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Community Vulnerability to Health Impacts of Smoke and Smoke Sense Research Initiative

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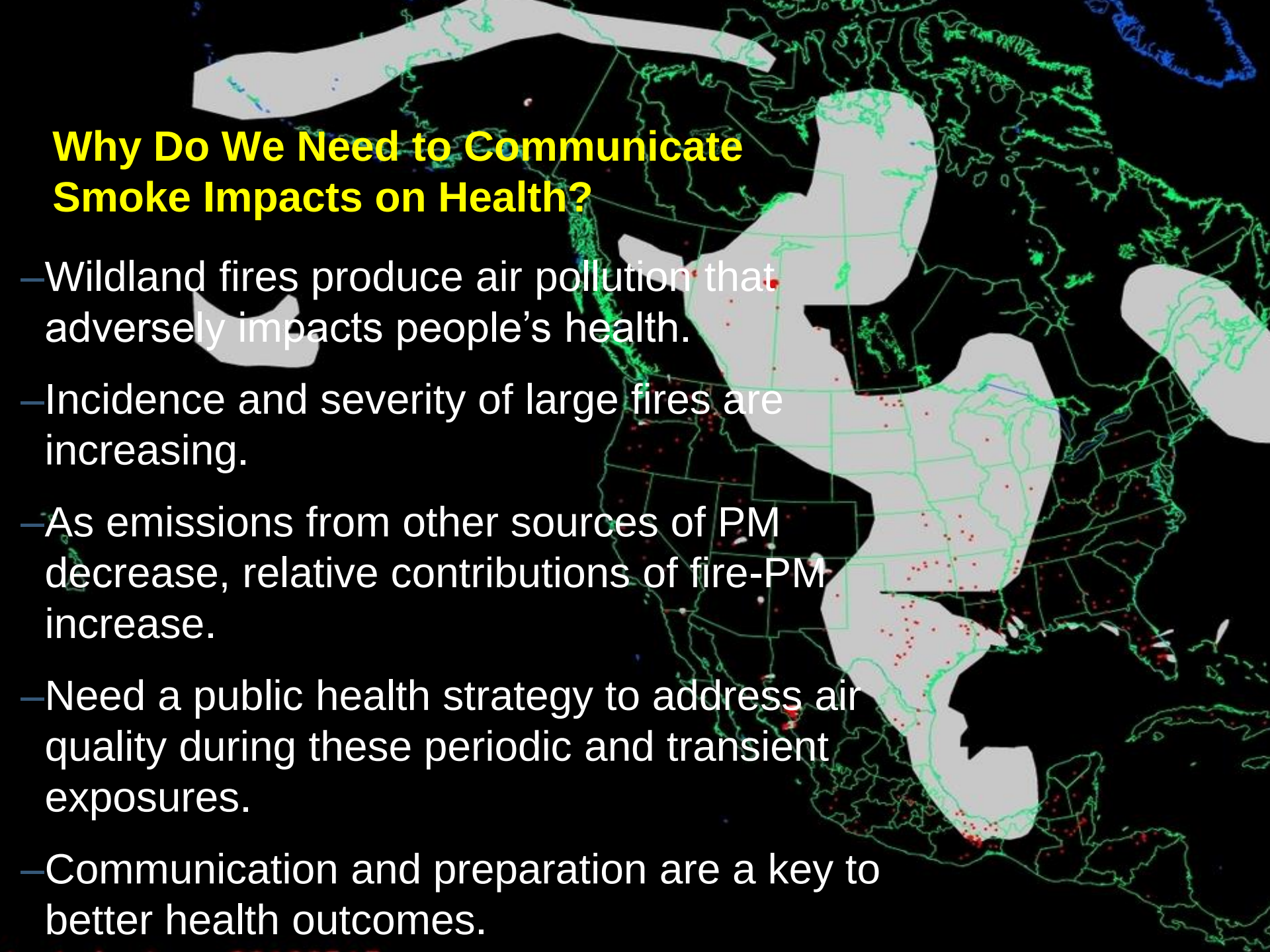


Why Do We Need to Communicate Smoke Impacts on Health?

