Workforce Health and Safety: NIOSH Update

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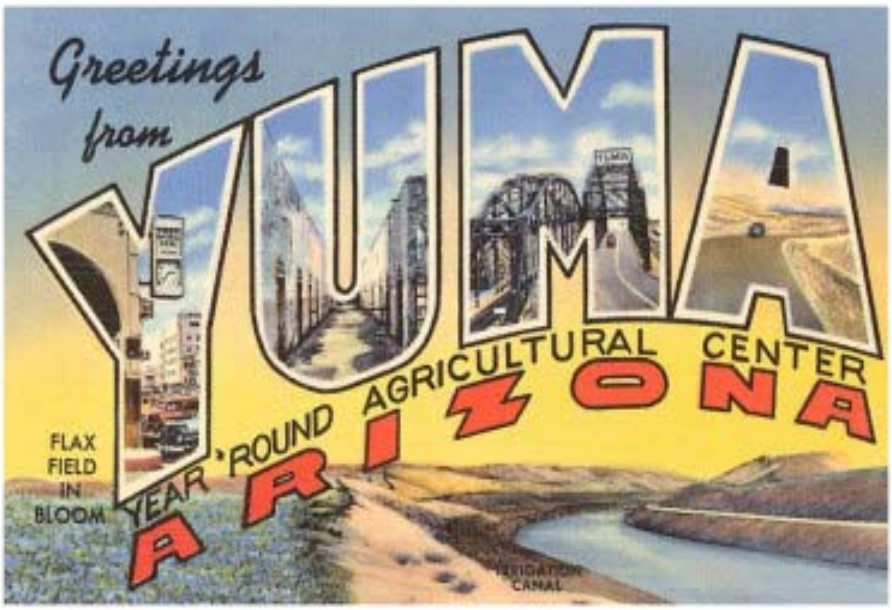
25 January 2013

38th Annual Meeting Yuma Pacific Southwest Section
American Industrial Hygiene Association
Bahia Resort Hotel
San Diego, California

Selected Topics

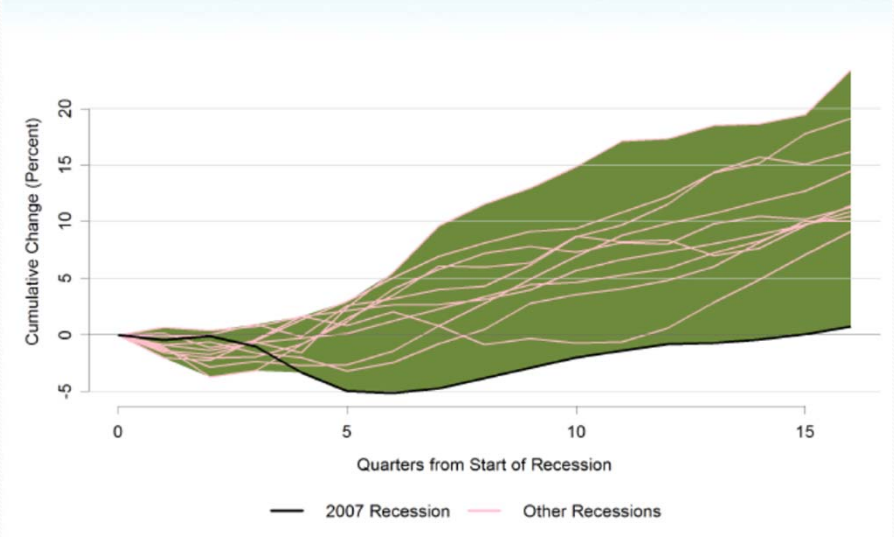
- Economic and Workforce Trends
- NIOSH Carcinogen Policy
- Nanotechnology and Risk
- Influenza Transmission Research
- Hydraulic Fracturing


