UCDAVIS HEALTH | SCHOOL OF MEDICINE
Public Health Sciences

UCDAVIS VETERINARY MEDICINE

Assessing Population-Level Health Outcomes Associated with Wildfire Smoke Exposures

23 March 2020

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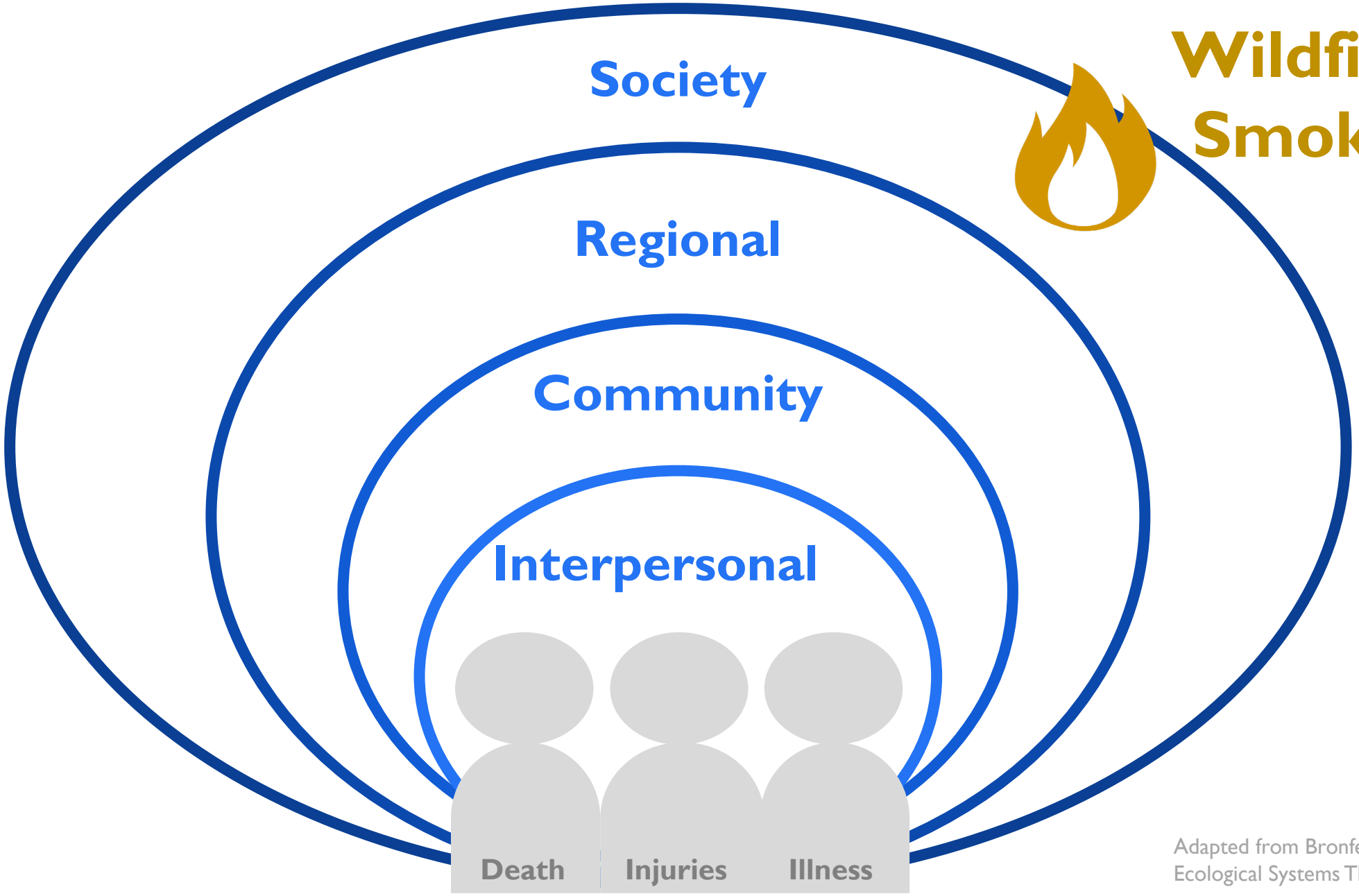


Adapted from Bronfenbrenner, 1987. Ecological Systems Theory.

