EPA
United States
Environmental Protection
Agency

EPA Tools and Resources Webinar: Wildfires and the Community Health Vulnerability Index

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Overview:

- Summarize four recent research examples where collaborations with state partners lead to impactful research.
- Motivate you to consider whether similar collaborations can happen in your state.
- Motivate us to consider what tools and research is needed to facilitate education, preparedness and resiliency in our communities.

Wildfire and Smoke in Our Community

Satellite image showing the location of Evans Road Fire in the Pocosin Lakes National Wildlife Refuge, NC

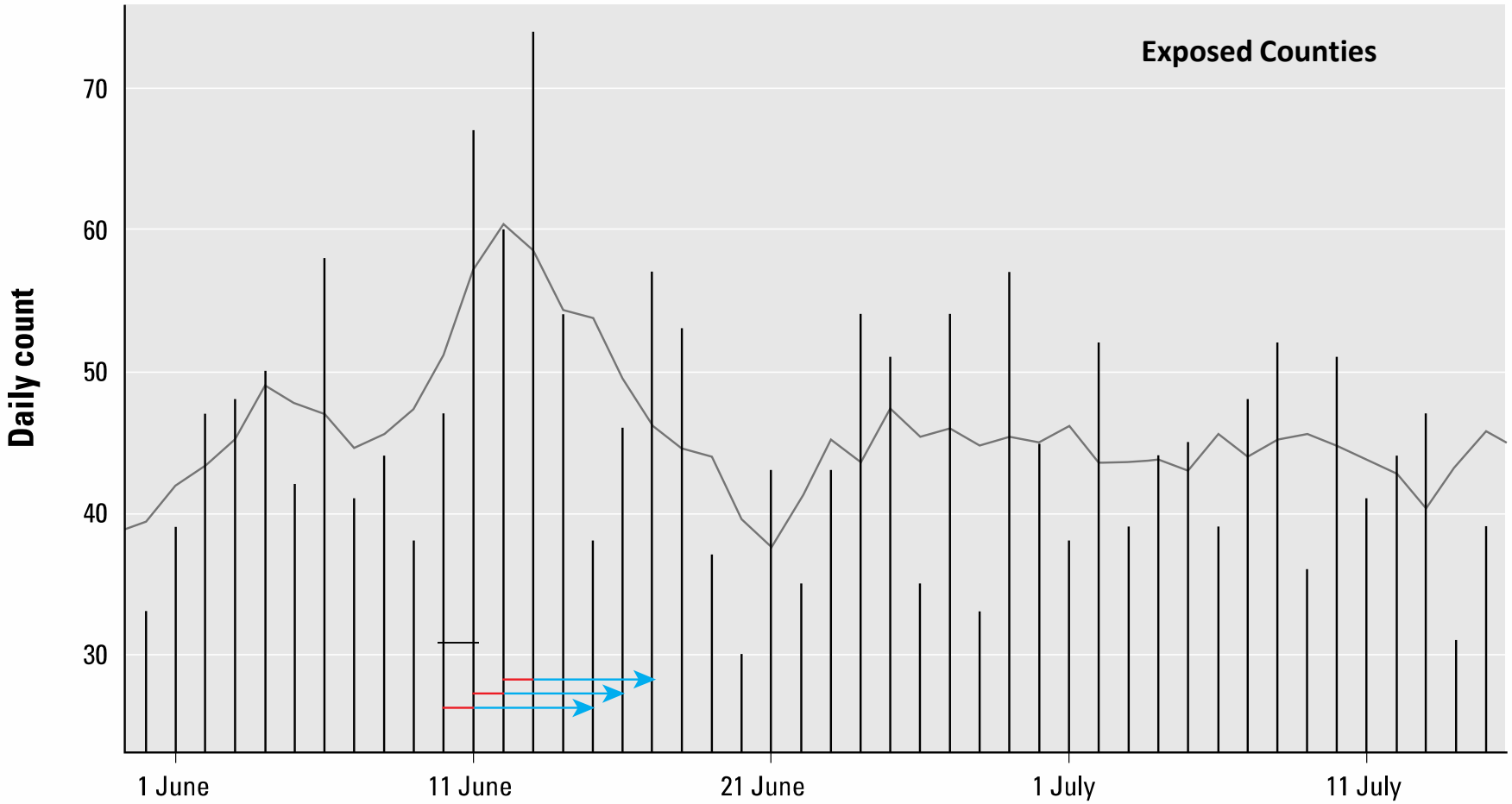
Evans Road Fire:

- Initiated by lightning strike on June 1, 2008
- Burned 40,704 acres of peat bogs
- On average peat was 3ft in deep, up to 15ft
- Suppression efforts cost approx. $20M, 2 billion gallons of water, 202 days
- 400 local, county, state and Federal personnel + volunteers

