

Gambling Tips From Industrial Hygiene
Five Good Bets for Protecting
Responders from AI and
Pandemic Flu

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Learning Objectives

At the end of my session, I'd like you to be able to:

1. Explain why respirators, not surgical mask, are essential for protecting responders
2. Describe the NIOSH respirator classification scheme and the importance of 0.3 micrometers
3. Explain why more filtration is generally better
4. Explain why fit-testing is critical and quantitative fit-testing is preferred
5. Explain why eye protection is important with Avian Influenza
6. Describe why safety issues can be critical

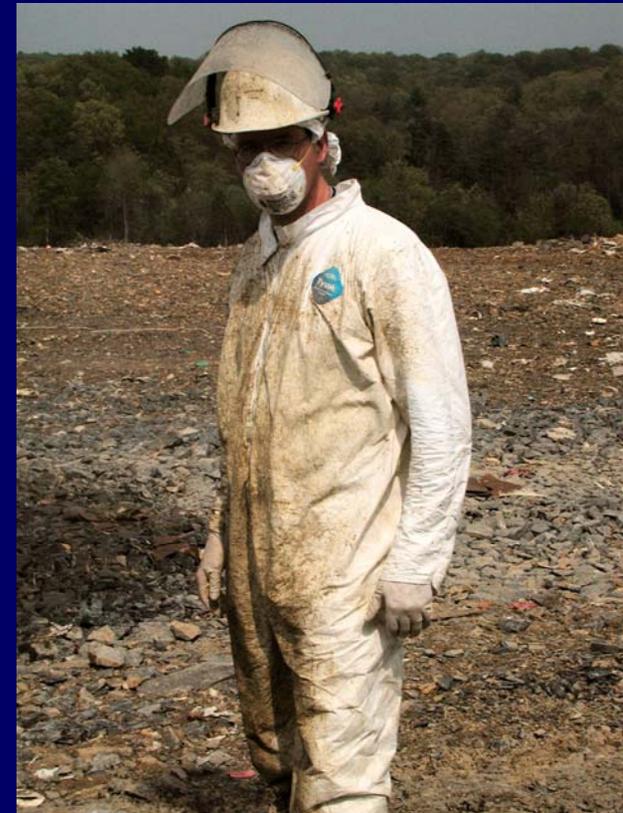
Good Bet Number 1

More respiratory filtration efficiency is generally better
(surgical masks don't cut it)



Classes of Filters

- Levels of filter efficiency are 95%, 99%, and 99.97%
- Categories of resistance to filter efficiency degradation are labeled **N, R, and P**



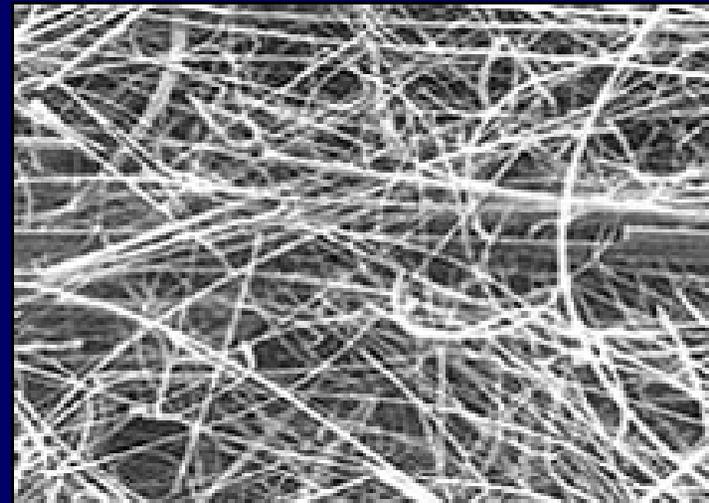
NIOSH Approval

- NIOSH evaluates the filtration efficiency, **not the fit on *your* face**
- N-95 under 42 CFR 84 are tested with sodium chloride aerosol with 0.3 μm mass median aerodynamic diameter in an airstream drawn at 85 liters/minute