Greetings
from
YUMA
AGRICULTURAL CENTER
ARIZONA
YEAR 'ROUND
FLAX
FIELD
IN
BLOOM
IRRIGATION
CANAL

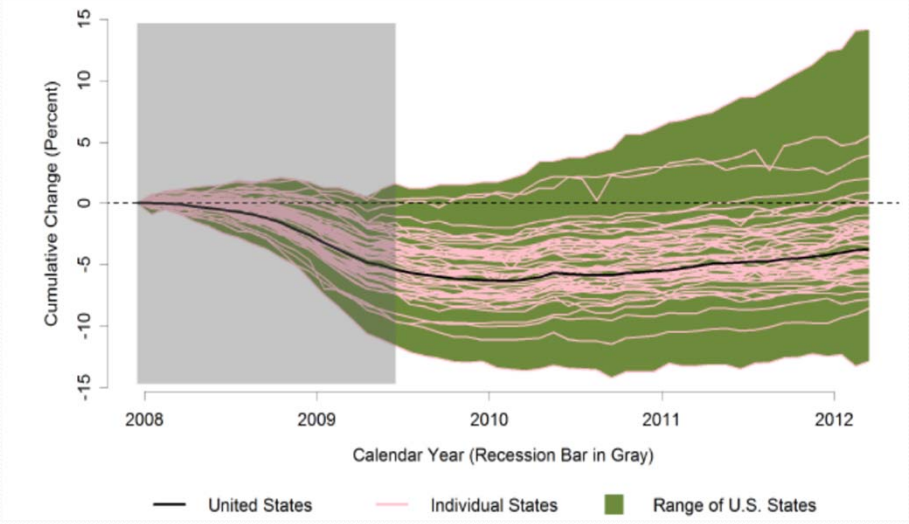
Facts About Yuma

- **Agriculture** plays a dominant role in the Yuma County Economy. Value of crops, livestock, fruits and vegetables produced on Yuma County farms and ranches was over $633 million in 1996. Crops accounted for 84%, while livestock products was 16%.
- **Military** bases contribute substantially to the local economy with the Marine Corps Air Station and Yuma Proving Grounds located in the county.
- **Tourism** to Yuma County generates an estimated gross revenue of over $380 million per year. New and exciting light industry increases Yuma's diversification.
- **Unemployment** rate in Yuma is 23.70 percent(U.S. avg. is 8.60%).

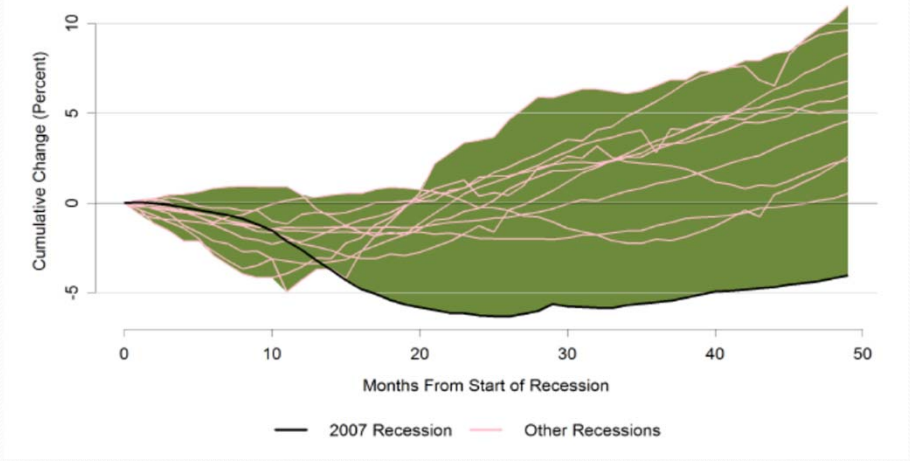
Pace of the Recovery



Employment Picture Varies by State



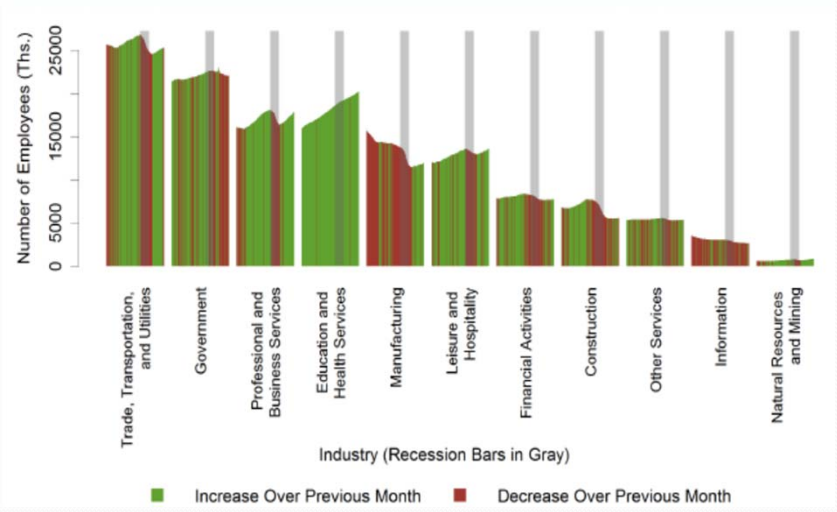
Non-Farm Employment



Unemployment High and Persistent

Industrial Structure is Changing

Health Care Growth Unabated



NIOSH Statutory Mandate Relative to Chemical Carcinogens

" … develop criteria dealing with toxic materials and harmful physical agents and substances which will describe exposure levels that are safe for various periods of employment, including but not limited to exposure levels at which **no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience**."