www.fws.gov/pocosinlakes/news/ERF/news-erf-out.html

Daily Counts of Asthma ED Visits

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

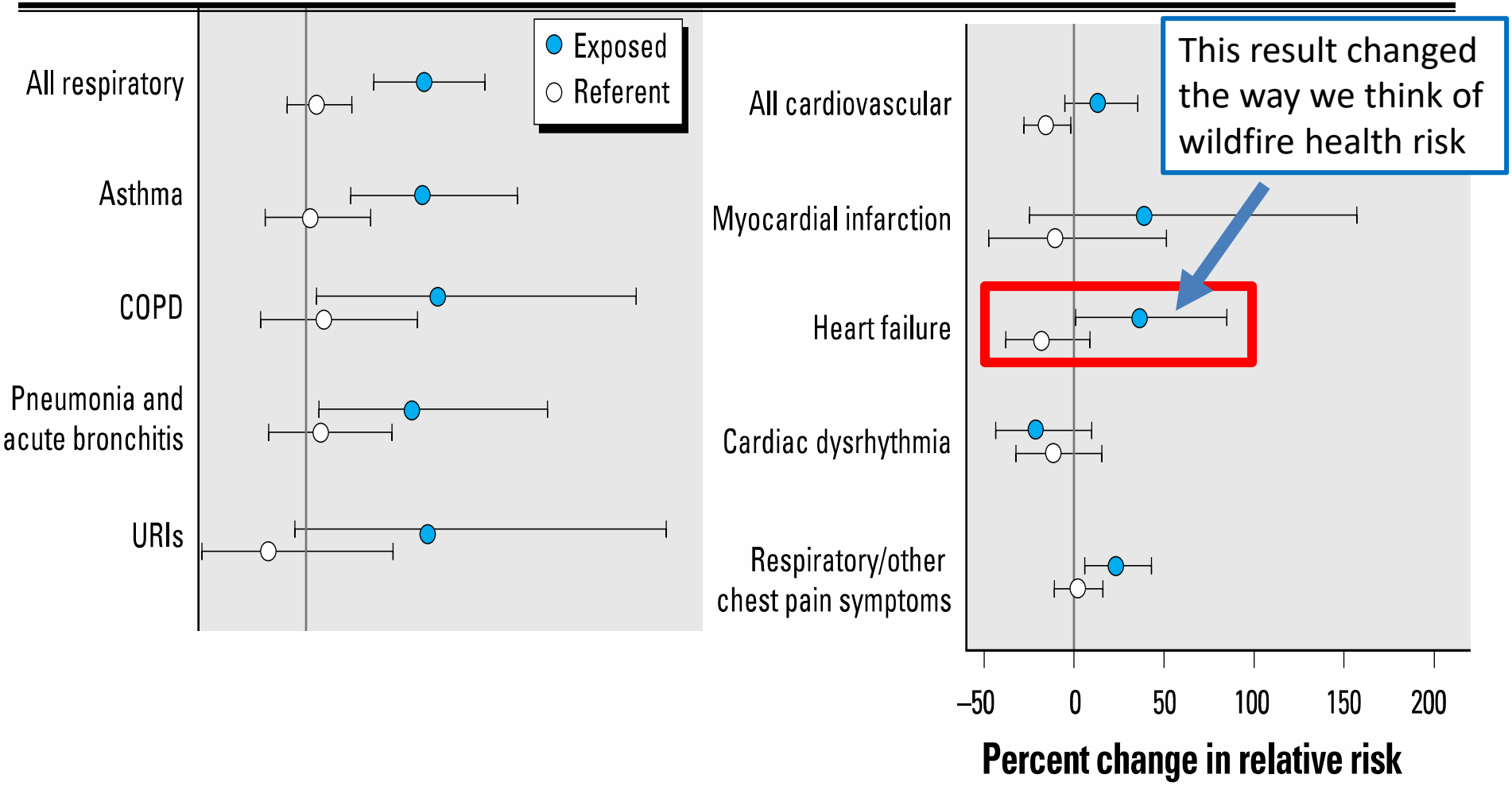


Arrows represent the 3 days of high exposure (red) and the subsequent 5 lag days (blue)

Rappold AG et al. Environ. Health Perspectives 2011

Regional Health Effects

2008 Pocosin Lakes National Wildlife Refuge Peat Fire



Over 50% increase in Emergency Department visits for Respiratory outcomes, Asthma, COPD, and Pneumonia and acute bronchitis. Over 37% increase for Heart failure related visits.

Rappold AG et al. Environ. Health Perspectives 2011

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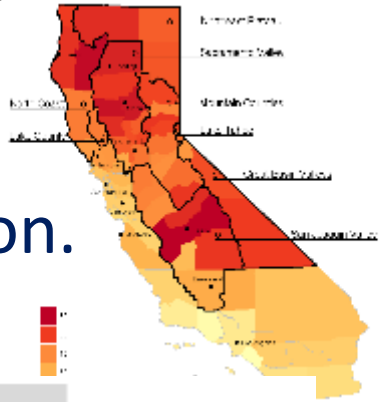
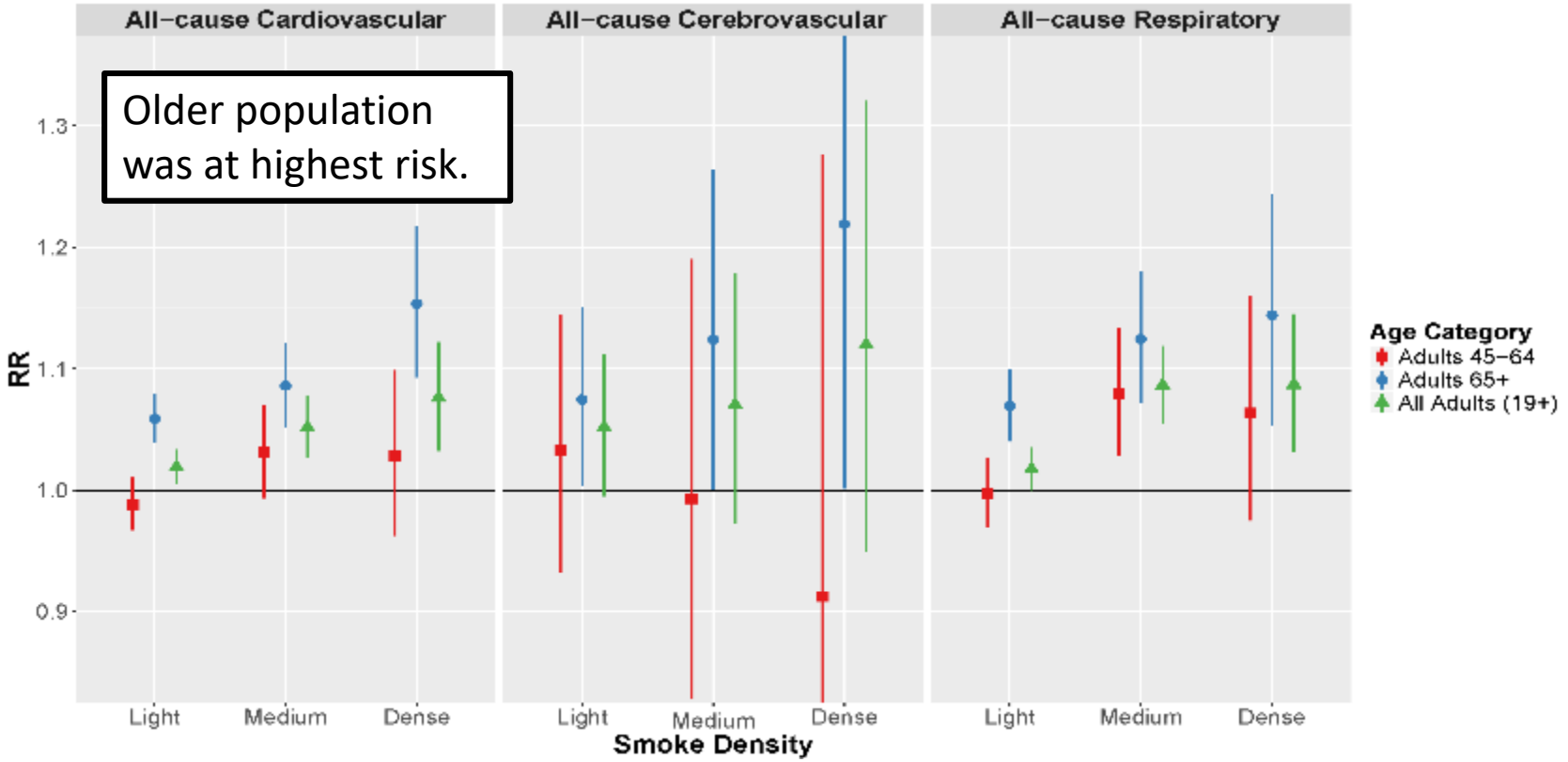
Number of days with smoke plumes;
May 1 - September 30, 2015.



Cardiovascular, Cerebrovascular and Respiratory Health During 2015 CA Fire Season.

Wettstein et al. Journal of American Heart Association, 2018.