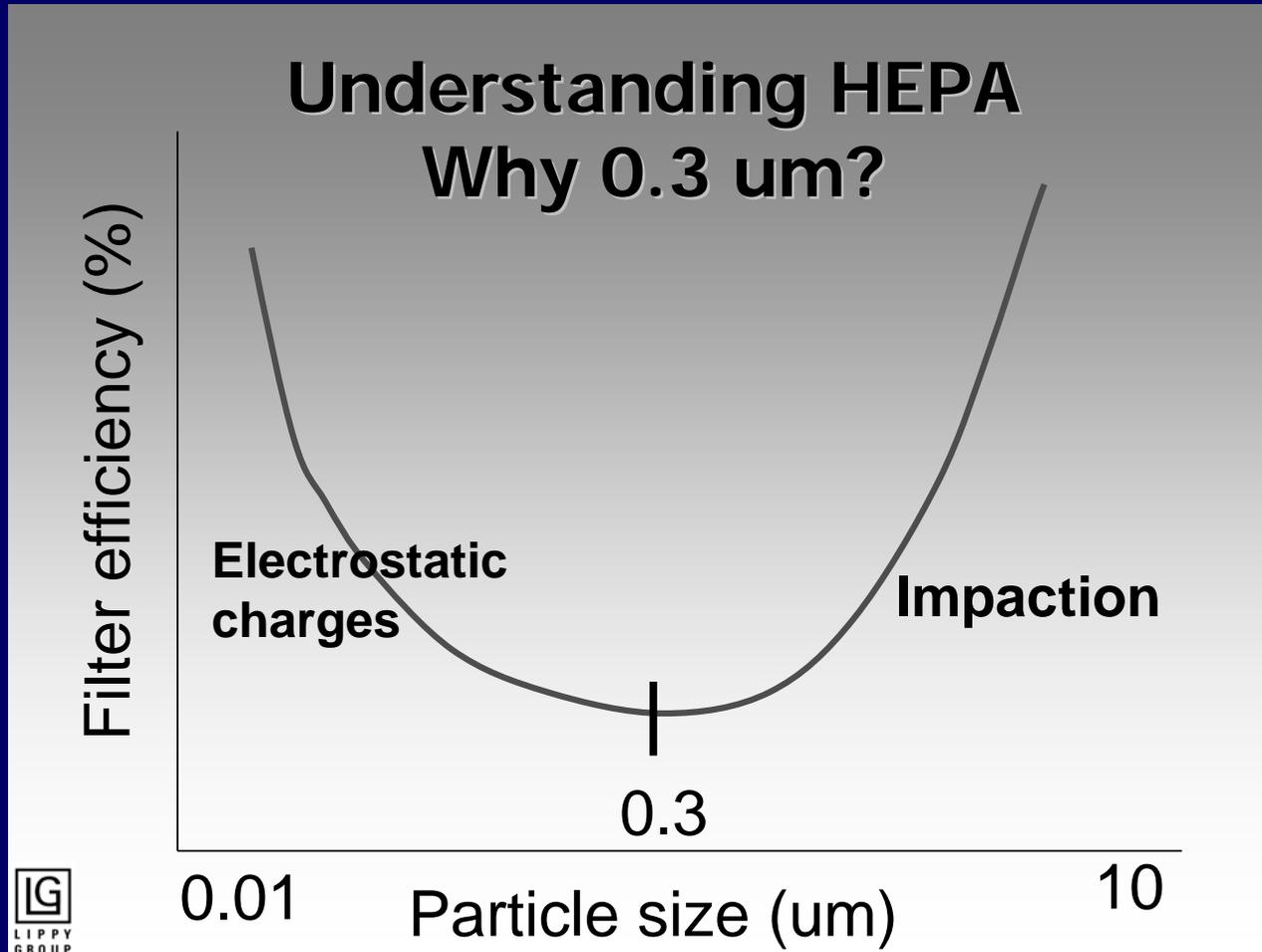
High Efficiency Filtration

Key Concepts

- Most penetrating particle size (MPPS)
- Tortuous path filtration (**non-popper scooper**)
- Filtration mechanisms:
 1. Interception
 2. Impaction
 3. Diffusion