Assessing Evidence for Public Health Adaptations

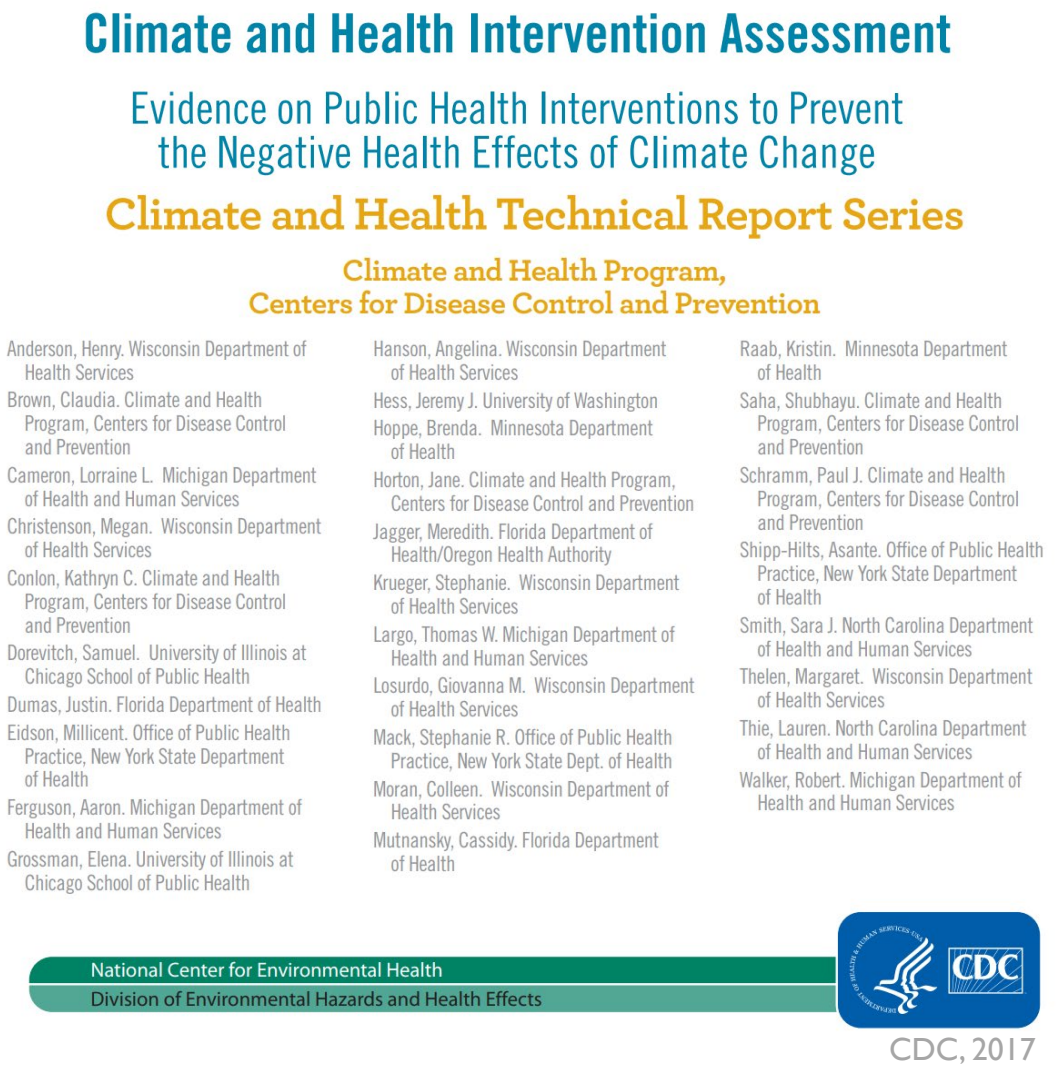
Three types of public health evidence for adaptation to climate-related health effects

Type One: Evidence linking climate-sensitive exposures to health outcomes of interest[6]