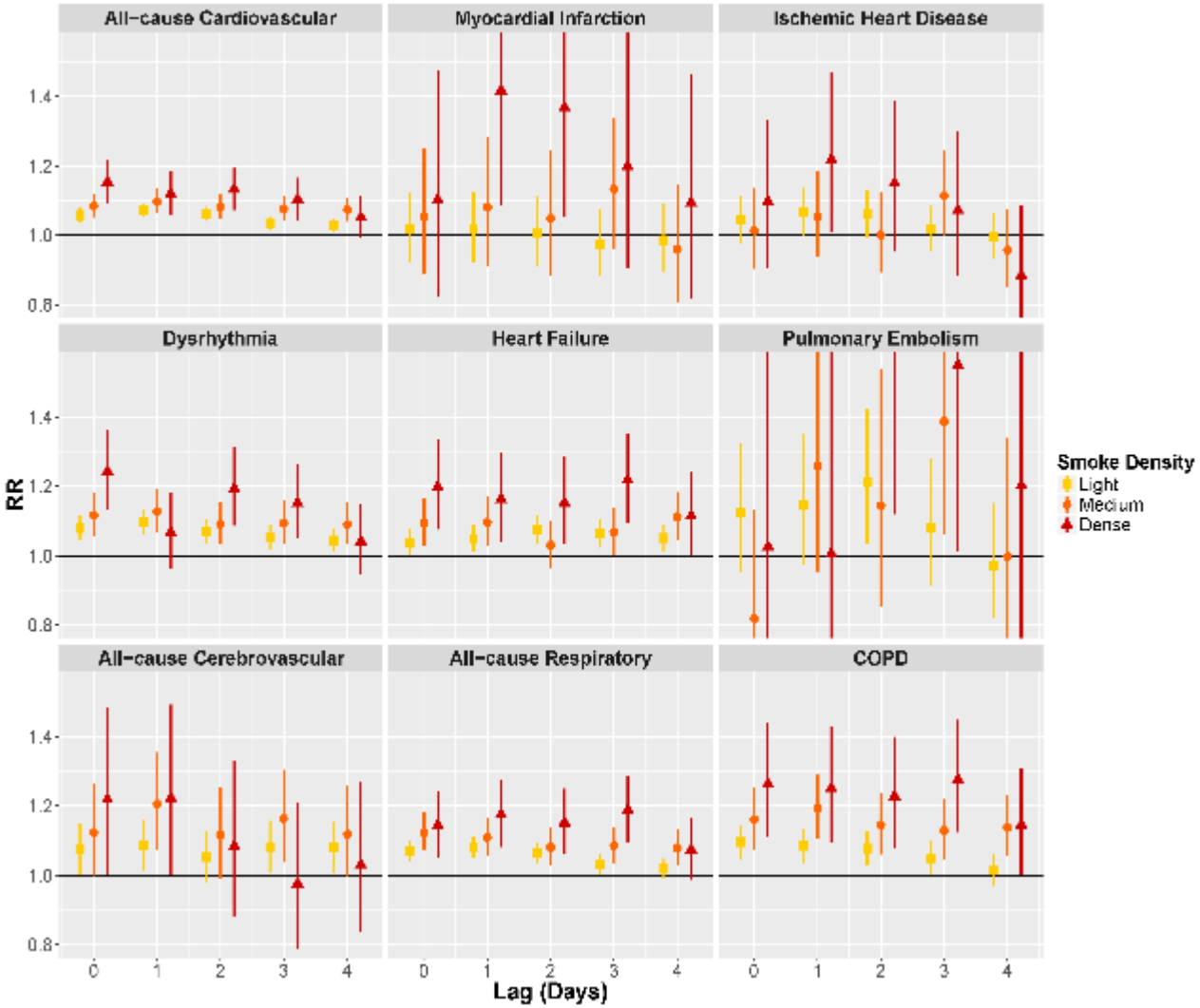
Methods

- Collaboration with California Department of Public Health and University of California San Francisco.
- Design: population-based **time series analysis.** 1million+ visits to ED.
- Setting
  - **May 1 – September 30, 2015**
  - **8 of 15 California Air Basins**
- Exposure data
  - NOAA Hazard Mapping System (**HMS**) Fire and Smoke Product [18]
  - **Daily $PM_{2.5}$ estimates** using visible-band satellite imagery:

	$PM_{2.5}$ range
• **Light**	*0-10 µg/m³*
• **Medium**	*10.5-21.5 µg/m³*
• **Dense**	*22+ µg/m³*

Adults 65+

Relative Risk (RR) for Select Cardiovascular, Cerebrovascular, Respiratory, and Control Outcomes Relative to Smoke-Free Days; 8 California Air Basins (May 1 – September 30, 2015).



Dense smoke days carried the highest risk, but light and medium smoke density were associated with all-cause cardiovascular, dysrhythmia, heart failure, stroke, COPD and all-cause respiratory outcomes.

Wettstein et al., Journal of American Heart Association 2018.

Conclusions

(from Wettstein et al. 2018)

- **Wildfire smoke density was associated with cardiovascular and cerebrovascular disease outcomes:**
  - All-cause cardiovascular
  - Ischemic heart disease and myocardial infarction
  - Dysrhythmia
  - Heart failure
  - Pulmonary embolism
  - All-cause cerebrovascular, ischemic stroke, and TIA
- **Impacts greatest among adults 65 years and older**
- **Primarily at lags 0 to 2 days**

Implications

- Findings strengthen the evidence of an association between wildfire smoke exposure and cardiovascular disease outcomes

- Frontline providers and public health officials
  - Identifying susceptible populations
  - Risk mitigation for individual patients
  - Hospital surge planning – stroke centers, cardiac catheterization facilities

Health outcomes known or suspected to be caused by wildfire smoke:

- All-cause mortality
- Asthma & COPD exacerbations
- Bronchitis & pneumonia
- Childhood respiratory disease
- Cardiovascular outcomes
- Adverse birth outcomes
- Anxiety
- Symptoms such as: eye irritation, sore throat, wheeze and cough

Elliott CT. Guidance for BC Public Health Decision Makers During Wildfire Smoke Events 2014

Wells EM, Dearborn DG, Jackson LW (2012). PLoS ONE 7(11): e50526

Trends and steps forward

- Severity of large fires has increased.
- Evidence is there: smoke produces a range of health outcomes and impacts productivity and well-being.
- Can we construct communication strategies that deliver information when we most need it and when we perceive salience of intervention?
- **Education + Engagement before and during smoke events are key to better health outcomes.**
- Can communication strategies that educate and engage improve health outcomes?
- How effective would we be? What are the barriers?

How often do fires impact air quality?

The odds are - if there is unhealthy air quality - there is a plume!

AIR QUALITY INDEX CHART

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Pollutant		AQI Color Code				
		Green	Yellow	Orange	Red	Purple
Ozone	% Plume Days for each AQI code	6.1%	18.0%	25.8%	30.1%	28.8%
	Odds Ratio	0.278	3.13	4.34	5.20	4.82
FRM $PM_{2.5}$	% Plume Days for each AQI code	4.2%	10.6%	15.8%	16.5%	50.0%
	Odds Ratio	0.360	2.65	2.88	3.02	15.0

Continental US 2006-2013 Adopted from "Impacts of fire smoke plumes on regional air quality", Alexandra Larsen, Reich BJ, Mark Ruminski and Rappold AG, JESEE 2018

Geographic Footprint of Smoke-$PM_{2.5}$ (Wild & Rx)