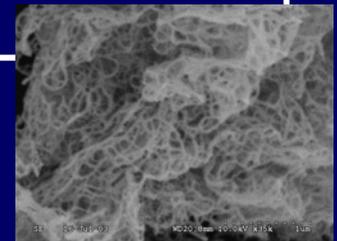


Understanding HEPA

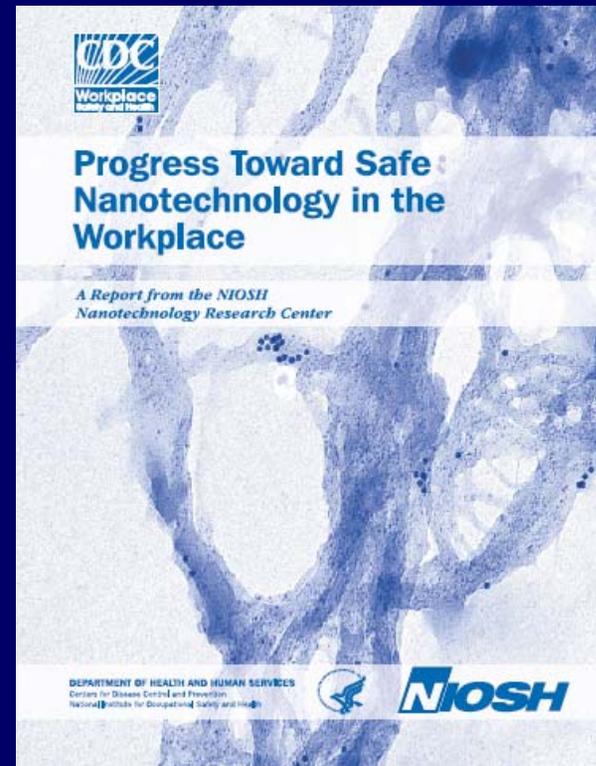


Nano-particles < 100 nm (Howard, NIOSH)

Natural	Anthropogenic	
	Incidental	Engineered
Forest Fires	Combustion engines	Controlled size and shape
Volcanoes	Incinerators	Semiconductors, carbon
Viruses	Jet engines	Metal oxides, polymers
Gas-to-particles	Welding fumes	Nanospheres, -wires, needles, -tubes, -shells, -rings, -platelets



No evidence of nanoparticles passing through respirator filters at a higher rate, NIOSH 2-07



U. Of MN tested respirator filter media to 3 nm

Do N95 Respirators Protect Against Viruses?

Balazy et al. (AJIC, 2005)