Type Two: Evidence on effectiveness of interventions

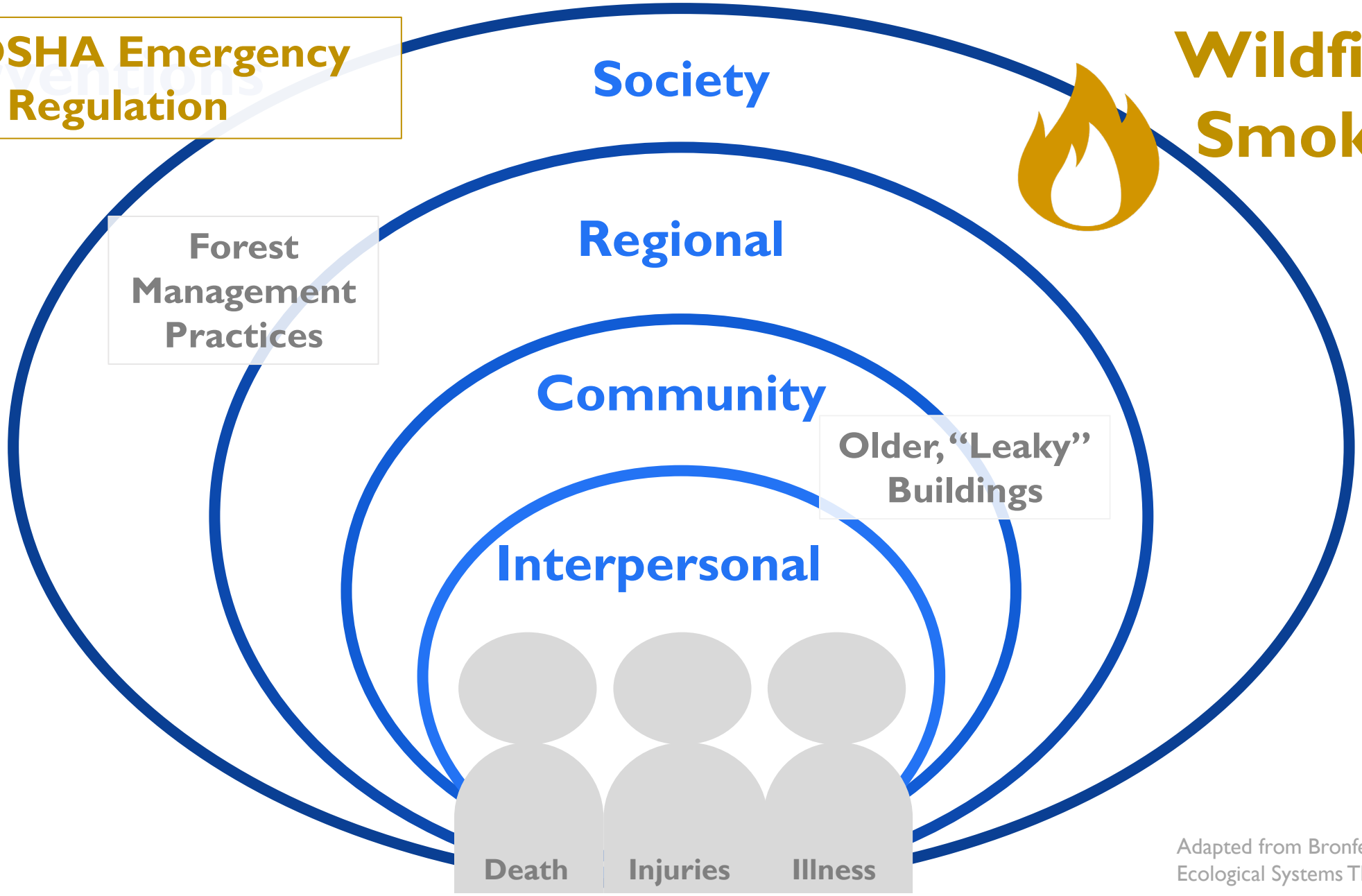
Type Three: Evidence on evaluation and implementation within a community[4,5,7,8]

- Substantial interest and focus on climate and health interventions
- Evidence-based public health practice