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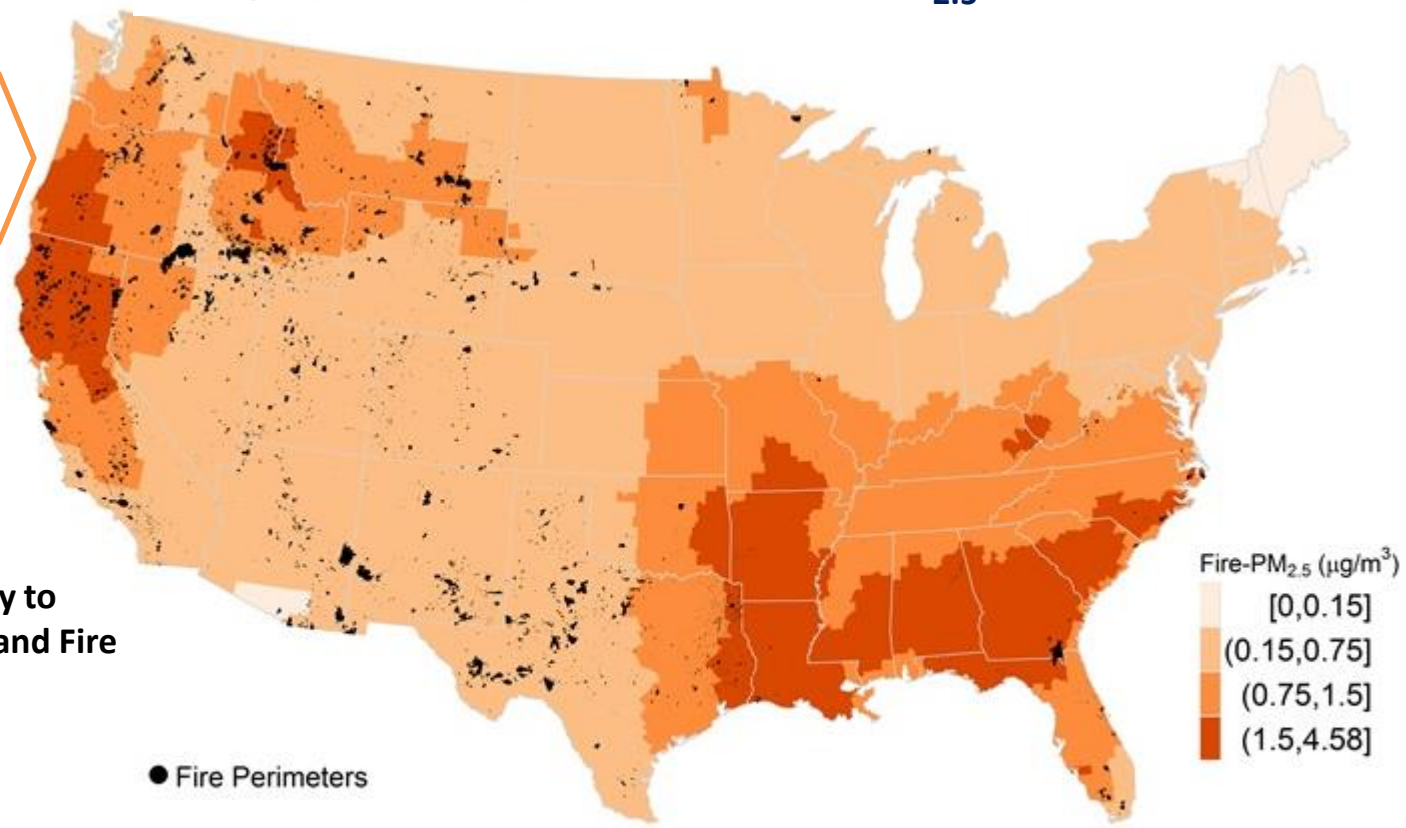
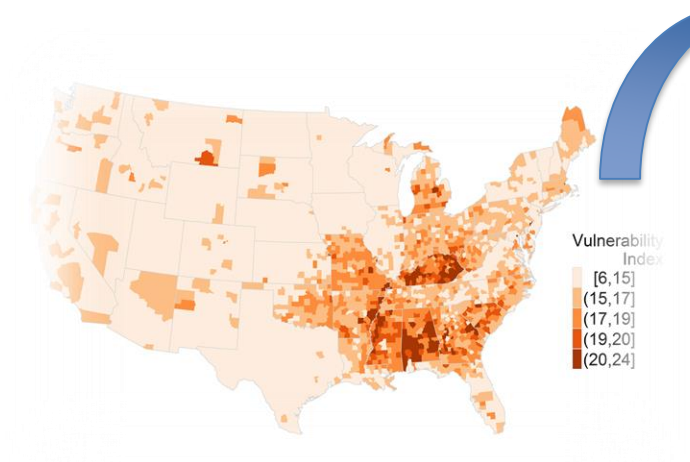
Building resiliency



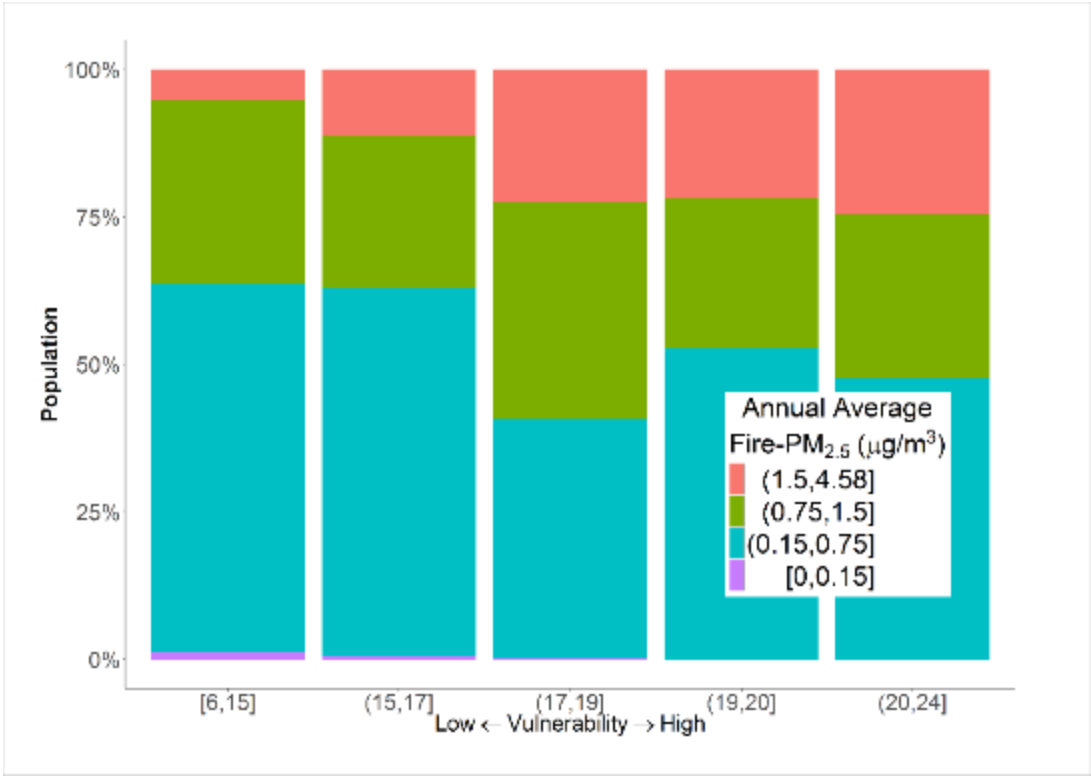
Community Vulnerability to Health Impacts of Wildland Fire Smoke Exposure.
Rappold et al. 2017 ES&T.