OSH Act, Section 20 (a)(3)

NIOSH and Carcinogens

- NIOSH conducts toxicological and epidemiological research on occupational carcinogens
- NIOSH assesses workplace exposures to carcinogens
- NIOSH sets recommended exposure limits (RELs)
- NIOSH pocket guide lists 135 substances as carcinogens

Current NIOSH Carcinogen Policy

- NIOSH reviews data on cancer as part of setting a REL for a substance
- NIOSH makes a determination whether a substance is a *potential occupational carcinogen*
- Peer review of this decision occurs as part of the peer review of the Criteria Document or Current Intelligence Bulletin
- Serves as the basis for risk management AND risk communication decisions

Reasons for Review

- ***"potential occupational carcinogen"*** conveys uncertainty not warranted with many known human carcinogens (e.g. asbestos, benzene, and cadmium)
- How to incorporate uncertainty from incomplete data and understanding of the mode of action in the policy
- How to incorporate advances in cancer science

Cancer Policy Revision Timeline

- Federal Register Notice: August 23, 2011
- Public Meeting: December 12, 2011
- Constructing Draft Policy: 2012
- Public Draft: Anticipated Early 2013 (?)

Federal Register Questions

- Should there explicitly be a carcinogen policy as opposed to a broader policy on toxicant identification and classification (e.g. carcinogens, reproductive hazards, neurotoxic agents)?
- What evidence should form the basis for determining that substances are carcinogens? How should these criteria correspond to nomenclature and categorizations (e.g., known, reasonably anticipated, etc.)?
- Should 1 in 1000 working lifetime risk (for persons occupationally exposed) be the target level for a recommended exposure limit (REL) for carcinogens or should lower targets be considered?
- In establishing NIOSH RELs, how should the phrase "to the extent feasible" (defined in the 1995 NIOSH Recommended Exposure Limit Policy) be interpreted and applied?
- In the absence of data, what uncertainties or assumptions are appropriate for use in the development of RELs? What is the utility of a standard "action level" (i.e., an exposure limit set below the REL typically used to trigger risk management actions) and how should it be set? How should NIOSH address worker exposure to complex mixtures?

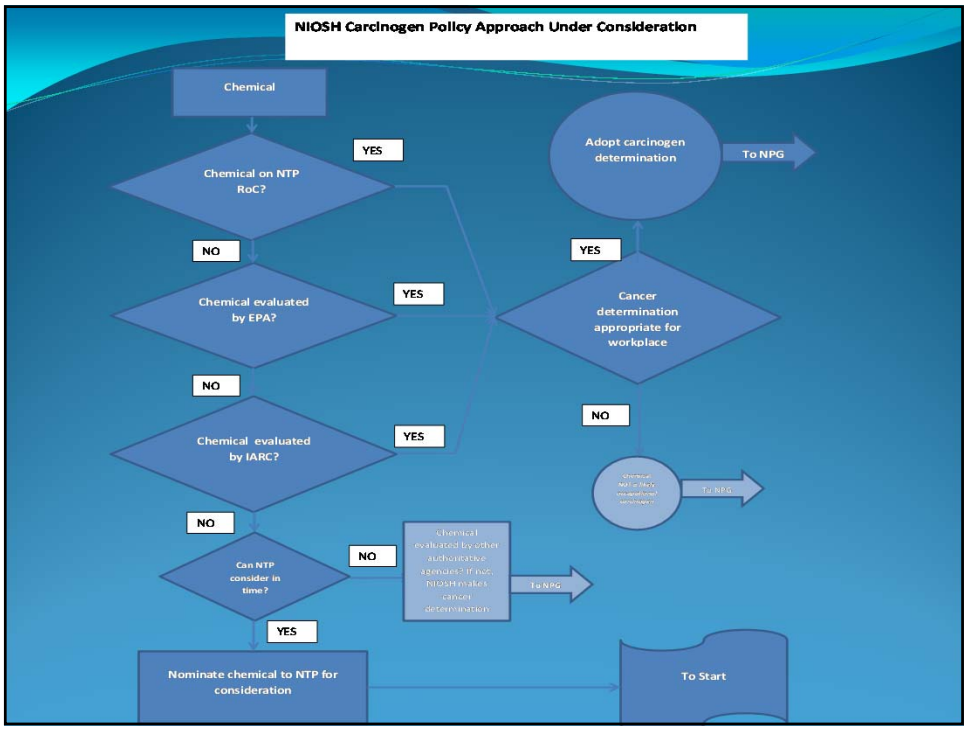
Approach?
Use of a Tiered Decision Logic