CDC, 2017

Cal/OSHA Emergency Regulation



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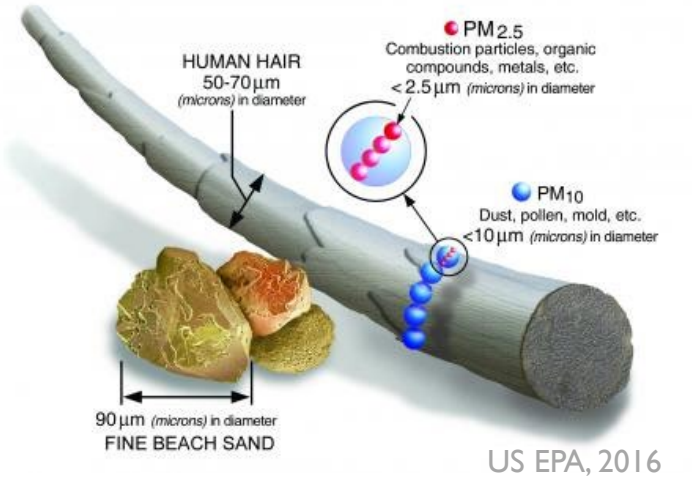
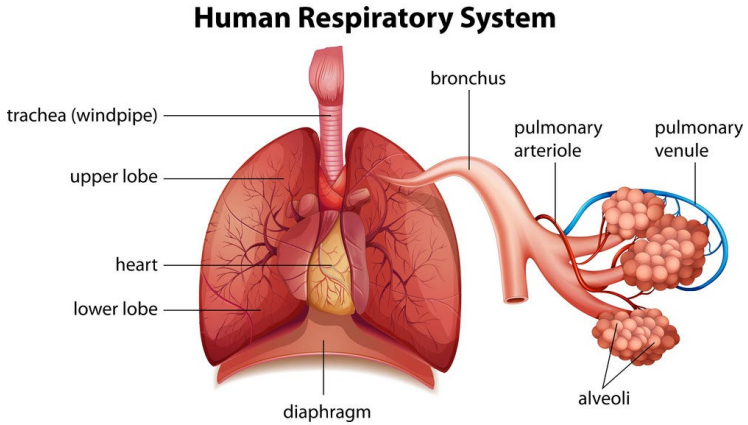
Wildfire Smoke Epidemiology

Emissions from Wildfires

- Primary air pollutants
  - CO
  - NO_2
  - PAHs
  - VOCs
  - Particulate Matter (PM_{10}, $PM_{2.5}$)
- Secondary air pollutants
  - Particulate Matter
  - Ozone (O_3)



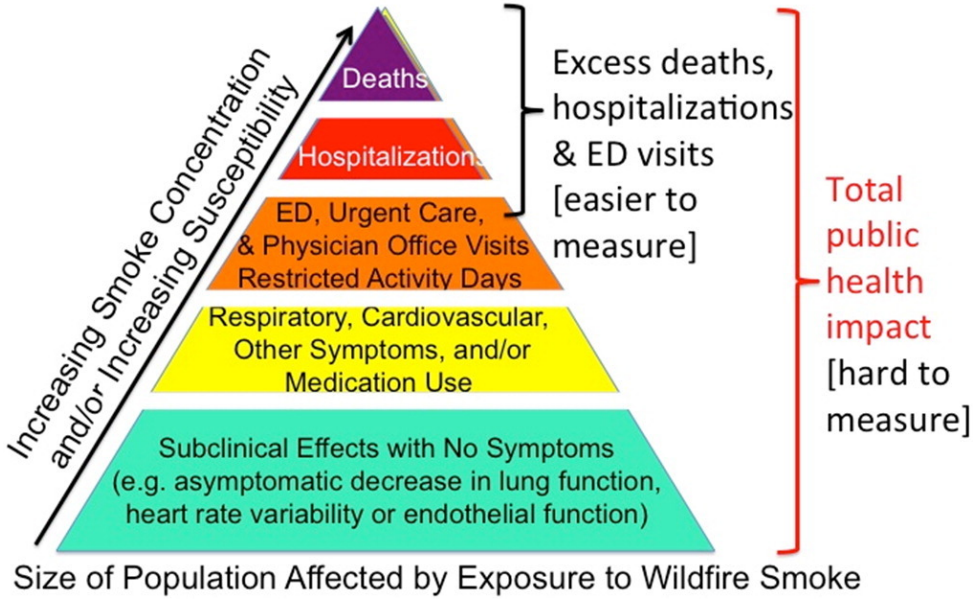
US EPA, 2016



Shutterstock, 2020

Studying Populations Impacted by Wildfire Smoke

- Retrospective study design
  - Rely on administrative datasets
- Acute events
- Behavior (e.g., exposure) difficult to ascertain
- Potentially low statistical power