$PM_{2.5}$ (µg/m3)	Adult Asthma	Pediatric Asthma	COPD	Hyper-tensive	Diabetes	Obesity	Poverty	Under 18	65 and Over	Total Population
	20.8	6.4	11.8	68.8	20.3	60.9	42.5	73.7	40.0	306.7
(0,0.15]	0.2	0.1	0.1	0.6	0.2	0.5	0.4	0.6	0.4	2.8
(0.15,0.75]	12.7	3.8	6.6	40.0	11.3	34.4	23.6	43.5	23.7	182.2
(0.75,1.5]	5.9	1.9	3.8	20.8	6.4	19.0	13.2	22.2	11.9	91.1
(1.5,4.58]	2.0	0.7	1.3	7.4	2.4	7.0	5.3	7.4	4.0	30.5

Community Health Vulnerability



Vulnerable populations are disproportionately affected by smoke



We indexed the health vulnerability to smoke exposure based on previously reported factors:

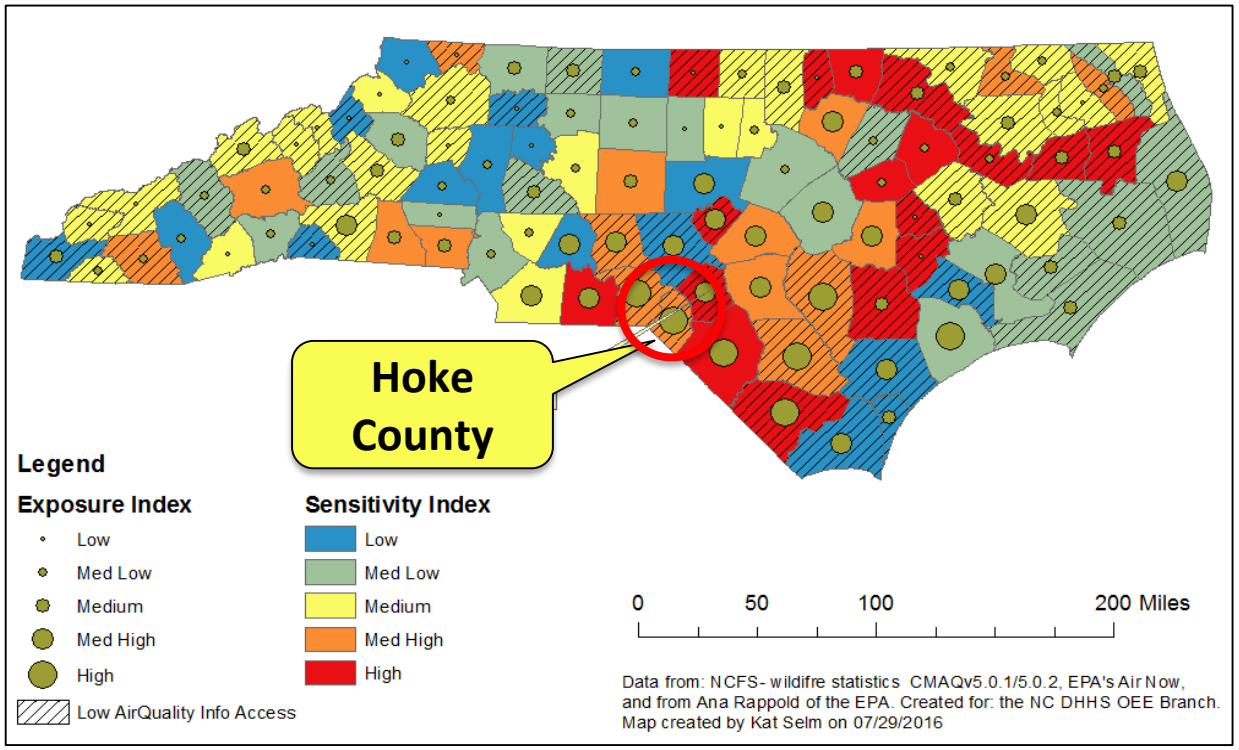
- Peds & Adult Asthma
- COPD
- Obesity
- Diabetes
- Hypertension
- % population age 65+
- Income, education, poverty, unemployment

Community Vulnerability to Health Impacts of Wildland Fire Smoke Exposure. Rappold et al. 2017 ES&T.

Community-Health Vulnerability Index (CHVI) Use in North Carolina

CDC-funded North Carolina Health Program

- **Community-Health Vulnerability Index was adapted for use in North Carolina**
- **Utilized CHVI to identify an at risk NC community**
- **Added NC-specific layers (e.g., NC Forestry data)**
- **Engaged Hoke County stakeholders (e.g., local fire departments) to discuss vulnerability to smoke health impacts**



- **CHVI discussion has given way to implementing prevention efforts, e.g. Smoke Sense**

Courtesy of Lauren Thie NC Department of Public Health

Smoke Sense

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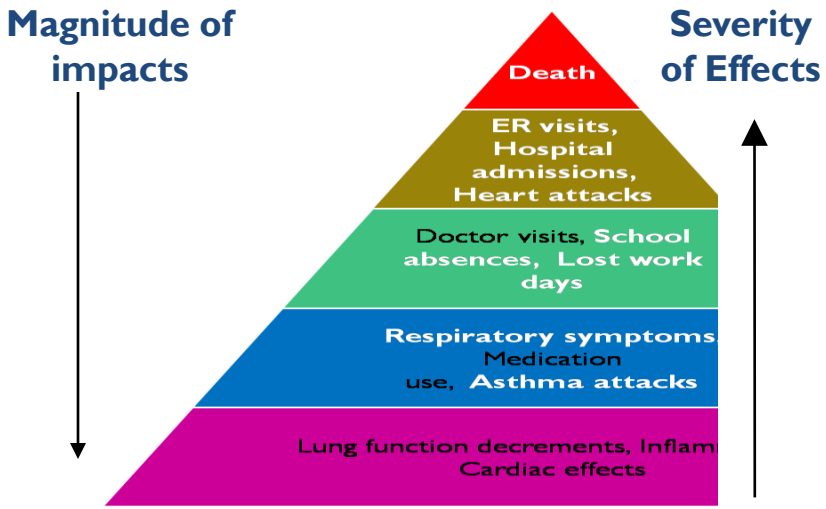
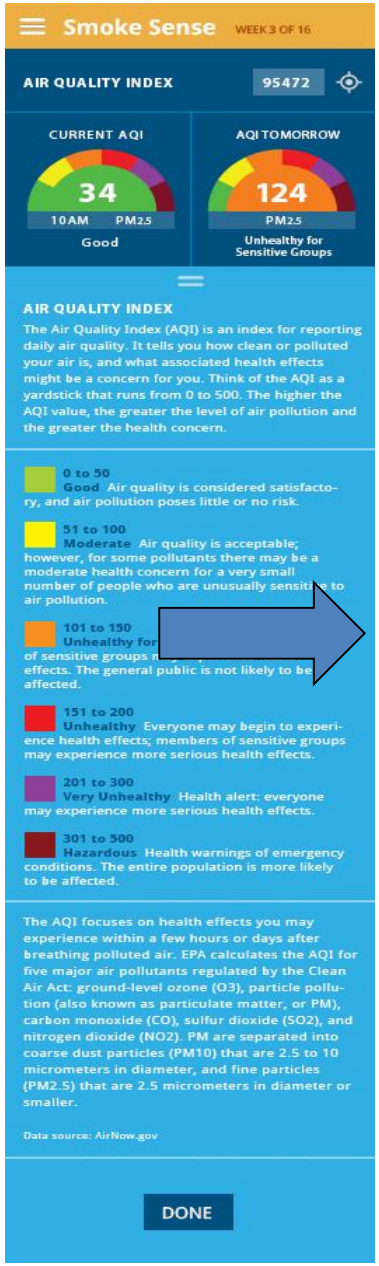
Engagement and Education

Citizen Science Study on Health Risk and Health Risk Communication during Wildfire Smoke Episodes



Smoke Sense Motivation and Objectives

- Addressing the gap between the recommended actions and the actions that individuals take to protect their health during wildfire.
- Smoke Sense is a citizen science initiative that brings wildfire smoke and health resources to the palm of your hand.
- Personal connection with environmental exposure and raising personal consciousness about health risks.
- Just-in-time information and salience of changing behavior.