- Wildland fires produce air pollution that adversely impacts people's health.
- Incidence and severity of large fires are increasing.
- As emissions from other sources of PM decrease, relative contributions of fire-PM increase.
- Need a public health strategy to address air quality during these periodic and transient exposures.
- Communication and preparation are a key to better health outcomes.

Health Effects of Wildland Fires

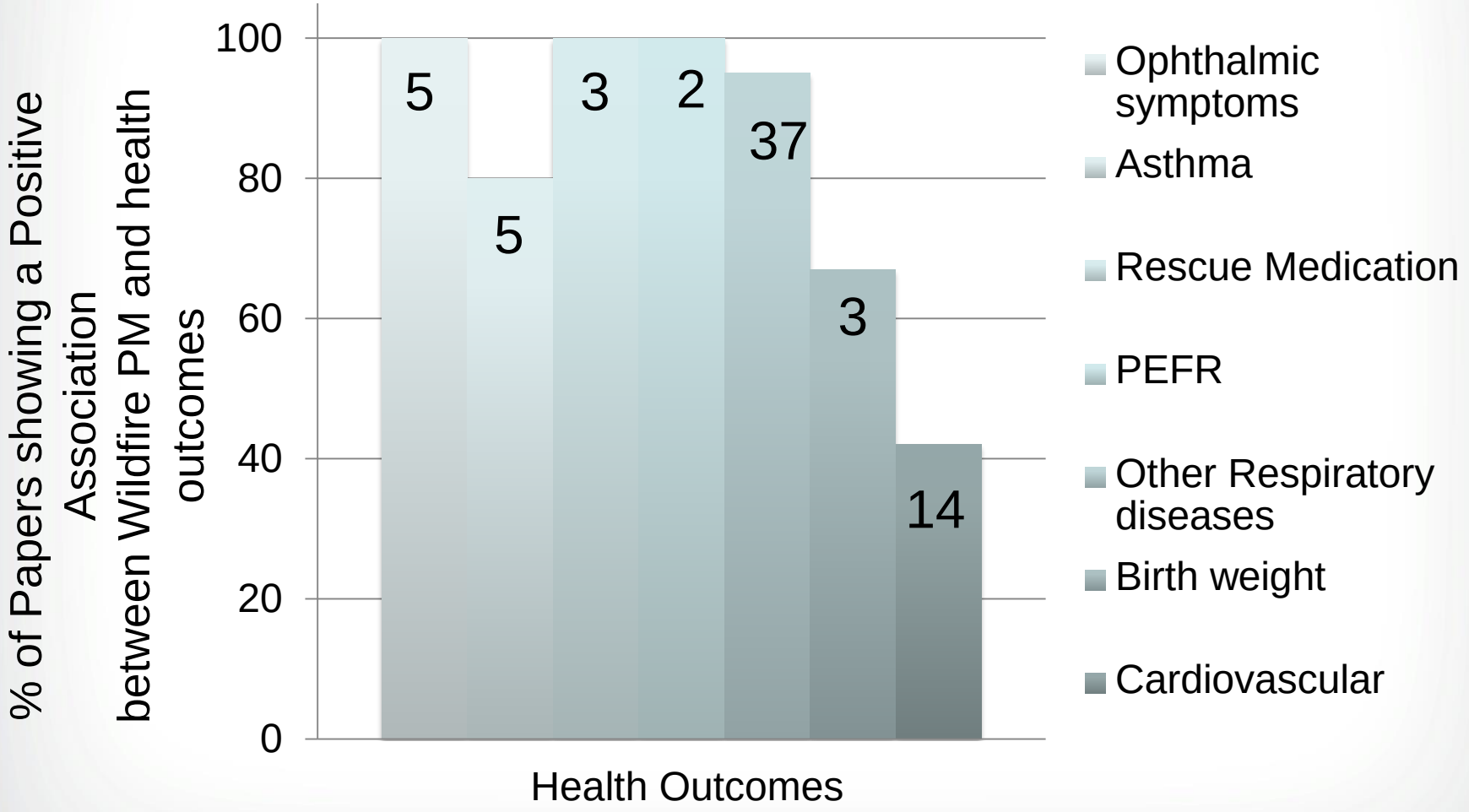
Health effects known or suspected to be caused by wildfire smoke:

- 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

Epi Studies & Health Outcomes

Studies with Positive Associations (in %)



Liu et al. A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. *Environmental Research 2015*

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How often do fires impact air quality?