Cascio, 2017

Wildfire Smoke & Health Impacts

Strong Evidence of Impacts on Respiratory Health

- Asthma, chronic obstructive pulmonary disease (COPD) significantly associated with higher wildfire smoke
  - Increased medication use
  - Increased physician visits
  - Increased ED visits
  - Increased hospitalizations
  - Particulate Matter (PM_{10}, $PM_{2.5}$)
- Respiratory infections (e.g., pneumonia, bronchitis)
  - Growing area of research

Strong Evidence of Impacts on Cardiovascular Health

- Results mostly null
- Recent studies found significant results:
  - ED visits for all-cause cardiac symptoms in CA (Wettstein, 2018)
  - Out-of-hospital cardiac arrests in CA (Hoshiko, 2019), Australia (Haikerwal, 2015; Salimi, 2016)
  - ED for congestive heart failure in NC (Rappold, 2011)
- More research to verify CV health impacts
  - More statistical power

Additional health impacts – including mental & psychological health – to be studied, evaluated.

Recent Risk of Wildfire Smoke & Health Impacts in CA

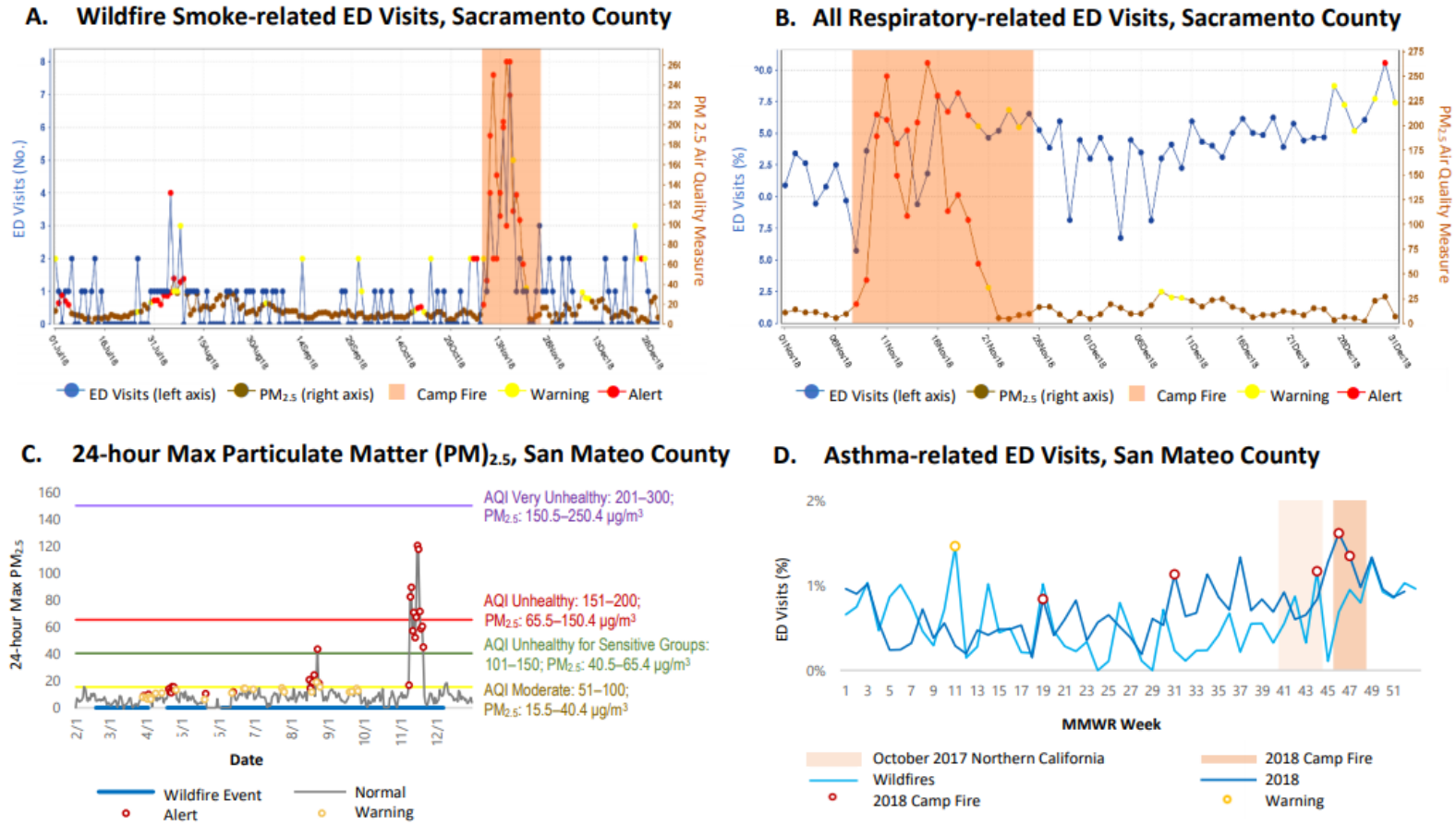


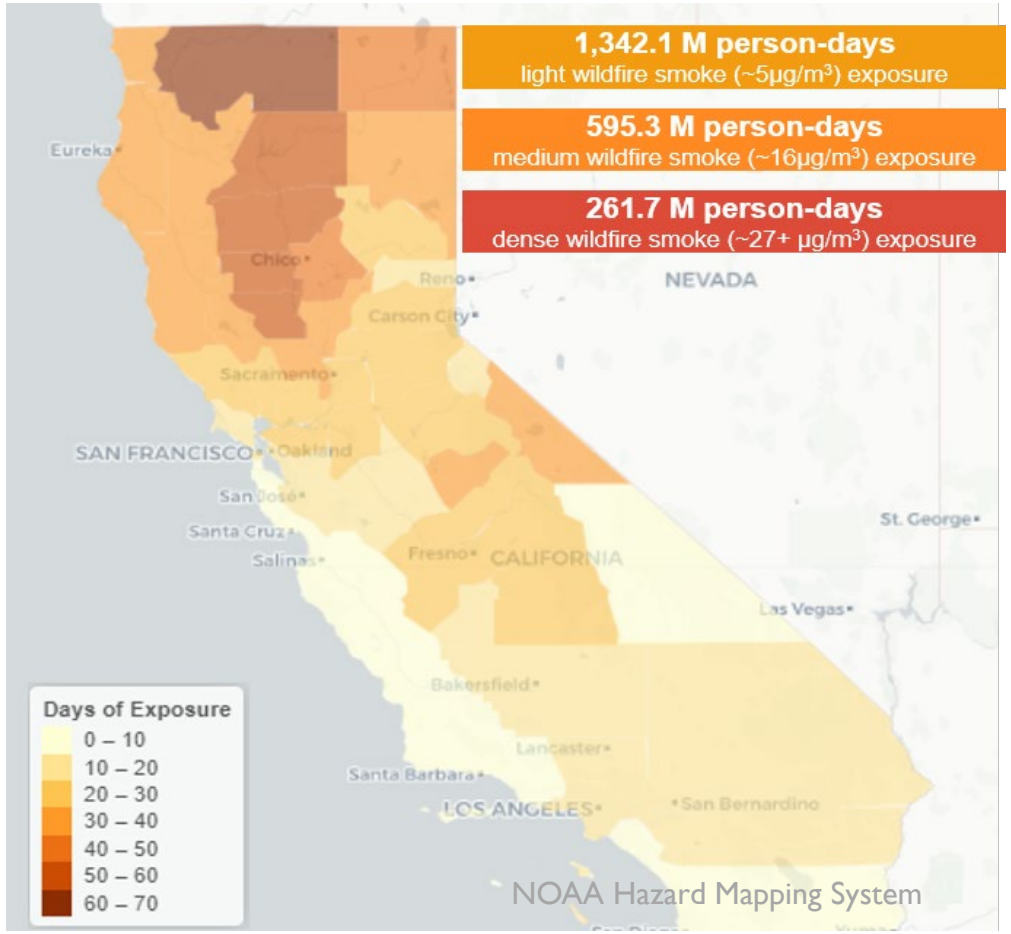
Figure 2: (A) Wildfire smoke-related ED visits, Sacramento County, July–December 2018; **(B)** All respiratory-related ED visits, Sacramento County, November–December 2018; **(C)** 24-hour maximum $PM_{2.5}$ concentrations in San Mateo County and California wildfires, February–December 2018; **(D)** percentage of ED visits due to asthma or RAD in San Mateo County during the October 2017 Northern California Wildfires and 2018 Camp Fire, February–December 2018.