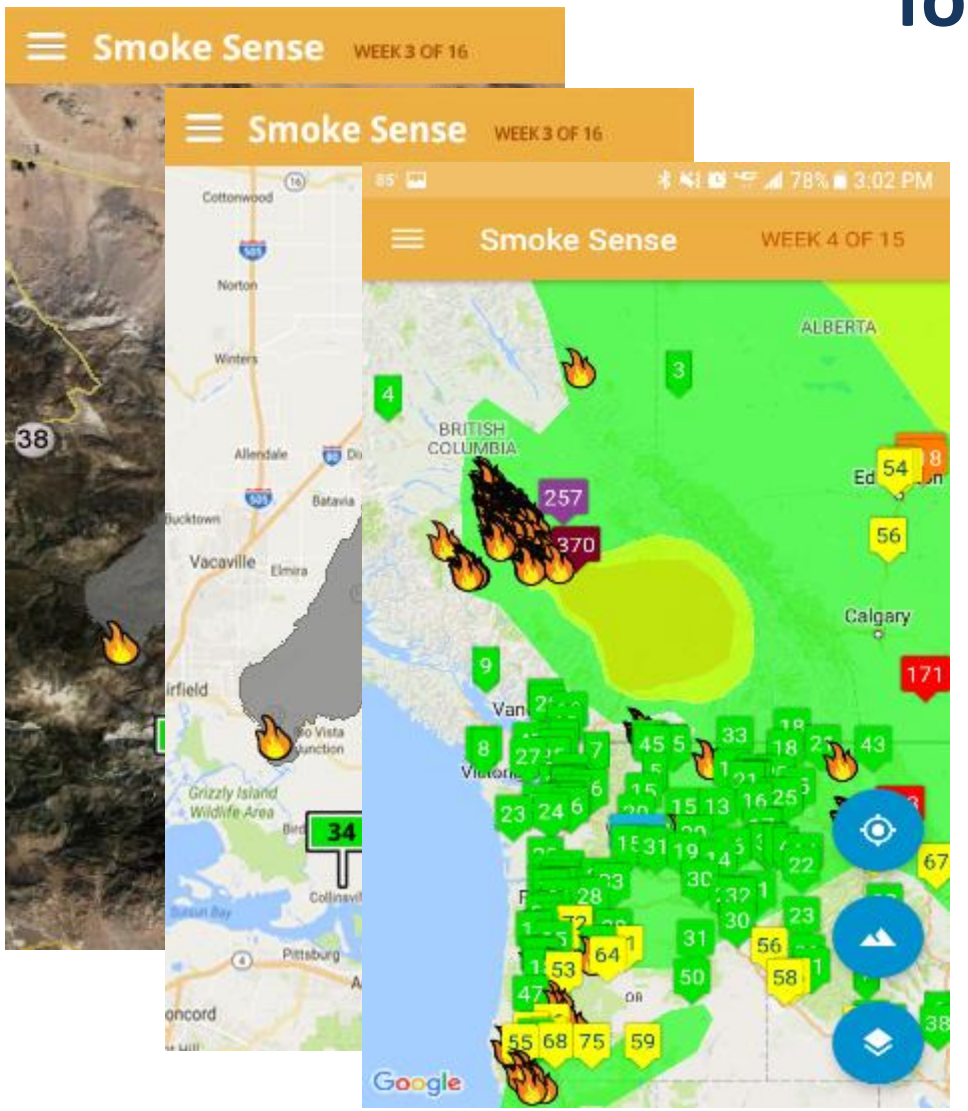
Smoke Sense App

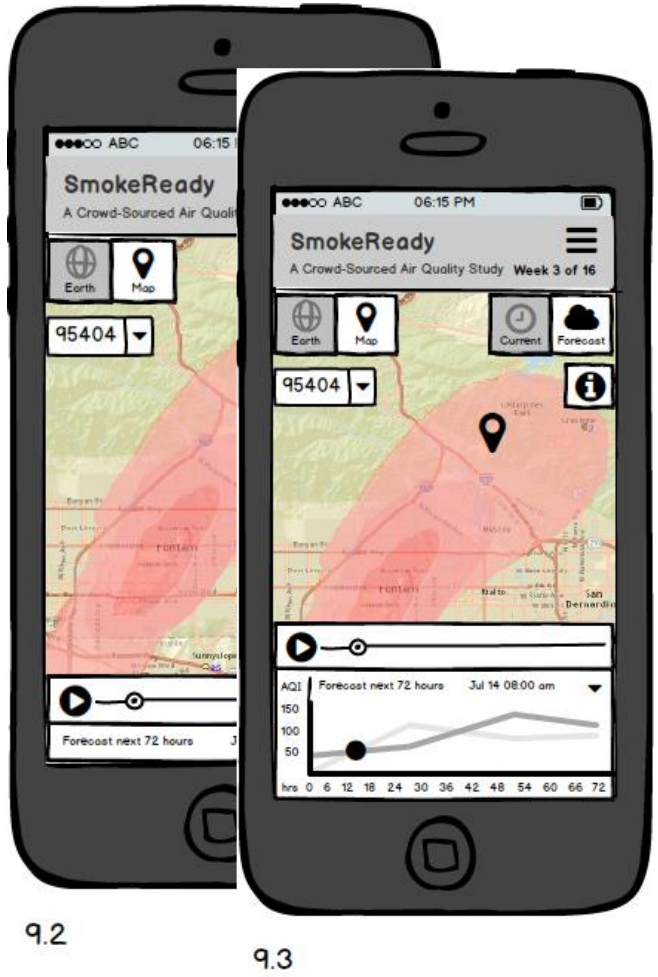
Users explore their:

- Current and forecast air quality
- Satellite imagery of smoke
- Public health risk messaging
- Air Quality 101 module
- Gamification to promote desired behaviors

The app promotes preventive health behaviors by inviting users to record their smoke observations and health symptoms, play educational trivia games, and explore what others are reporting.