- Surgical masks are not NIOSH-certified
- Tested with actual viruses

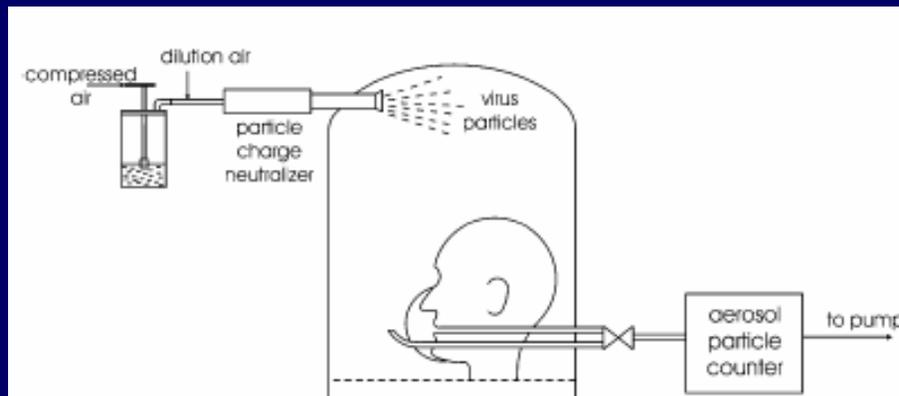
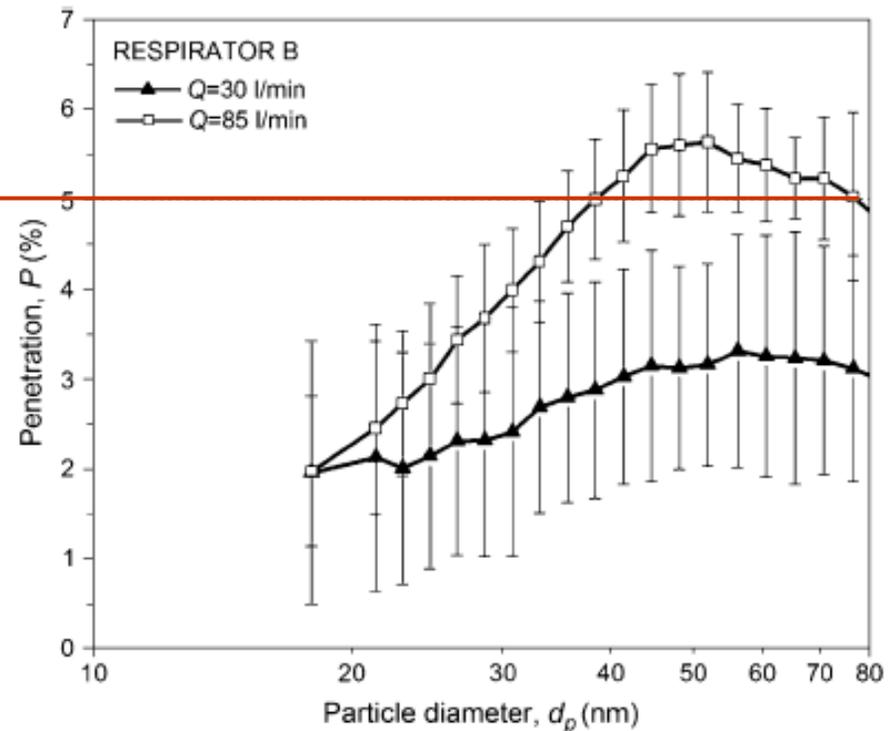
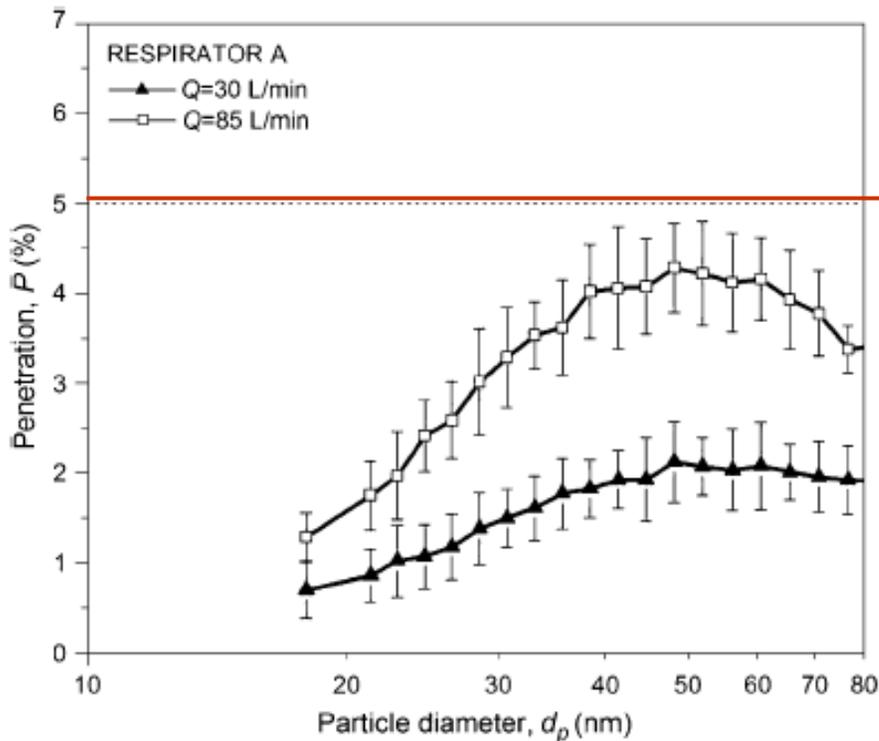


Fig 1. Experimental setup.

Do N95 Respirators Protect Against Viruses?