NSSP, 2020

At-Risk Populations During Wildfire Smoke Events

California Outdoor Worker Populations

Estimating Population-Level Wildfire Smoke Exposure



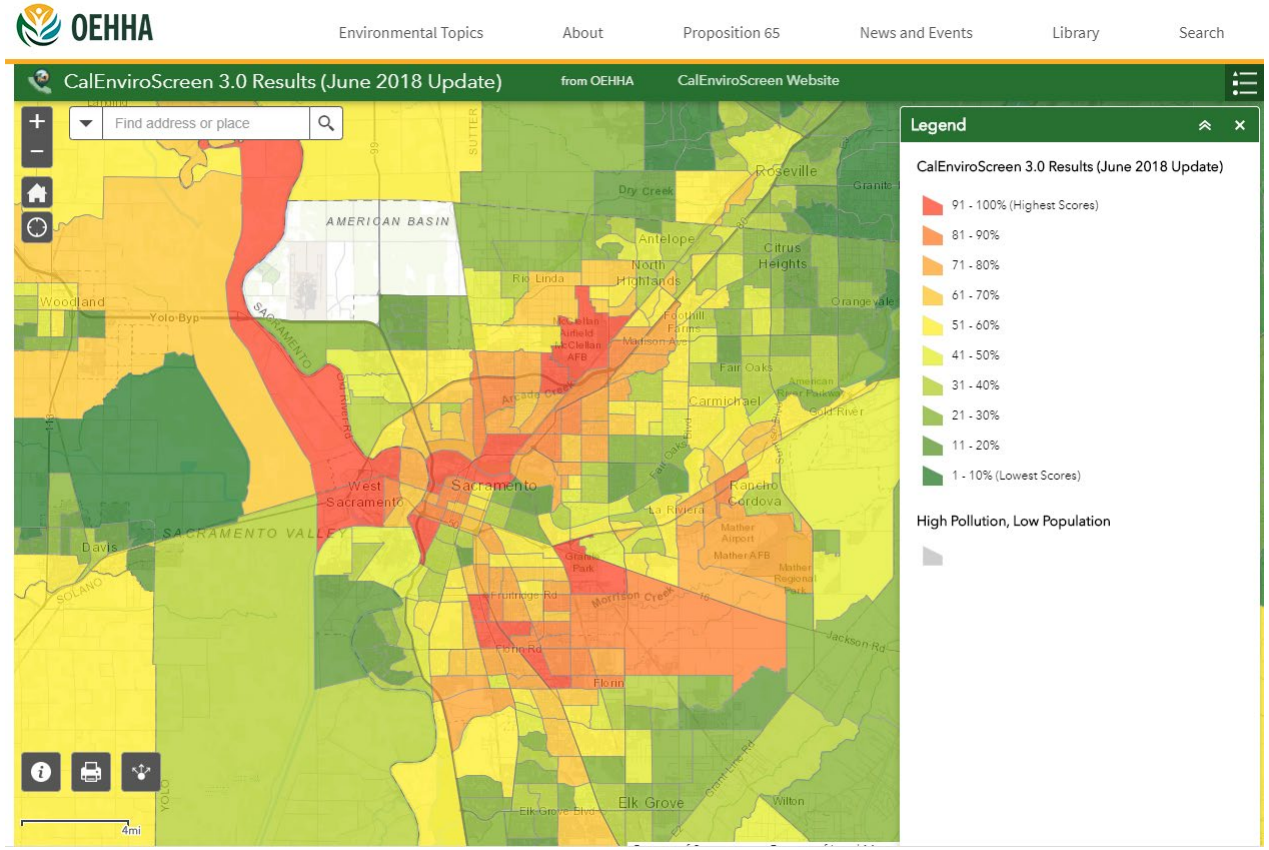
Vargo, Mirabelli, Conlon (Forthcoming)

- Between 2011 – 2018, on average, 47% of US population experienced heavy smoke > 1 day/year
  - ~ 3.2 billion affected person-days across period
- Half of all heavy smoke person-days occurred 2017-2018
- In all years, at least one day of light smoke occurred across entire US

Creating Exposure Profiles

Place-Based Population Exposure Profiles

- Represent most common populations at risk to wildfire smoke in California
- Fine-scale (ideally, sub-county)
- Contain information on risk factors relating to:
  - Environment
  - Demographics
  - Socioeconomic status
  - Health status
  - Housing



