

Smoke Signals: Epidemiologic Evidence of Wildfire Toxicity

*Webinar for the Inhalation and Respiratory Specialty Section,
Society of Toxicology
December 13, 2019*

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Disclosures

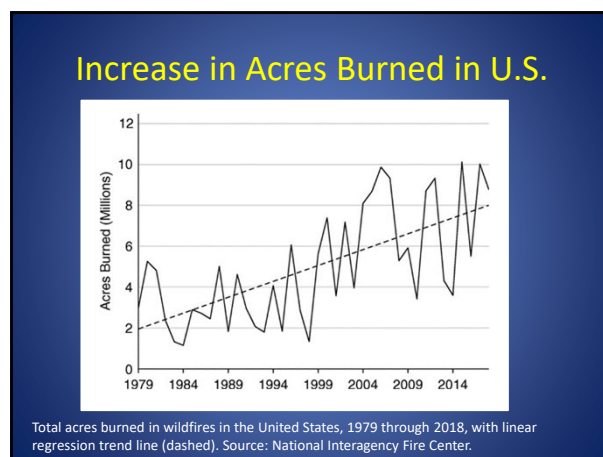
- No relevant financial relationships with a commercial interest
- Chair of the American Thoracic Society Environmental Health Policy Committee
- Sources of funding: NIEHS, NHLBI

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At the end of this talk, I hope you will be able to:

- Describe the reasons for recent increases in wildland fire activity in the U.S.
- Identify respiratory effects of wildfire exposure
- Recognize likely cardiovascular effects of wildfire exposure among elderly

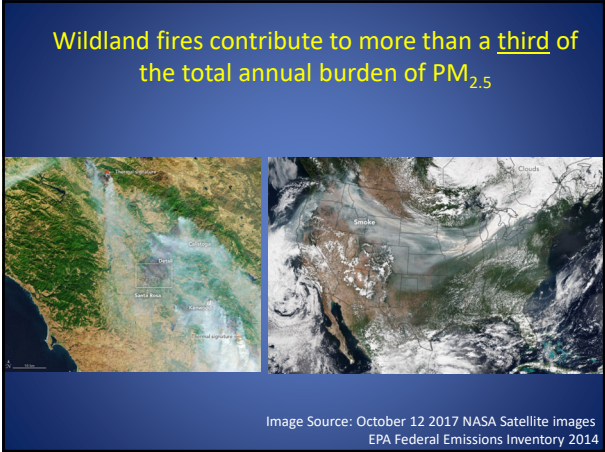
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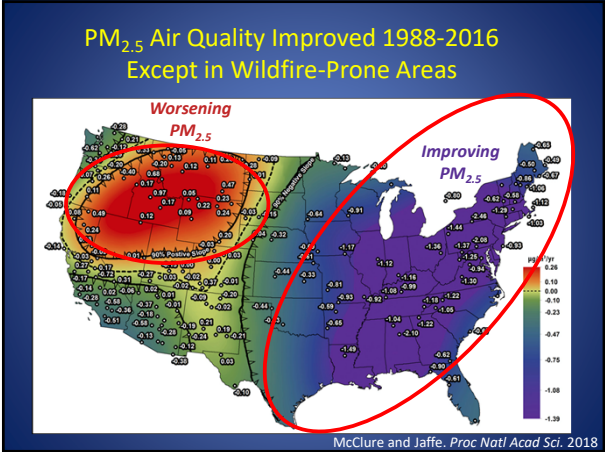
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Wildfire $PM_{2.5}$ Often Exceeds Standards

Air Quality Index (AQI) Values	Levels of Health Concern	Health Effects
0 to 50	Good	Little or no risk
51 to 100	Moderate	Acceptable quality
101 to 150	Unhealthy for Sensitive Groups	General Public not likely affected
151 to 200	Unhealthy	All may experience some effects
201 to 300	Very Unhealthy	All may experience more serious effects
301 to 500	Hazardous	Emergency conditions

Public health and OSHA advisories

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Key Drivers of Wildland Fire Activity

- More Acres Burned
 - Drier conditions (climate change explains ~55% increase in aridity 1979-2015 in Western U.S.¹)
 - Many more prescribed fires (300% ↑ in acres/yr in past 10 years)²
- More Loss of Life & Property
 - Years of fire suppression (biomass accumulation)
 - Wildland-urban interface