NTP
- If substance is listed on the NTP Report on Carcinogens, adopt cancer classification

EPA
- If substance is listed by EPA as carcinogen, adopt cancer classification

IARC
- If substance is listed by IARC as carcinogen, adopt cancer classification

None?
- Nominate to NTP for cancer classification



Benefits of Draft Policy Approach

- Avoids duplication of effort
- Preserves scarce government resources
- Allows NIOSH to focus on the occupational aspects of exposures
- Streamlines the RELs process

Disadvantages of Draft Policy Approach

- NIOSH no longer conducts separate in-depth carcinogenesis review
- Some inconsistency with past practice
- More reliance on other agencies with different agendas and different cancer criteria

Issues Under Discussion

- 1/1000 Risk Level
- Meaning of *to the extent feasible*
- Action level: purpose and criteria
- Incorporating uncertainty into cancer classifications
- How to deal with complex mixtures

1/1000 Risk Level

- Risk level NIOSH historically has used
- Selected to be supportive of OSHA needs (*Benzene* decision)
- Determined by quantitative risk assessment

Meaning of *"to the extent feasible"*

- Stated in 1996 NIOSH Cancer/RELs Policy revision
- 1996 Policy stated NIOSH would project a range of risks and select a level where there might be residual risk

Action Level

- Historically meant to address the variability in exposure measurements
- Also triggered preventive action
- Should it continue to be used?

Incorporating Uncertainty into Cancer Classification

- What to do when there are limited data?
- How to determine occupational relevance?

The Complexities of Complex Mixtures

- Cumulative risk considerations from multiple chemical exposures
- How to set RELs that make sense for components of complex mixtures

Nanotechnology and Risk

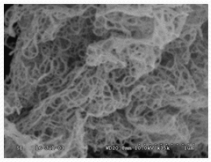
- **Nanotechnology - The Motivation**
  - Purposely engineered nanomaterials and devices demonstrate novel size-dependent properties and behavior that hold great promise in many areas of benefit to man.
- **Nanotechnology - The Challenge**
  - Does the nature of engineered nanomaterials and devices present new occupational safety and health risks?
  - How can the benefits of nanomaterials be realized while proactively minimizing or eliminating the potential risks?

Key Communication Products

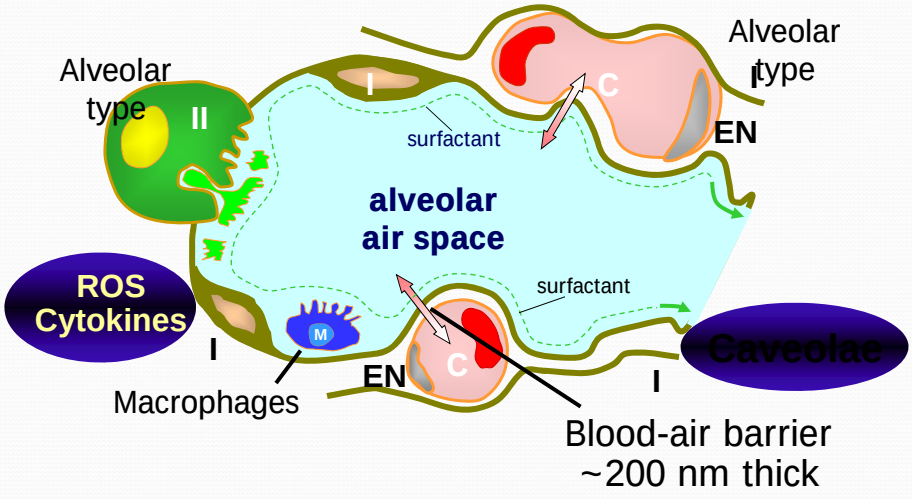
What's So Unique About Nano?

Natural	Anthropogenic	
	Incidental	Engineered
Forest Fires	Combustion engines	Controlled size and shape: Nanospheres, -wires,-rings
Volcanoes	Incinerators	Controlled properties: Electronic, chemical
Ocean Spray	Jet engines	Controlled composition: metal oxides, polymers
Viruses, macromolecules	Welding fumes	





Inhalational Hazard?