Balazy et al. (AJIC, 2005)

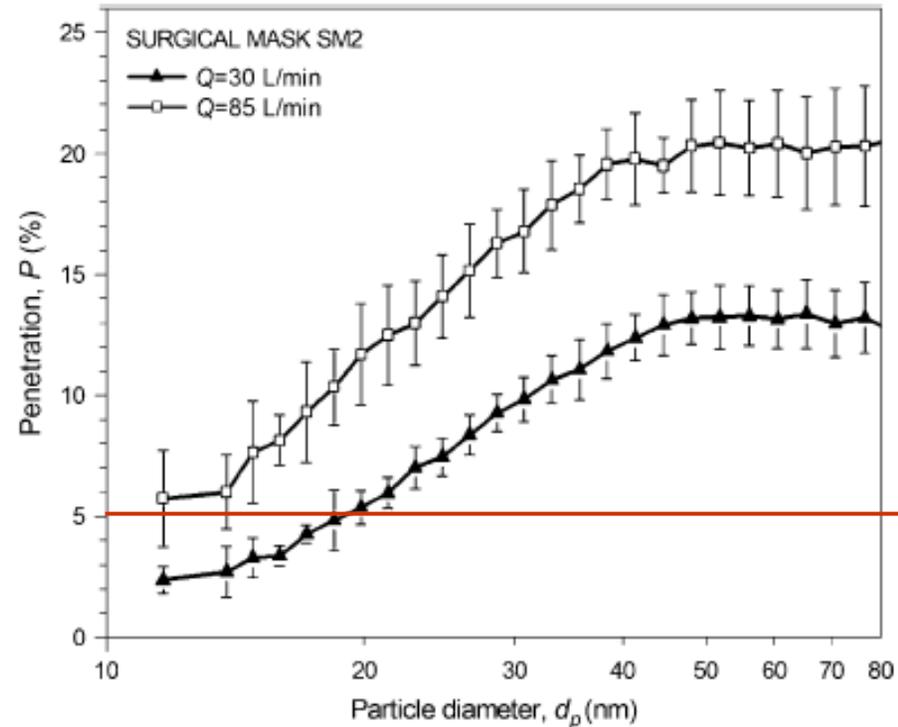
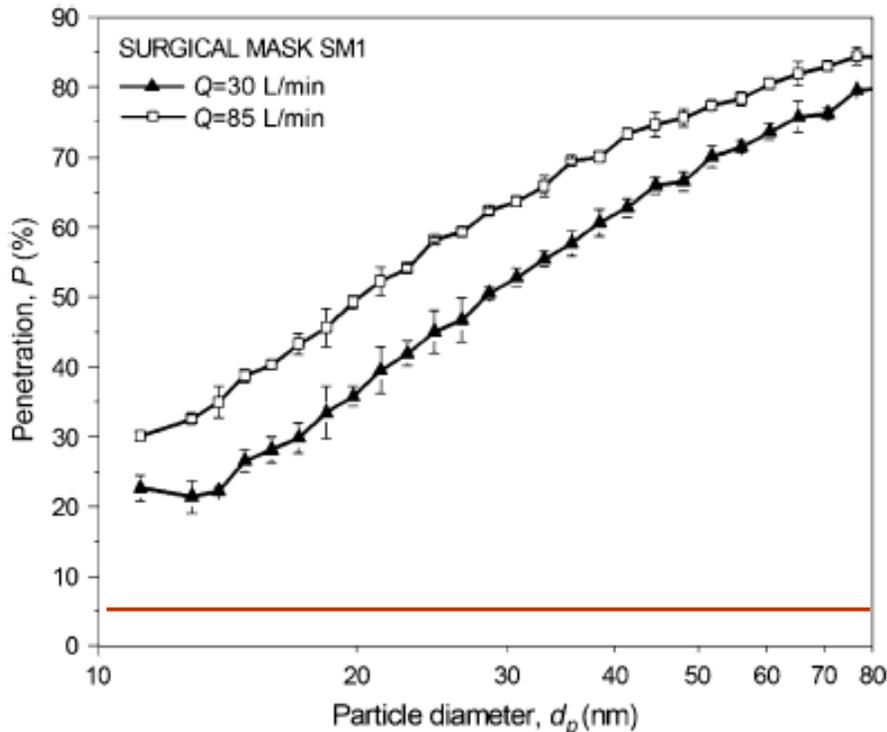
Results for N95 respirators



Do N95 Respirators Protect Against Viruses?

Balazy et al. (AJIC, 2005)

Results for surgical masks



Conclusions

“Thus, the protection against the airborne viral agents provided by some N95 respirators may fall below 95%, especially at higher inhalation flow rates.”

