RESEARCH ON RESPIRATORY PROTECTION

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BRIEF HISTORY

- Funding from NIOSH and other agencies/industries since early 1980s
- Evaluation of newly developed and existing respiratory protection devices
- Development of methods and techniques for testing the performance of respirators and facemasks challenged with inert and biological particles
  - filter media
  - manikin-based experiments
  - experiments with human subjects
- Development and evaluation of User Seal check procedures and fit test methods
IMPACT

• 58 peer-reviewed publications on respiratory protection since 1975
• Development of CNC-based quantitative fit testing method (Willeke 1981)
• Evaluation of dozens newly-developed and commercially available respirators and facemasks – data generated for federal agencies and manufacturers
• Committee work (ANSI Z88, Z88.6, Z88.7, Z88.10; AIHA Respiratory Protection Committee, etc.)
• Training of graduate students:
  – 25 MS students; 6 PhD students
  – 10 Postdoctoral fellows
• Continuing education courses on Quantitative Fit Testing and Worker Training (>10 courses/year):
  – In-house (clinic) and on-site
  – Provided to Local & Regional Companies
LABORATORY STUDIES

RECENT EXAMPLES:

• Penetration of biological vs. non-biological particles through respirator filters
• Penetration of viruses and nanoparticles through respirator filters
• Simulated workplace protection factor study for N95 filtering facepiece vs. surgical mask (0.3 -1 μm particles)
• Evaluation and use of a novel Breathing Recording and Simulation System (BRSS):
  – Particle penetration pathways (filter vs. faceseal)
  – Realistic breathing patterns
• Development of novel respirators with specific properties
• Evaluation of user seal checks

NIOSH PPT meeting – Dr. Reponen
SMALL TEST CHAMBERS
Fit inside Biosafety Cabinet, BL-2

2.75 m³
CHAMBERS

WALK-IN CHAMBER
(24.3 m³)
EFFICIENCY OF RESPIRATORS AGAINST BIOAEROSOLS IN AGRICULTURAL WORKPLACES

NIOSH RO1-OH-04085
BACKGROUND

• Farmers are exposed to high levels of bioaerosols
• No general guidelines for respiratory protection against bioaerosols in agricultural workplaces
• N95 filtering facepiece respirators are commonly used
• No previous data on WPF (workplace protection factors) against bioaerosols
SIZES OF BIOLOGICAL PARTICLES

NIOSH filter certification

APF: no size range defined
Most previous studies based on particle mass
(large particles dominate)
NEW SET-UP FOR MEASURING WPF AGAINST BIOAEROSOLS

Lee et al. Aerosol Air Quality Res. 4:55-72, 2004

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MAIN FINDINGS FROM FIRST PHASE

- WPF decreases with decreasing particle size
- WPF smaller for biological particles than for dust particles
- Exposure reduction for bioaerosols may be smaller than expected from the APF
CURRENT FOCUS

• Compare filter and faceseal penetration of biological vs. non-biological particles
• Continue collecting WPF data in the field – including microbial fragments
Performance evaluation: Filter versus Face seal

Particle penetration through **filter medium** (filtration efficiency)

Particle penetration through the **face seal leaks** (fitting issue)

How are filter and face seal penetrations affected by particle characteristics?
How findings can be used to improve workplace safety and health

- Give information on performance of respirators against biological particles
- Justify the need for developing better fitting respirators
- Suggest revisions to respirator testing protocols to better evaluate performance
  - against different types of particles
  - under realistic working conditions
Our research supports following PPT Program Strategic Goals:

Goal 1: Reduce exposure to inhalation hazards.

- **Intermediate Objective 1.2**: Develop CBRN respirator standards to reduce exposure to CBRN threats
- **Intermediate Objective 1.4**: Improve reliability and level of protection by developing criteria that influence PPE designs to better fit the range of facial dimensions of respirator users in the U.S. workforce
- **Intermediate Objective 1.5**: Quantify the impacts of various PPE on viral transmission
- **Intermediate Objective 1.6**: Evaluate the nanofiber-based fabrics and NIOSH-certified respirators for respiratory protection against nanoparticles