Simeonova, 2006

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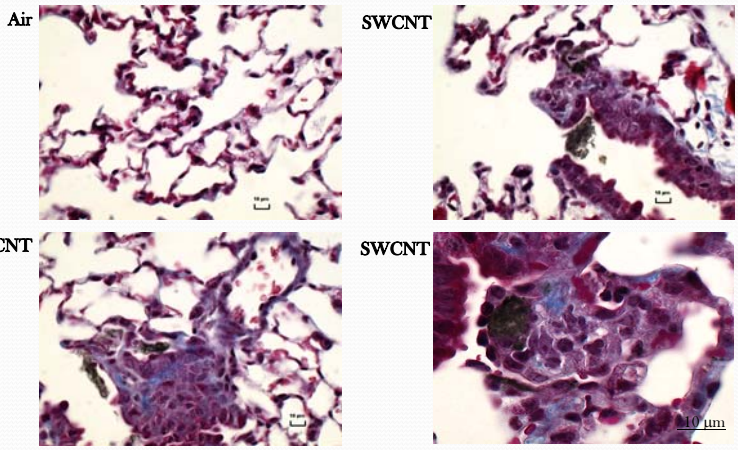
Granuloma Formation from SWCNTs

Whole body inhalation exposure to SWCNT elicited acute inflammation combined with early progressive fibrosis and granulomas in mice.



A.A. Shvedova et al, Am. J. Physiol. Lung Cell. Mol. Physiol., 2008

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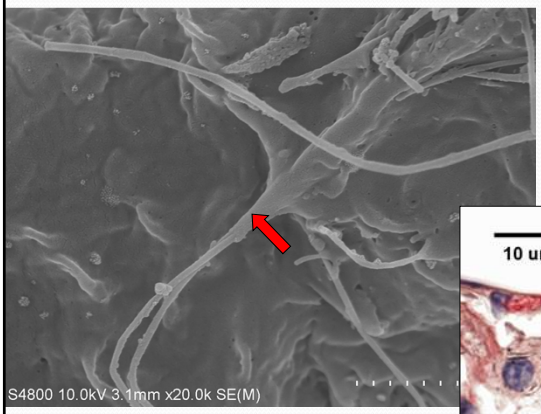
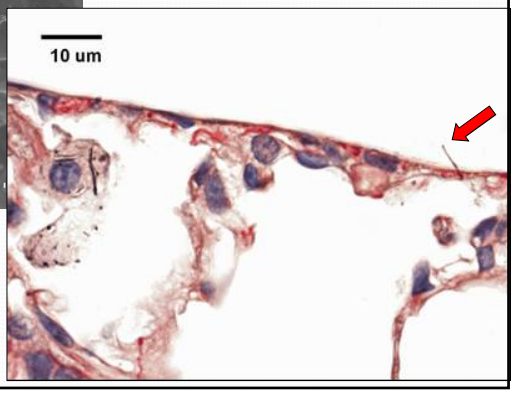
CNTs Penetrate the Pleura



- Multiwall CNTs aspirated by laboratory mice can migrate from the alveoli in the lung, through the lung, to the pleura



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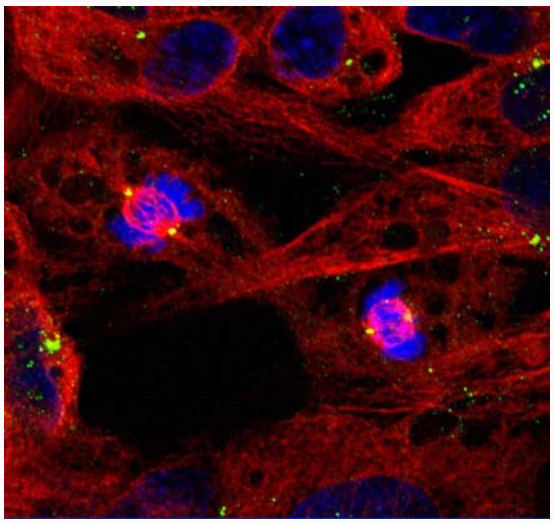
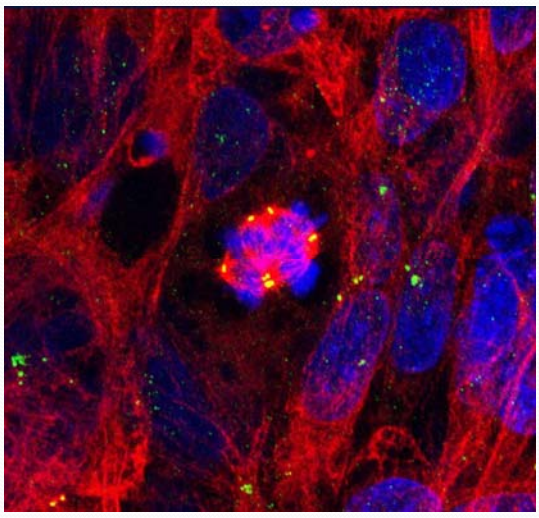
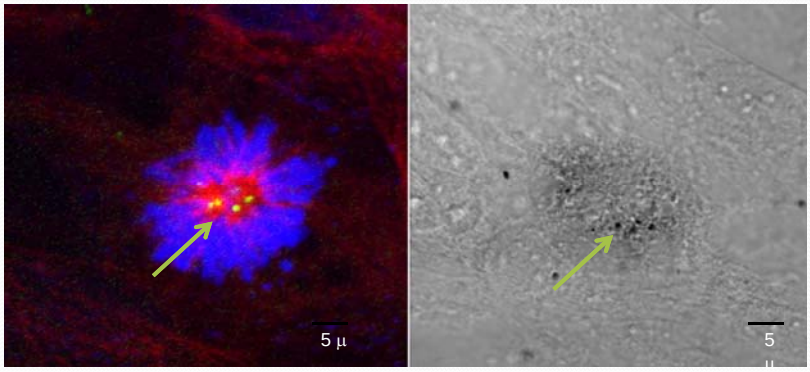