Satellite images of smoke, hourly smoke forecasts



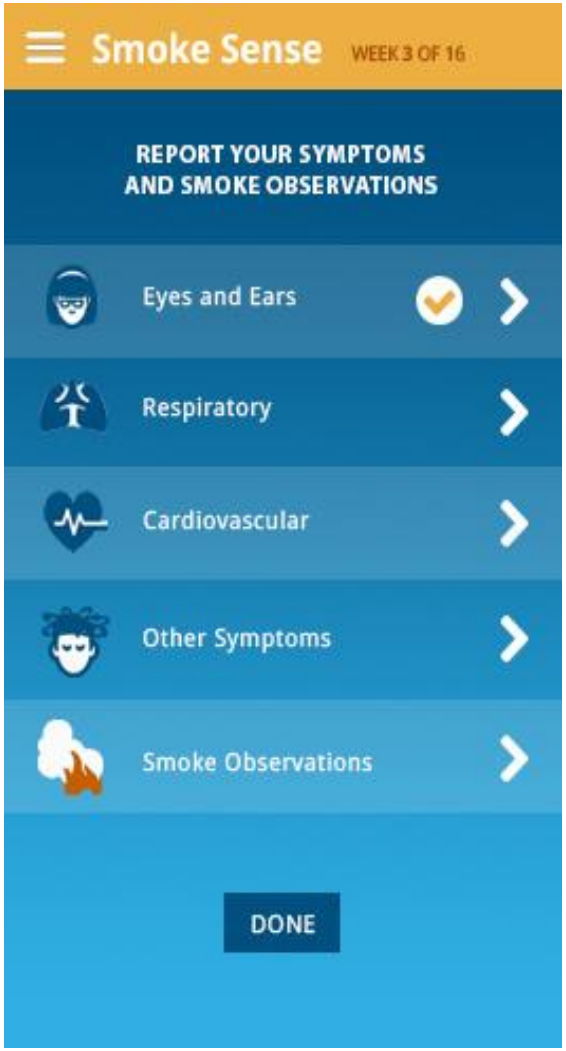


Smoke and Symptoms Reporting

Profile: demographic information, baseline health symptoms, baseline activity level, and perceptions about health risks of air pollution.

Symptoms Reporting: participants receive weekly notifications on their device inviting them to complete the weekly report on health symptoms.

Smoke Observation Reporting: questions about smoke exposure during the previous week including their actions (e.g. did you miss days from work) and perceived or actual exposures (did you smell smoke inside your home).



Gamification Component

Badge Reward System **facilitates and measures** engagement.

Air Quality Badge: for participating and launching the app at least once per week.

Science Science/Reporter Badge: for reporting symptoms and smoke observations once per week.

Knowledge Badge: for expanding air quality knowledge with a weekly air quality 101 lesson.

Smoke Explorer Badge: for exploring fire and smoke maps.

Feedback to the Users

Individual weekly survey results will be aggregated and reported back to the app and available to the users.

Pilot season stats:

Duration:

- Aug. – Nov. 2017

Context:

- Significant smoke events in WA, OR, CA
- Participants from all 50 states

Participant Traffic Volume:

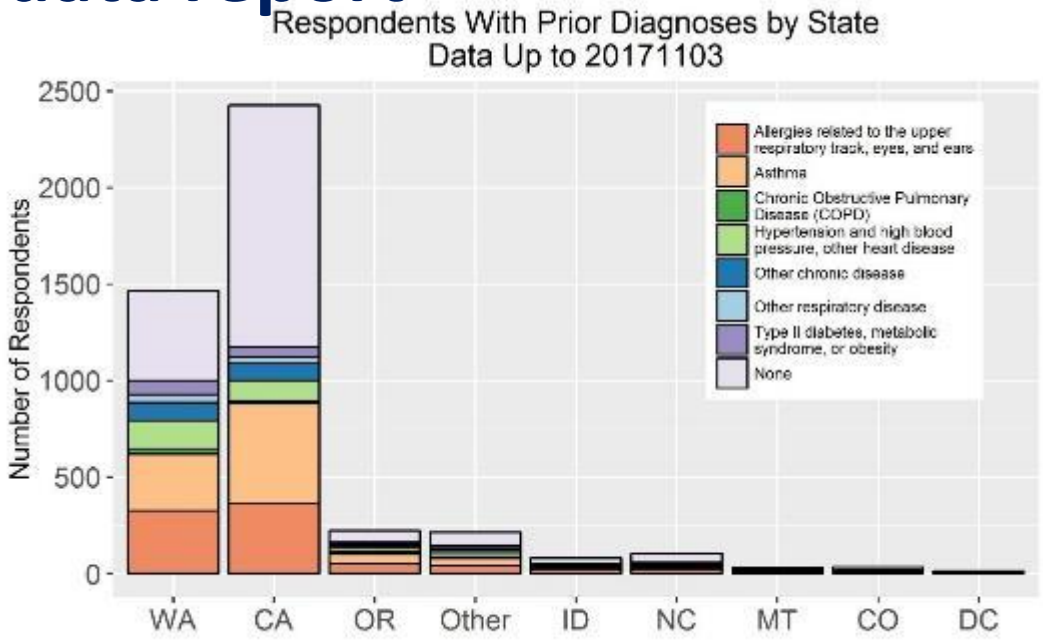
- **50,000+** sessions
- **5,000+** users during the pilot season
- 90% sessions are returning users

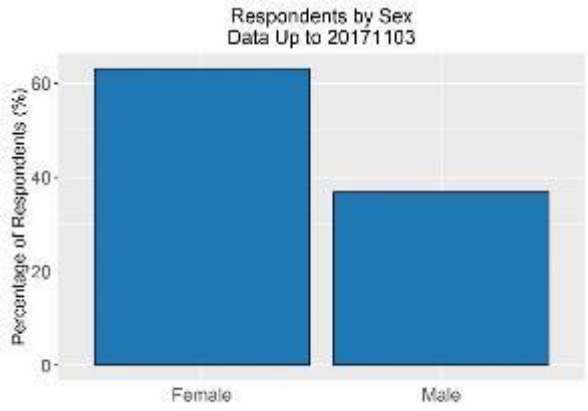
Pilot season data report

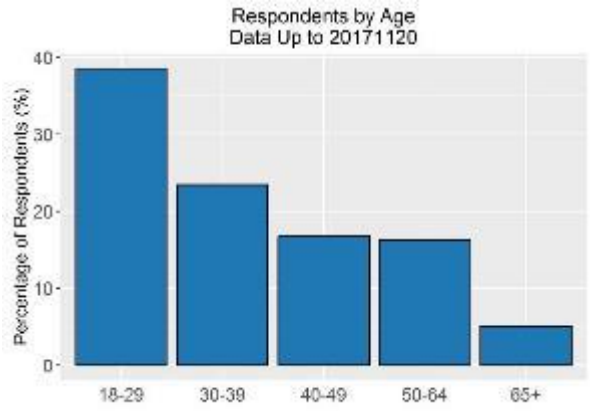
Pilot season: Aug - Nov 2017
Large smoke events in WA, OR, CA

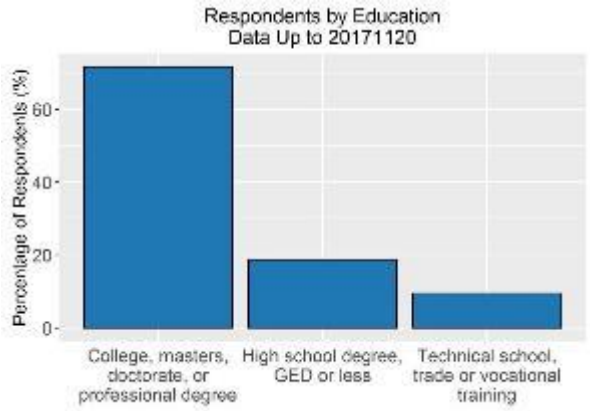
50,000+ sessions
5,000+ users
90% sessions are returning users

