Health Effects of Wildfire Smoke: new findings?

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Health Effects of Wood Smoke

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<< Roger Ottmar, USFS-PNW at RX410
Health Effects

**Short Term**
- Irritated eyes, nose, throat
- Headache
- Acute bronchitis
- *Exacerbate asthma*
- *Irregular heart beat*
- *Stroke, heart attack*

**Long Term**
- Reduced lung function
- Chronic bronchitis
- *Lung cancer*
- *Heart disease*
- *Premature death*
SMOKE: Particle Size Matters

- PM<sub>10</sub> > 10 μm
- PM<sub>2.5</sub> 2.5 - 10 μm
- PM<sub>0.1</sub> < 2.5 μm

HUMAN HAIR: 50-70 μm (microns) in diameter

- PM<sub>10</sub> Dust, pollen, mold, etc. < 10 μm (microns) in diameter
- PM<sub>2.5</sub> Combustion particles, organic compounds, metals, etc. < 2.5 μm (microns) in diameter

90 μm (microns) in diameter

FINE BEACH SAND

Image courtesy of the U.S. EPA
Smoke particles from wood are relatively small. Particulate Matter:

- PM 2.5 microns: 70.0%
- PM 2.5-10 microns: 20.0%
- > PM 10 microns: 10.0%

Virus: 0.3 microns

Roger Ottmar: RX410-4-5-EP
Are Respiratory Masks Effective?

- Effect of protective filters on fire fighter respiratory health: field validation during prescribed burns (DeVos, 2008)
- Effective vs. particles, VOC’s, irritants
- None filter CO!!!
- Thus, alerts on masks
What’s the big deal about carbon monoxide?

- CO attaches to hemoglobin in RBC’s, robbing you of oxygen.
- Causes headache, dizziness, weakness, disorientation and impaired decision making (Raub, 1999; Raubet al., 2000).
- Elimination half-life of COHb is 4–5 hours without any intervention.
Headaches and raspy voices as wildfire smoke chokes US West

Air quality has been rated unhealthy across the region because of blazes that show no signs of abating, officials said.

Sep 2, 2017
Ft. McMurray fire set new smoke records

New publications on Ft. MM indicate smoke was “off the chart” high for towns in its path.
Recent review articles on smoke and public/firefighter health:

✓ Review-type articles analyze multiple studies and rate the quality of the study (Reid et al 2016, Adetona et al 2016).

✓ Links to increased pneumonia and bronchitis in general population well documented.
Increases in hospital visits . . .

. . . were documented just after wildfires in California, Greece, Australia, etc.

Hospital admissions increased with ambient air PM2.5 concentration suggesting acute respiratory effects of wildfire smoke exposure.
Combinations of air toxins may be harmful at lower concentrations:

✓ Increased cardiovascular admissions among Medicare patients


Fairbanks, 2004 Boundary Fire
Photo by Dale Haggstrom
Documented adverse effects on wildland firefighters?

- Decline in lung capacity over a workshift (which seemed to return to normal after seasonal rest).
- Links to oxidative (stress) indicators in blood/urine mostly inconclusive or subtle effects.
- Body ramps up repair mechanisms (like smokers)

Photo credit: Tom McCabe
The good news:

- Mixed, mostly negative, results evaluating whether smoke contributed to or exacerbated asthma.

- Mixed results relating smoke exposure to angina, arrhythmias, and heart attack. *(Reid et al 2016, Adetona et al 2016).*

- Scant evidence, to date, tying smoke exposure to hypertension.
Pike & Alpine Hotshot crews

Did smoke exposure influence an index of arterial stiffness that has been linked to increased risk of cardiac events? Gaughan et al. 2014

Photo credit: NPS
Producing a clearer picture of smoke toxins

Kay Ansell quotes CRC Bushfire (Reisen et al.)
“In general, burning wood-based and polymeric materials released volatile organic compounds at higher concentrations than pine”.
“This means that the combustion of these products in fires at the rural/urban interface is likely to be a greater health risk than forest bushfires.”
Wood and wood-based products make up the majority of materials burned in the WUI.

Polymeric compounds in particleboard, fiberboard, carpet and polyurethane foam contain N, so burning these releases HCn, ammonia, nitriles and nitrogenated hydrocarbons.

Polystyrene foam, particleboard and polyester release CO, VOC’s.

Polyester, polystyrene foam emitted 20x more particulates than wood.

Carpet emitted 9x more particulates than wood.
What is a safe distance?

- Results -- within 150 ft of a burning house, average toxin levels constantly exceed both peak and short-term exposure limits and there is no safe approach without protection.
- At 300 ft, exposures are still exceeding peak limits, but average concentrations are within safe exposure limits.
- At 450 ft, peak concentrations can still be close to their respective limits, primarily at high wind speeds.
National Institute for Occupational Safety and Health research project to clarify the relationship between firefighter occupational exposures and cancer.

**Current study phase: 9% increased risk vs. general population**

Examine health records of the approximately 30,000 firefighter study participants using an exposure surrogate metric . . . to increase the accuracy of cancer risk estimates. Examples of exposure metrics might include number of fire-runs and time at a fire. We also examine the relationship between occupational exposures and the specific causes of firefighter deaths from cancer.
Any evidence for increased smoke impacts?
Also air quality alerts statewide

Tips on mitigating exposure risk
Questions?