Two dividing control cells with normal centrosome morphology



Four polar mitosis, nanotube association 24 hours following exposure to 0.024 μg/cm² SWCNT

Monopolar mitotic spindle 24-hr following exposure to MWCNT – nanotube association with centrosomes*



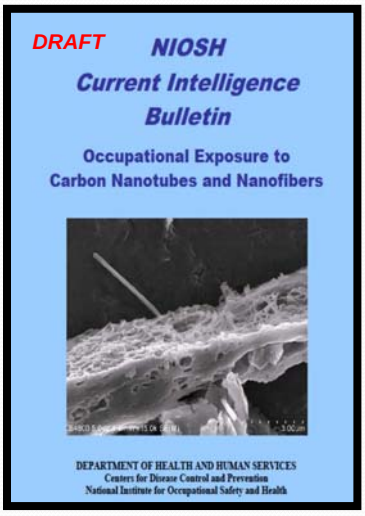
* Resulting errors in chromosome number (aneuploidy) is a key event in the progression of cancer.

[Adapted from: Sargent L, SOT 2011 presentation, with permission]

Occupational Exposure Limits for CNTs

- Summary of the hazard
- Dose-response risk assessment
- ***Draft*** NIOSH proposed REL:
  - 7 ug/m³ for CNT and CNF
  - Measured as elemental carbon
  - Set as LOQ for NIOSH Method 5040
  - 8-hr TWA concentration, respirable fraction
- ***"Probable"*** proposed REL:
  - Since 2010 draft, NIOSH Method 5040 LOQ improved
  - LOQ is now 1 ug/m³

http://www.cdc.gov/niosh/docket/review/docket161A/



Can CNTs Initiate and/or Promote Cancer?

- Focus of NIOSH toxicology research
- NIOSH has performed several subchronic inhalation studies in rats
- Results?
- Attend the Society of Toxicology 2013 Meeting
  - San Antonio, March 10-13

Influenza Issues

- Is the word "pandemic" counterproductive?
  - Yes
- H5N1 Influenza – Is it coming?
  - Yes
- What is the relative contribution of droplets vs. aerosols in influenza transmission?
  - NIOSH research goal
- Should CDC Guidance become an OSHA standard?
  - OSHA thinks so
- Should vaccination be mandatory for healthcare providers?
  - Many think so; others do not.

Avian Influenza (H_5N_1)

- In 1997, influenza A viruses of H5N1 subtype first isolated from a patient in Hong Kong
- Highly contagious and deadly pathogen in poultry and has reached epizootic levels in Asian domestic fowl
- Spread to wild bird populations across Europe and Africa, but no cases yet in US birds
- Human spread has been limited (2003-2012):
  - WHO reports 610 confirmed cases
  - 192 Indonesia, 123 Viet Nam, 169 Egypt, 43 China
  - 360 deaths for a 59% case fatality rate!

As of 13 January 2013, World Health Organization

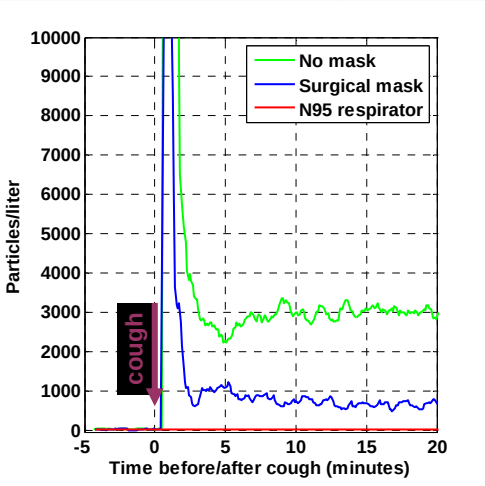
Science Research: Influenza

- **Influenza Transmissibility Study**
  - Respirable aerosol sampler
  - Live virus analysis
  - Evaluate Exposures for High Risk Procedures