CalEPA EnviroScreen
OEHHA, 2020

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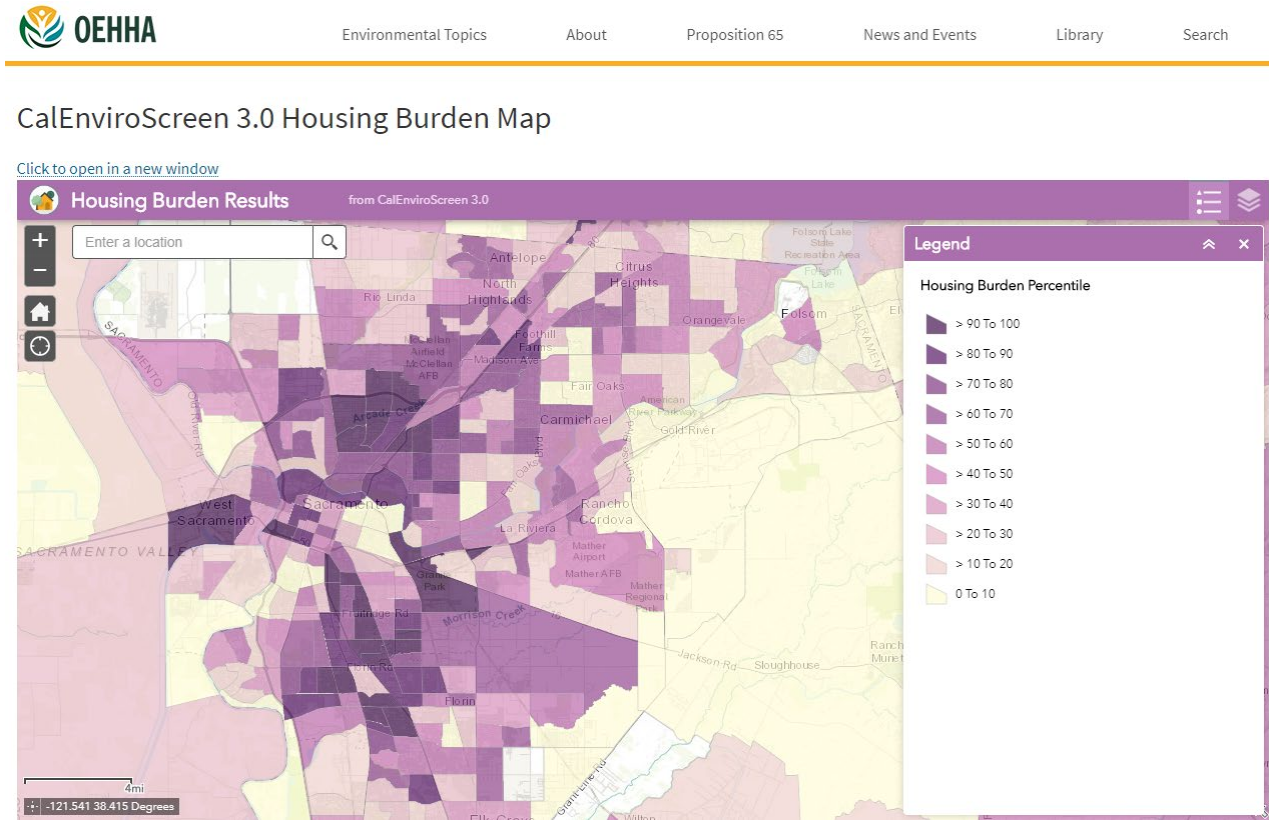

CalEPA EnviroScreen
OEHHA, 2020

Linking Exposure Profiles to Modeled Exposures

Calculating the Health Effects of Wildfire-Driven Air Quality Scenarios (Aim 3.3)

- Estimate baseline burdens (hospitalization data)
  - Respiratory
  - Cardiovascular
  - Cerebrovascular
- Apply modeled air quality (from fire emissions and ambient air quality resulting from Aims 1, 2, 4) to estimate health burden
  - Current
  - Future
- Further population-level changes in cause-specific disease burden under 4 distinct mitigation scenarios (Aim 4)

OSHPD
Office of Statewide Health Planning and Development

BenMAP
COMMUNITY EDITION

CMAQ

Thank you!

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