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

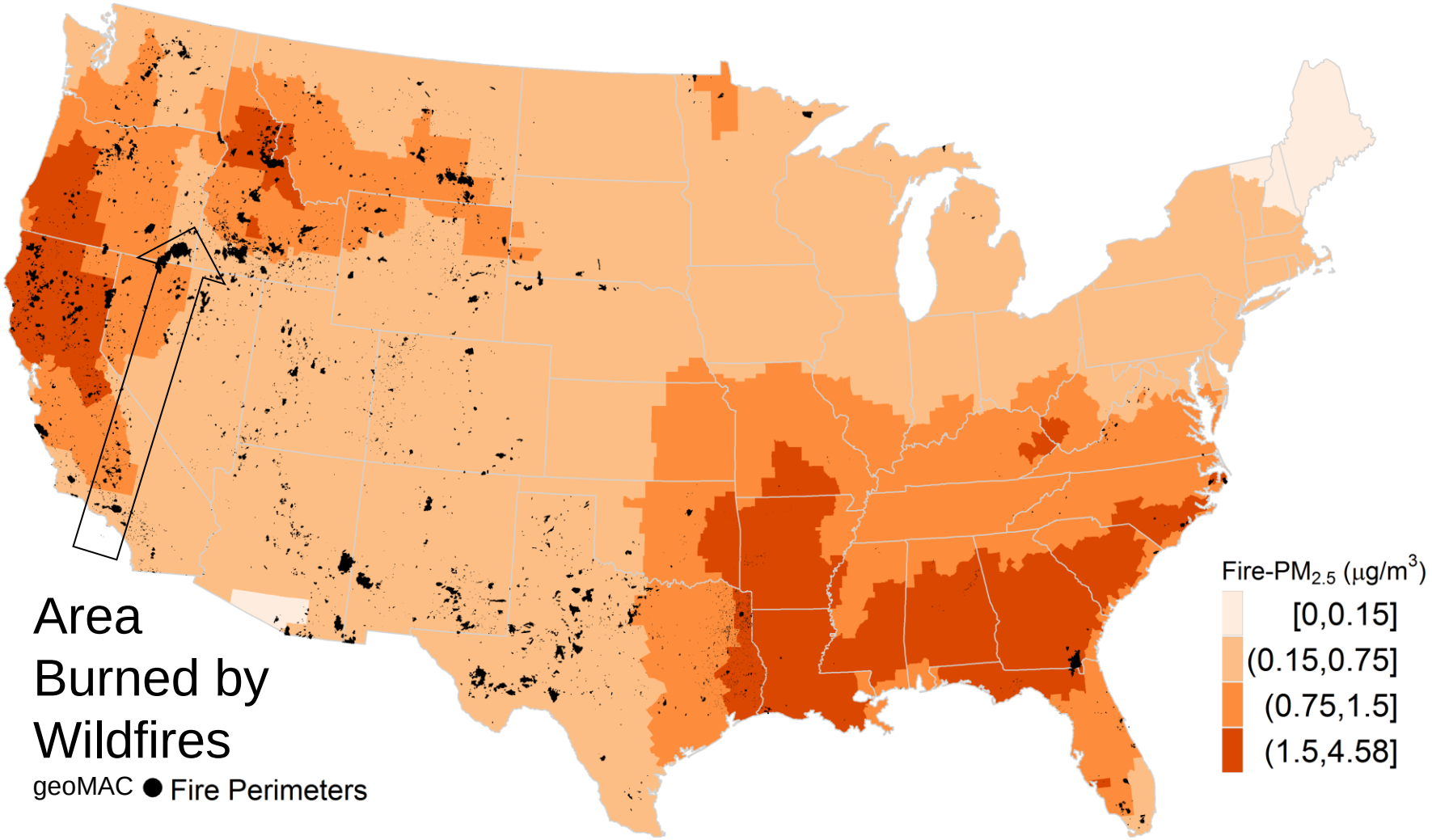
AIR QUALITY INDEX CHART

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, accepted in JESEE

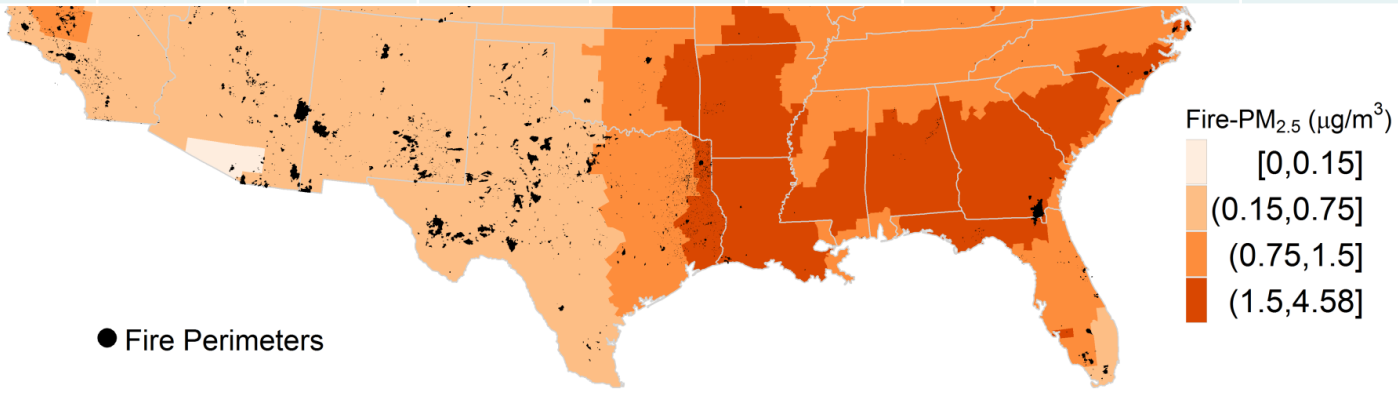
Geographic Footprint of Smoke-$PM_{2.5}$ (wild & rx)



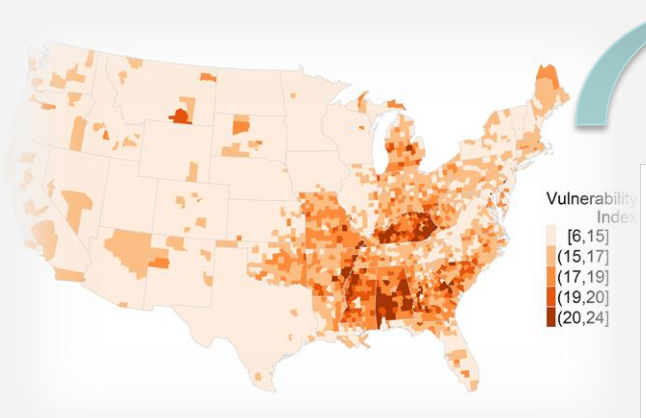
Community Vulnerability to Health Impacts of Wildland Fire Smoke Exposure. Rappold et al. 2017 ES&T.