- **N95 vs. Surgical Masks Effectiveness**
  - Large-scale clinical trial
  - Veterans Hospital Clinics

Particles inhaled while wearing no mask, surgical mask & N95 respirator

- Coughing and breathing systems were 6 feet apart and facing each other.
- Plot shows concentration of aerosol particles at mouth of breathing mannequin.
- Surgical mask admitted ~20% of particles.
- N95 respirator blocked virtually all particles.
- Similar results are seen for other masks and respirators and for all positions of the breathing simulator.



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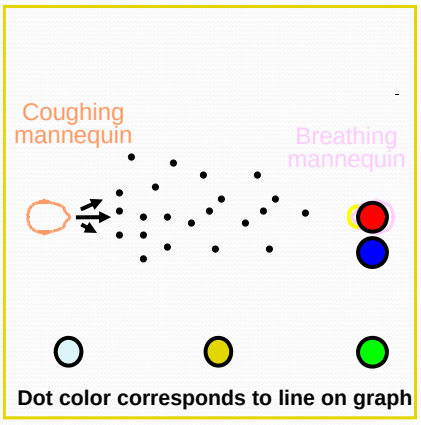
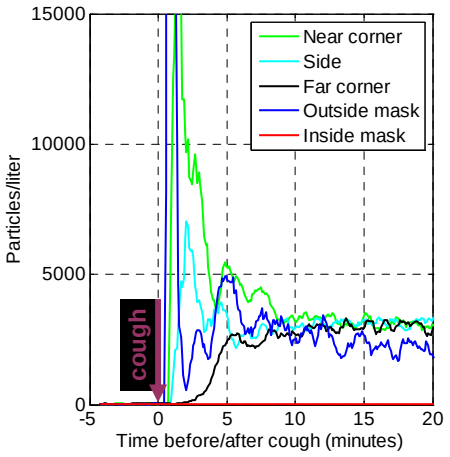
Spread of particles in room after cough

- Coughing and breathing systems were 6 feet apart and facing each other.
- Breathing machine wearing N95 respirator and operating at 32 liters/minute.
- Plot shows concentration of 0.3 to 0.4 μm KCl aerosol particles at different locations after a single cough.





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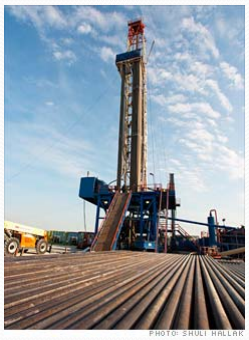
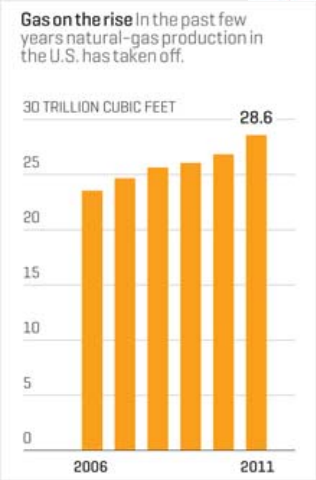
The Energy Workforce

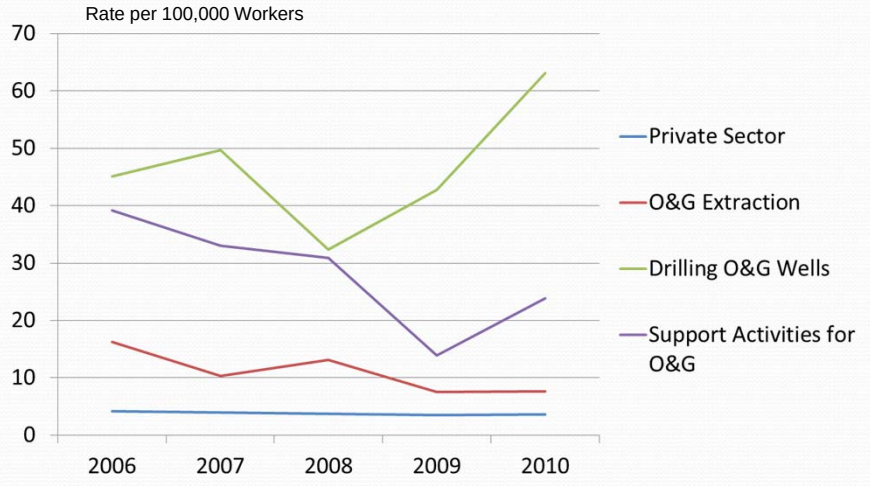
- America's Energy Hotspots
  - Deeping Sea Drilling
  - Hydraulic Fracturing