Engagement with States and Tribal communities was the Key









Sample Results – 11/20/2017

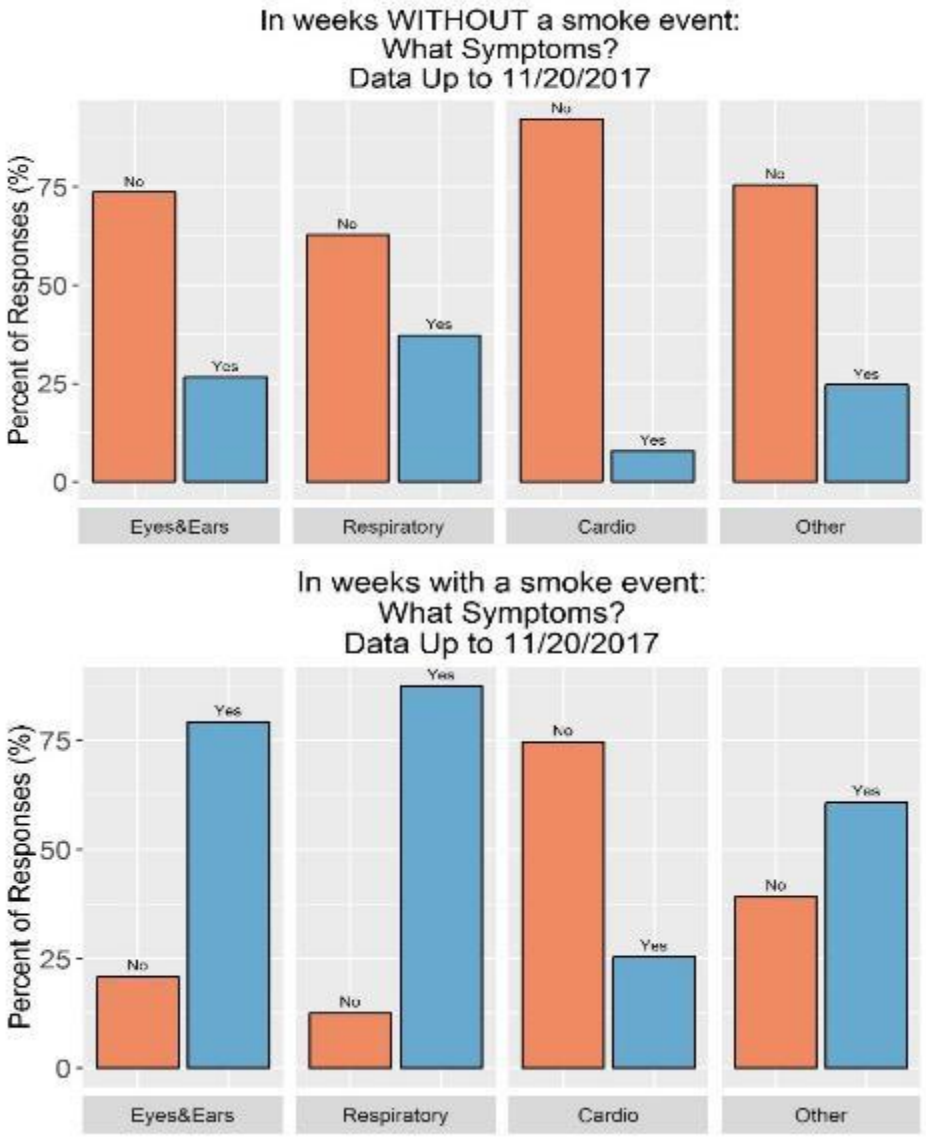
Did you experience symptoms such as:

Eyes & Ears: stinging, itchy, or watery eyes, ear infection, allergic symptoms, or similar?

Respiratory: runny or stuffy nose, scratchy throat, irritated sinuses, coughing, trouble breathing, shortness of breath, wheezing, asthma attack, allergic symptoms, or similar?

Cardio: fast or irregular heart rate, pain or tightness in the chest, high blood pressure, or similar?

Other: tiredness, dizziness, viral infections, or other?



Why Citizen Science?

- Develops entry points for members of the public to contribute to research and access data.
- Mutually beneficial relationship: citizen participation helps EPA answer questions, and it also serves as educational/data resource that community leaders can leverage to address issues related to air quality and health in their communities.
- This framework for two-way interaction and communication is the citizen science feature in Smoke Sense and adds value to the project that would otherwise be missed.

Individual and Community Impacts

- Smoke Sense as a cue to action for individuals
- Smoke Sense as a communication tool for environmental and health professionals
- Sharing data and fostering change
- Smoke Sense is fostering new conversations among individuals, organizations and communities

Social Media and Contact

Follow us on Twitter #SmokeSense

Search “Smoke Sense at EPA”

https://www.epa.gov/air-research/smoke-sense

Email: smokesense@epa.gov

Smoke Ready Toolbox for Wildfires

epa.gov/air-research/smoke-ready-toolbox-wildfi

Airnow.gov: Current Fire Conditions
Get current air quality conditions and learn what to do to protect your health from air pollution, including smoke from wildland fires. Airnow.gov provides local air quality forecasts using EPA's science-based air quality index. https://airnow.gov/index.cfm?action=topics.smoke_wildfires

How Smoke From Fires Can Affect Your Health
Learn who is more at risk from smoke, how to tell if it is affecting you, and steps you can take to protect your health. Learn what to do before, during and after a wildfire. https://airnow.gov/index.cfm?action=smoke.index

Wildfire Smoke: A Guide for Public Health Officials
The guide is an easy-to-use resource that outlines whose health is most affected by wildfire smoke, how to reduce exposure to smoke, what public health actions are recommended, and how to communicate air quality to the public. The recommendations are based on science conducted by EPA and others. https://www3.epa.gov/airnow/wildfire_may2016.pdf

Wildfire Smoke Exposure Infographics
Two infographics provide information on actions to take to reduce health risks from smoke exposure in areas with wildfire smoke and what respirator (mask) to wear if you have to go outside and how to wear it properly. https://www3.epa.gov/airnow/smoke_fires/reduce-health-risks-with-wildfire-smoke.pdf and https://airnow.gov/static/topics/images/epa-infographic-respirator.jpg

Smoke Sense App
The Smoke Sense mobile app, developed by EPA researchers, enables you to get information on air quality and learn how to protect your health from wildland fire smoke. The app is being used in a citizen science study to determine how smoke from fires impacts public health. The app is available for anyone to use and can be downloaded on Android or iOS. www.epa.gov/air-research/smoke-sense

Particle Pollution and Your Patients' Health Course
Particle pollution, also known as particulate matter or PM, is the main component of haze, smoke, and dust. This course provides health professionals with knowledge they can share with patients to help reduce overall risk of PM-related health effects, particularly in individuals with heart and lung disease. www.epa.gov/pmcourse

Online Healthy Heart Toolkit
Breathing in fine particulate matter ($PM_{2.5}$) can trigger heart attacks, ischemic stroke, abnormal heart rhythms and worsen heart failure in people with cardiovascular disease or older adults with medical conditions that put them at risk. Particle pollution is a main component of smoke. Use the toolkit to protect your heart. https://www.epa.gov/air-research/healthy-heart-toolkit-and-research

Smoke Ready Toolbox for Wildfires

- Resources health officials can use to educate the public about risks of smoke exposure and actions people can take to protect their health

https://www.epa.gov/sites/production/files/2018-04/documents/smoke_ready_toolbox_for_wildfires_tagged.pdf

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