What we now know about the WTC dust particles

- Particle quantity and size
  - 1.2 million tons of building materials
  - 90% particles >10 μm diameter
  - 11,000 tons of particles < 2.5 mm were released
  - Gases and fumes from fires that burned until December 19, 2001

*Lioy et al. Environmental Health Perspectives Vol 110,, July 2002
Early onset disease: Acute eosinophilic pneumonia in a firefighter

Rom et al. Am J Respir Crit Care Med 2002
Mineralogic analysis of bronchoalveolar lavage from firefighter

(A) Amosite asbestos fiber (uncoated)  (B) Fly ash particle  (C) Degraded fibrous glass.

305 commercial asbestos fibers/10^6 macrophages

Rom et al. Am J Respir Crit Care Med 2002
Lung cancer and asbestos exposure

- North American insulators union with 17,800 workers followed from 1967-1987 revealed lung cancer 1166 deaths 267 expected RR 4.4
- Mesothelioma 457 deaths (9%)
- Synergism with cigarette smoking
- Risk decreases dramatically after quitting
- Since the removal of asbestos from insulation materials in the early 1970's, death rates have declined for lung cancer but continued to increase for mesothelioma
PLEURAL PLAQUES AND RISK FOR BRONCHIAL CARCINOMA AND MESOTHELIOMA

• Epidemiologic survey of 1,596 men with pleural plaques in Uppsala, Sweden, were followed from 1963-1985.
  • Bilateral lesions
  • ≥ 5MM thick and/or calcified, well-demarcated.
  • No remnants of pleurisy, i.e. costophrenic angles not obliterated.

• 50 Bronchial carcinomas observed while 32.1 expected after correction for smoking (O/E 1.6; CI 1.2-2.1).
  • 2.3 (CI 1.1-4.4) with asbestosis
  • 1.4 (CI 1.0-2.0) without asbestosis

• 9 Mesotheliomas with 0.8 expected (O/E 11.3; CI 5.1-21.4).

American Cancer Society Follow-up for Long Term Health Effects

- ACS enrolled 1.2M adults in 1982 and a questionnaire assessed age, sex, race, weight, smoking, education, diet, alcohol, and occupation.
- 500K adults were linked with air pollution data for metropolitan areas throughout the U.S. with vital status and cause of death data through December 31, 1998.
- PM$_{2.5}$ and SO$_2$ were associated with all-cause, cardiopulmonary, and lung cancer mortality.
- Each 10µg/m$^3$ elevation in PM$_{2.5}$ was associated with approximately 4%, 6%, and 8% increased risk of all-cause, cardiopulmonary, and lung cancer mortality, respectively.
- Coarse fraction PM$_{10-2.5}$ not consistently associated with mortality.
Adjusted Mortality Relative Risk (RR) Evaluated at Subject-Weighted Mean Concentrations
Representative Images of Carbon in Airway Macrophages from Healthy Children
Carbon in Airway Macrophages and Lung Function in Children

- Alveolar Macrophages (AMs) reflect a particle burden from occupational/environmental exposure.
- Children aged 8-15 U.K. (excluding parental smoking, house with coal combustion) 64 healthy children, 9 with asthma enrolled. Salivary cotinine measured.
- PM$_{10}$ recorded including hourly near traffic plus annual; PFT; induced sputum with C area calculated under light microscopy.
- Each increase in 1.0 $\mu$m$^2$ in C associated with 17% decrease in FEV$_1$ % predicted and 12.9% in FVC % predicted; Each increase in 1.0 $\mu$g/m$^3$ PM$_{10}$ was associated with a 0.115 $\mu$m$^2$ in C.
- Increased primary PM$_{10}$ was inversely associated with FEV % predicted.
Associations between Carbon in Airway Macrophages and Lung Function in Healthy Children
Field Cancerization of Squamous Cell Carcinoma of the Lung

SOMAmers: Unique DNA Reagents for Protein Detection

Red, green, purple atoms are modified nucleotides that provide binding energy

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Red, green, purple atoms are modified nucleotides that provide binding energy

• Single-stranded nucleic acids that bind with high affinity and specificity—currently available SOMAmers (1,043).
• The limits of detection average (300 fM) and the overall dynamic range spans 7 logs using different dilutions with a ~6% coefficient of variation.

• PLoS ONE 2010; 5(12): e15003. (December 2010)
SomaLogic

89% sensitivity and 83% specificity

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PLoS One. 2010 Dec 7; 5(12):e15003