Good Bet Number 2

Respirators must be worn to be effective

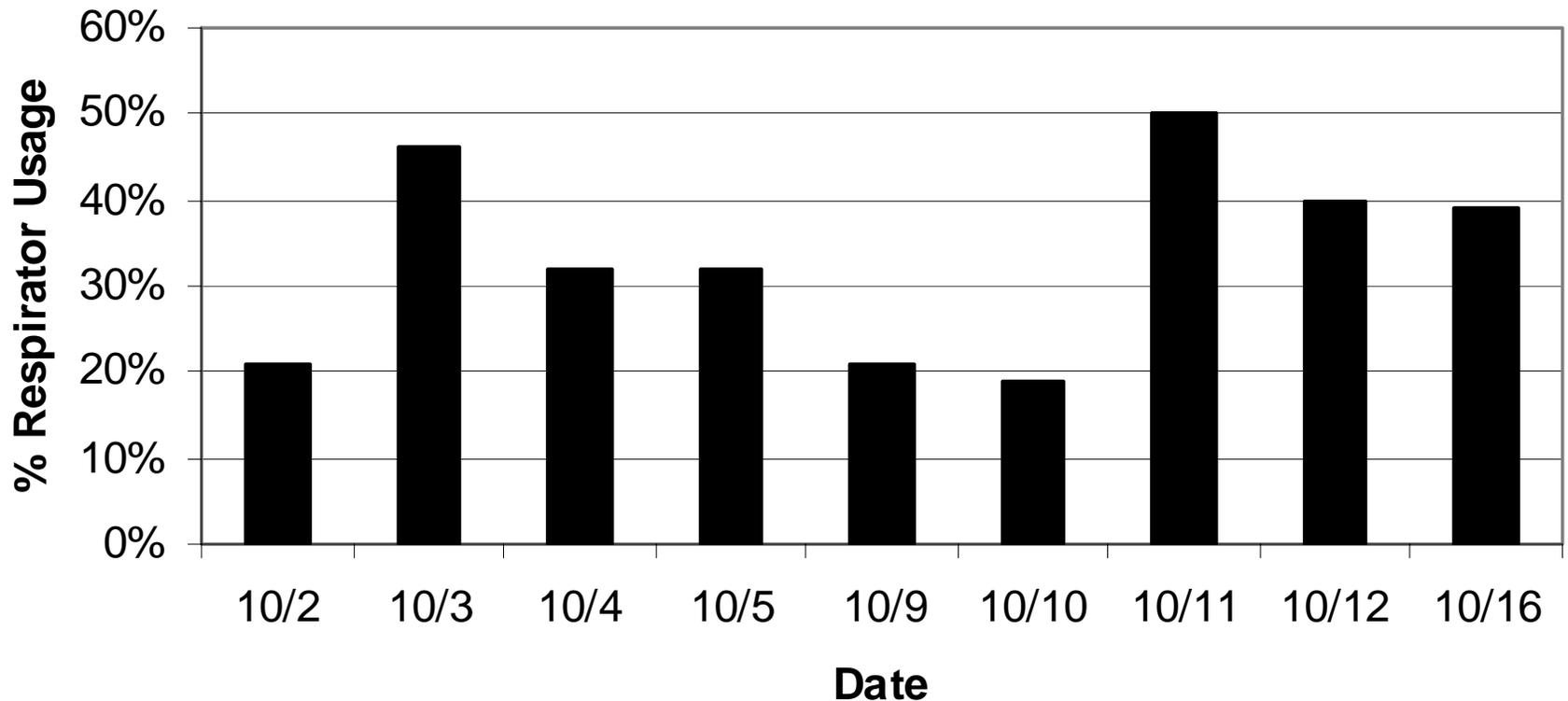


At WTC we
chose the
right
respirator: a
half-face
with P-100,
OV/AG
cartridges



But they weren't worn conscientiously!

**Respirator Usage by Heavy Equipment Operators
at Ground Zero, October 2-16, 2001**



Much better (80-90%) at Fresh Kills!

