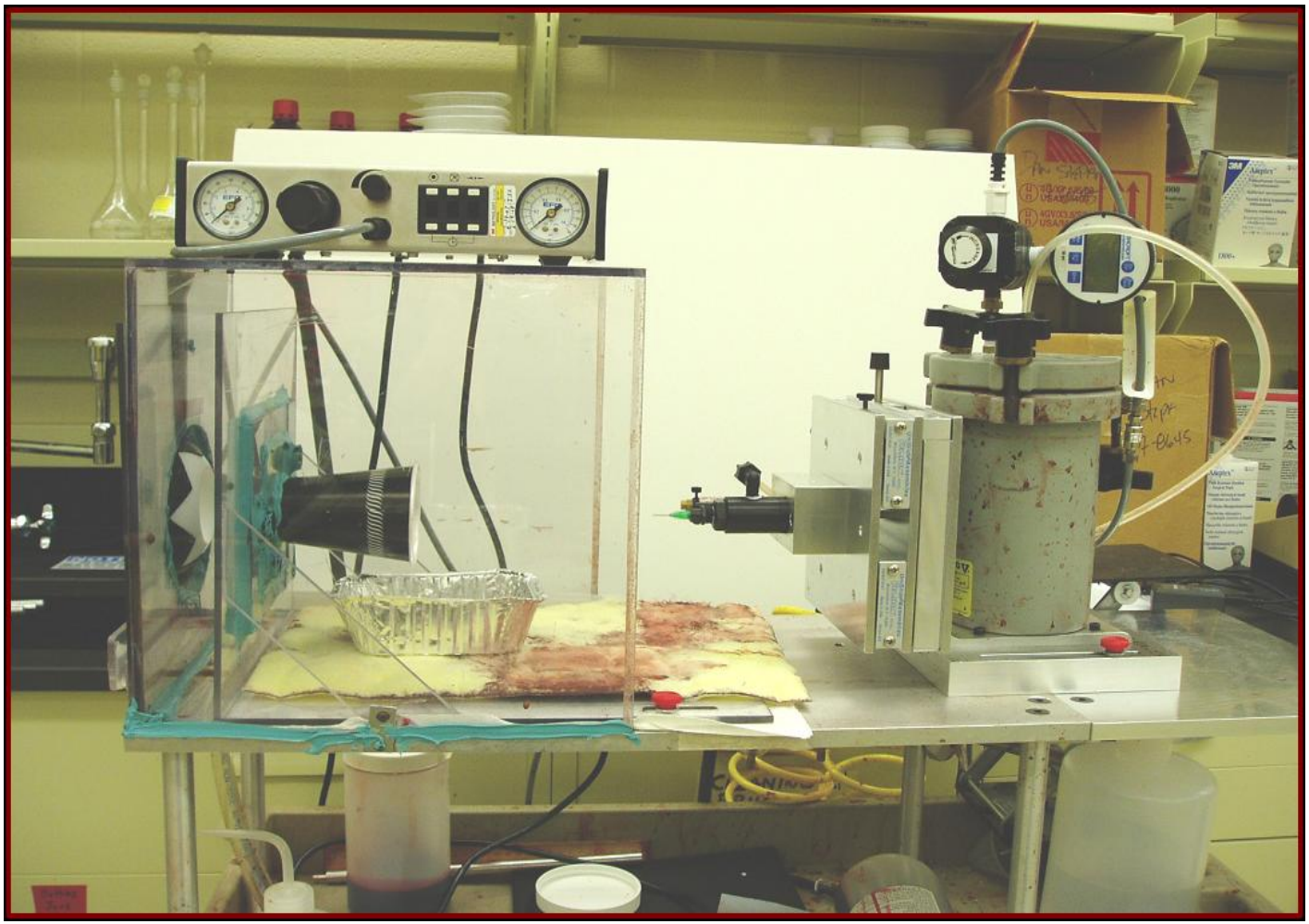
Conclusions:

• Evidence that conventional filtering facepiece respirators can be very effective at capturing virus particles.

• No statistical evidence to demonstrate that an antimicrobial agent on a respirator has an effect on the few virus particles that do penetrate through the filter.

Lore M., Brown T., Hinrichs S., Sebastian J., Viner A., McCullough N. Performance of Conventional & Antimicrobial – Treated Filtering Facepiece Respirators against Viable Influenza A. Paper presented at American Industrial Hygiene Conference & Expo Session PO 124, May 18, 2011.

Fluid Resistance - ASTM 1860 Test Apparatus



3M and Project BREATHE

- 3M is a partner with the VA and NIOSH on Project BREATHE
- 3M's contribution to this effort
  - *Fit and Comfort*
  - *Filter Media*
  - *Respirator Design*
  - *Microbial Testing*
  - *Analytical Capability*