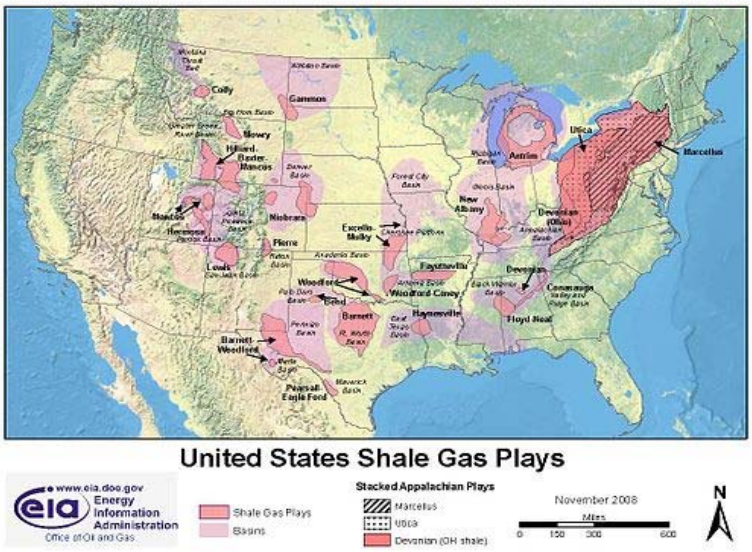
Hydraulic Fracturing

One in many upstream operations in an industry with a high fatality rate (2006-2010)



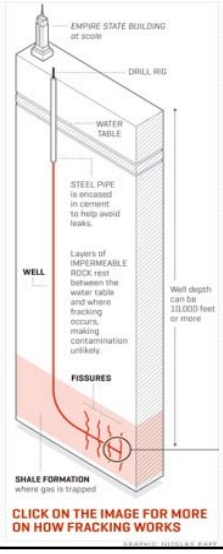
Source:
Private Sector Fatality Rates- Bureau of Labor Statistics Census of Fatal Occupational injuries (CFOI)
O&G Fatality Rates - OSHA calculated using CFOI fatality counts and employment data from the BLS Quarterly Census of employment and Wages.

United States of Shale

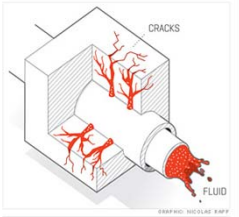


United States Shale Gas Plays

Hydraulic Fracturing Process

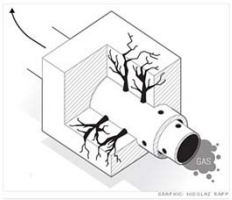


3. A mix of water and chemicals is injected at high pressure to fracture the shale. Sand is included to keep the cracks open.



4. Part of the water and sand mix flows back to the surface. The natural gas then flows up through the well.

NEXT



Potential Chemical Exposures

- Silica
- Diesel particulate
- Volatile organic compounds (NBTEX)
- Hydrogen sulfide (H_2S)
- Acid gases (HCL)
- Aldehydes (biocides)
- Metals (Pb)

Not an inclusive list

HF Needs Many Truckloads of Sand

Where Does Exposure Occur?
During All Sand Moving Operations

NIOSH Field Studies

- 11 site visits in five states
- 116 samples for silica

- Findings:
  - 54 / 116 (47%) > OSHA Permissible Exposure Limit
  - 92 / 116 (79%) > NIOSH Recommended Exposure Limit
  - 36 / 116 (31%) > 10 X NIOSH REL
- http://blogs.cdc.gov/niosh-science-blog/2012/05/silica-fracking/

Protecting Workers

- Use a less hazardous non-silica proppant (e.g., ceramic) where feasible.
- Use local exhaust ventilation for capture and collection.
- Use passive enclosures at points of dust generation.
- Minimize distances between the dragon tail and T-belts and blender hoppers
- Replace transfer belts with screw augers on sand movers
- Use amended water (e.g., containing chloride and magnesium salts) to reduce dust generation on roads into and at the well site
- Mandate use of cam-lock caps for fill ports on sand movers
- Use administrative controls
- Provide worker training
- Monitor workers to determine their exposure to crystalline silica
- Use appropriate respiratory protection as an interim measure until engineering controls are implemented

Proposed Controls

NIOSH Mini-baghouse retrofit assembly

Proposed Controls

NIOSH screw augur retrofit assembly

Legislation Passed by Congress on 23 December 2010

Signed by President Obama on 2 January 2011

Effective 1 July 2011