**99.97% efficient
respirator drops to
95% if it isn't worn
24 minutes in an 8-
hour work day of
exposure**

Good Bet Number 3

**Respirators must be fit
tested to be
adequately protective
(and, hey, it's the law)**



At WTC we took too long to do respirator fit testing

- October 17th Fit test booth through IUOE
- Prior to that OSHA performed “user seal checks” that proved 80% effective
 - (4,000 given out/day)
 - (800 failures/day)

3M Mobile Van onsite



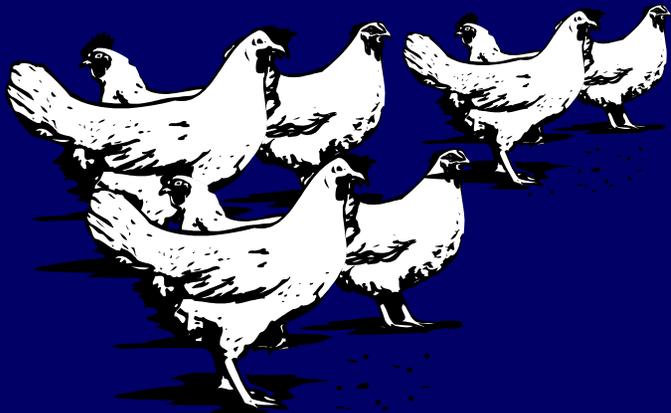
Anthrax lessons learned

- Quantitative testing was necessary
- Several team members **failed** quantitative tests
- Double-gloving with nitrile critical



Quantitative Fit Test (QNFT)

How many of you conduct Portacount testing?



Simulated workplace performance of N95 Respirators

(Coffey, Campbell & Zhuang, AIHAJ, 1999)

- NIOSH researchers tested 21 different N95 respirators
- Ran 100 penetration tests on each type
- 95th percentile of total penetrations without fit testing ranged from 6 to 88%
- “Therefore, fit-testing of N95 respirators is necessary to ensure that the user receives the expected level of protection”

N95 Quantitative fit testing Lee, Slavcev & Nicas (JOEH, 2004)*

TABLE I. Quantitative Fit Testing Results of Five Type N95 Respirators

	Pass Rate with Medium/Regular Respirator (%)	Pass Rate with Any Size of Respirator (%)	Pass Rate with 200+ Fit Factor Among Pass (%)	Comfort (%)
Respirator A	95	98	67	77
Respirator B	75	90	53	72
Respirator C	68	80	69	67
Respirator D	45	63	46	67
Respirator E	8	NA	20	38

Note: NA = only the medium/regular size of Brand E was tested.



Respiratory Protection Against *Mycobacterium tuberculosis*: Quantitative Fit Test Outcomes for Five Type N95 Filtering-Facepiece Respirators



N95 Quantitative fit testing

Lee, Slavcev & Nicas (2)