1. Abatzoglou and Williams. *Proc Natl Acad Sci USA*. 2016
2. Data from John Hall, Director, Joint Fire Science Program

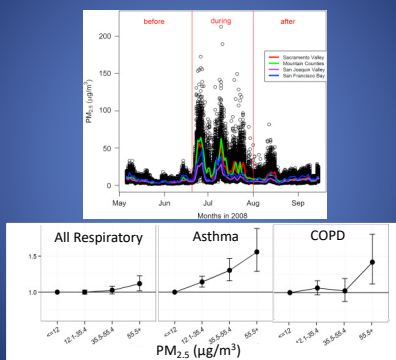
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Wildfires are “Natural” Experiments

- Acute** respiratory health effects have been identified in many studies comparing rates of respiratory visits & admissions before, during and after smoke events
- Chronic** respiratory health effects of repeated exposure to regional wildfire smoke are not well-studied

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Wildfire-Associated PM_{2.5} and Respiratory ED Visits

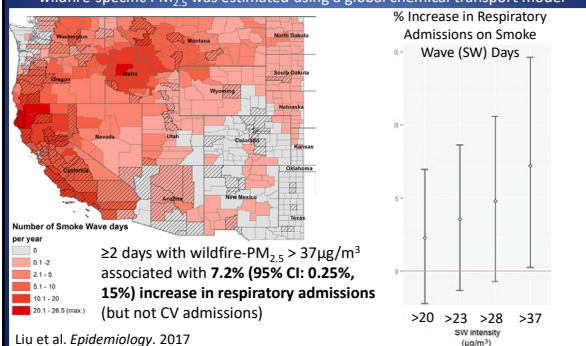


Reid, Balmes et al. *Environ Res*. 2016.

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Wildfire-Specific PM_{2.5} and Respiratory Hospitalization of Medicare Patients

wildfire-specific PM_{2.5} was estimated using a global chemical transport model

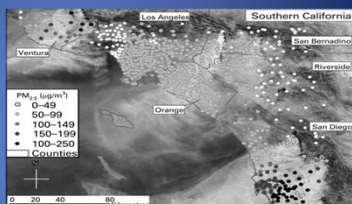


Liu et al. *Epidemiology*. 2017

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Many Studies Find Increases in Asthma Admissions & Treatment During Wildfires

- More admissions for:
 - Asthma (34% increase during heavy smoke)
 - Acute bronchitis
 - Pneumonia
 - COPD (not CV admissions)



- Wildfire PM may be more toxic for asthmatics than PM from other sources: 6.7% vs 1.3% increase in Medicare asthma hospitalization per 10 µg/m³ of wildfire vs non-wildfire PM²

1. Delfino et al. *Occup Environ Med*. 2009
2. DeFlorio-Barker et al. *EHP*. 2019.

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Respiratory Symptoms in Children

- Children's Health Study (ages 6-7 & 17-18)¹ found wildfire smoke associated with:

- Upper respiratory symptoms (nose, eyes, throat irritation)
- Lower respiratory symptoms (cough, bronchitis, wheeze)
- Medication use for above symptoms
- Greater symptom increases among asthmatics
- 63% increase in asthma attacks



- Among non-asthmatic children, airway size (MMEF:FVC) associated with greater susceptibility to respiratory symptoms²

1. Kunzli et al. *AJRCCM*. 2006.
2. Mirabelli et al. *Epidemiology*. 2009.

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Wildland Firefighters

- Volunteer and professional (e.g. USFS firefighters)
- No approved respirator!
- Few studies of health effects due to research challenges
- Using exposures and PM dose-response functions,¹ firefighters with 5-25 yr career have:
 - 8-43% higher risk of lung cancer mortality
 - 16-30% higher risk of CV mortality

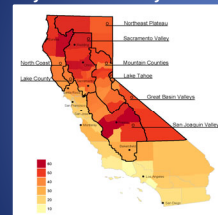


Photo by Kathleen Navarro.
1. Navarro et al. *Environ Res*. 2019.

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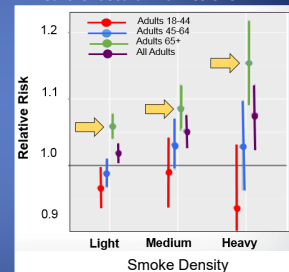
Elderly Likely at Risk for Acute Cardiovascular Effects of Wildfire Smoke

California 2015 Wildfire Study



- Wildfire-PM_{2.5} associated with hypertension, myocardial infarction, arrhythmia, and heart failure, particularly >65 years old

All Cardiovascular Admissions



Wettstein et al. *JAMA* 2018

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Conclusion

- Wildland fires are a major source of PM exposure, and air quality has worsened in wildfire-prone areas in US
- Wildfire smoke is associated with asthma attacks and respiratory admissions, and likely CV admissions among elderly
- Chronic health effects of repeated smoke exposure to communities and firefighters are not well-described