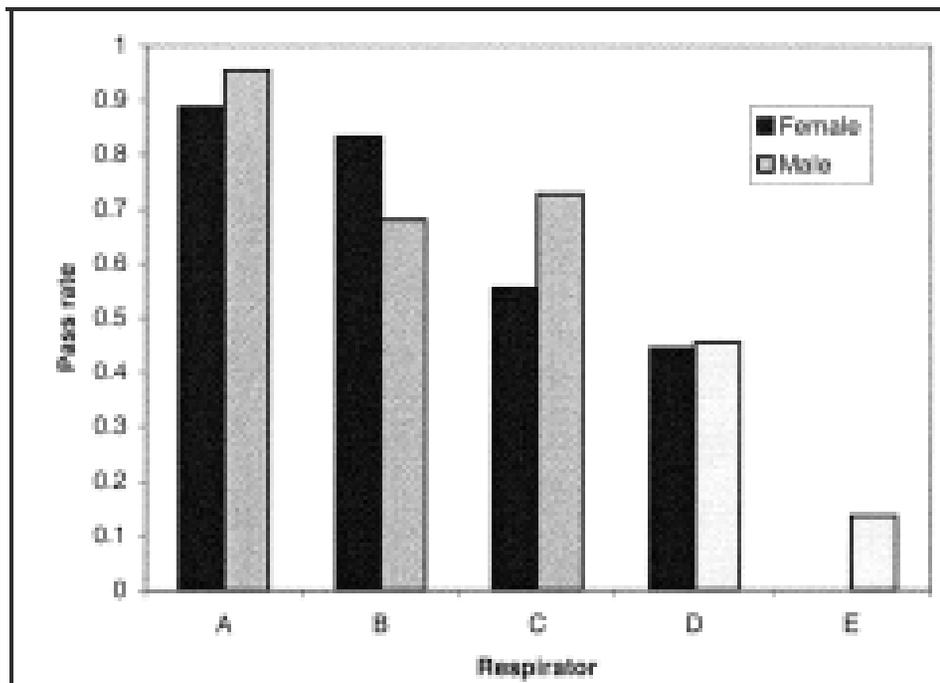


FIGURE 2. Pass rates of Type N95 respirators by gender based on 'medium' or 'regular' size

N95 Quantitative fit testing

Lee, Slavcev & Nicas

“The entire basis of conducting fit testing is the premise that fit test results indicate future workplace performance, yet there are no data that convincingly demonstrate a strong association between these two outcomes.”

Good Bet Number 3

Other Routes of Entry
for AI Must be
Considered



Biological Portals of Entry

- Inhaled
- Mucous membrane (eye, nose, mouth)
- Break in skin (cut, wound, etc)
- Portals of entry differ by disease!

D. M. Skowronski et al.

Protective measures during H7N3 AI outbreak in poultry in Canada, CMAJ, Jan 2007

“the only human infections in British Columbia followed direct contact with unprotected conjunctiva.”

Present in poultry barn for any reason

88

65/88 (74)

ated activities performed by participants

No. (%) using barrier precautions at all times during direct contact† with known infected birds

Gloves

Mask

Goggles

5/11 (45)

6/11 (54)

3/11 (27)

5/5 (100)

4/5 (80)

4/5 (80)

10/10 (100)

9/10 (90)

7/10 (70)

21/32 (66)

19/32 (59)

13/32 (41)

30/37 (81)

29/37 (78)

17/37 (46)

25/28 (89)

24/28 (86)

18/28 (64)

22/25 (88)

20/25 (80)

13/25 (52)

4/5 (80)

4/5 (80)

3/5 (60)

26/31 (84)

25/31 (81)

12/31 (39)

55/65 (85)

54/65 (83)

36/65 (55)

*Not mutually exclusive.

†Same confined airspace or handling poultry or poultry products of infected birds.

Good Bet Number 4

**Other Safety and
Health Issues Must be
Considered for AI**



We worked them too hard which impacted PPE use

- At WTC, the shifts continued to be 12 hours until the end
- NRT is now working on a document about risks of fatigue on job
- 18 hours sustained wakefulness produces performance impairment = .05% BAC
- *24 hours = .10% BAC*
(Dawson & Reid, 1997; Williamson & Feyer, 2000)

Impact of long work hours

Dembe et al.

Occup Environ Med 2005

- Analyzed 110,236 job records for nationally representative sample of U.S. workers over 13-year period
- 61% higher injury rate for workers in jobs with overtime schedules
- 37% increased rate for ≥ 12 hrs/day
- 23% increased rate for ≥ 60 hrs/week

Good Bet Number 5

**Safety Issues Must
be Given Priority,
too**

Euthanasia

- **Considerations for euthanasia methods**
 - Humane
 - Human safety
 - Skill
 - Aesthetics
 - Cost
 - Limitations



Physical Methods

(don't help the birds, but can pose risks to the workers, too)

- Decapitation
- Cervical dislocation
- Electrocution
- Maceration

Chemical Methods

Any S&H issues?

- Argon gas
- Carbon dioxide gas
- Water-based foam
- Carbon monoxide
- Anesthetic overdose

Safety Issues with Disposal

- Disposal methods must comply with both state and federal EPA regulations
- Composting
- Burial
 - Private property
 - Landfill
- Incineration
 - Air curtain
 - Fixed facility



Air Curtain Incineration



Air Curtain Incineration



What about responders?

“If the agent was contagious in human-to-human transmission, then just about the first people to die would be the medical caregivers and the first responders. The population of doctors, nurses, firemen, ambulance crews, and police - they’d disappear, fast as hell.”

Richard Preston, *The Cobra Event*



Hand washing exercise (OSHA guidance)

- Follow Ron's lead



Thanks. Bruce Lippy

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