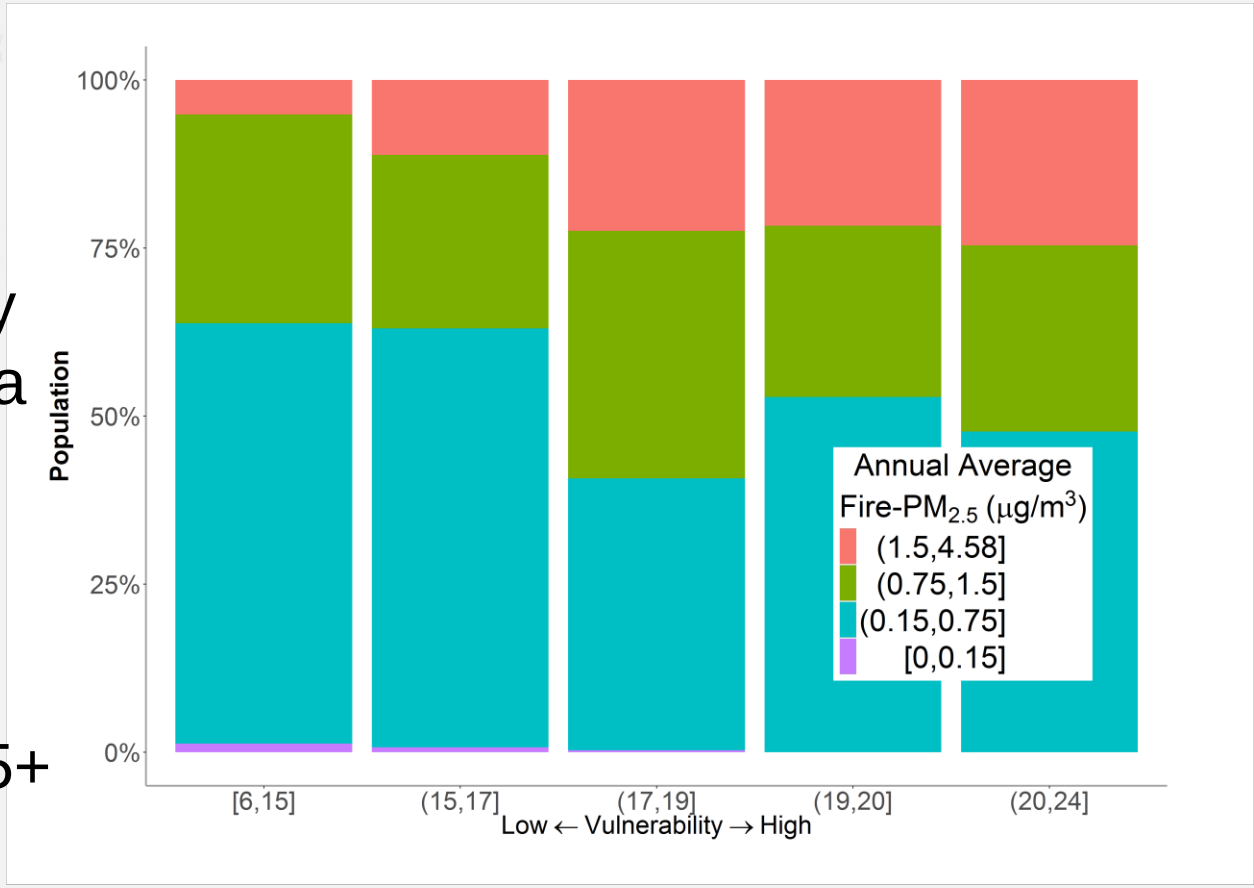
Population Size at Risk
(in millions)

$PM_{2.5}$ (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





Factors of Vulnerability

- 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.

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Community Health Vulnerability Index

Goals and Objectives

- Community health vulnerability to health effects of air pollution and wildfire smoke was indexed based on previously studied clinical and social risk-factors that were found to modify the association between air pollution and adverse health outcomes.
- We used the index to quantify the population size at risk and map the distribution of vulnerability with respect to the past smoke exposure patterns.
- Identifying communities vulnerable to adverse health outcomes during smoke days is valuable for planning and prioritizing public health actions on fire-smoke days.
- Social vulnerability is also important and not accounted for in this particular work.
- Adaptation – we need better data on adaptation and related practices.

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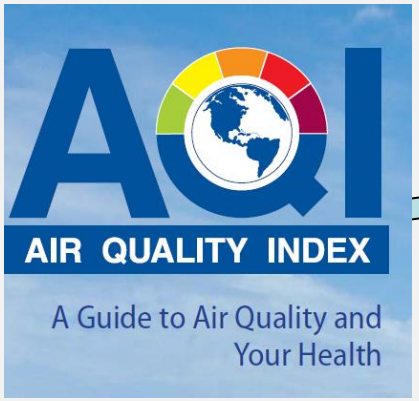
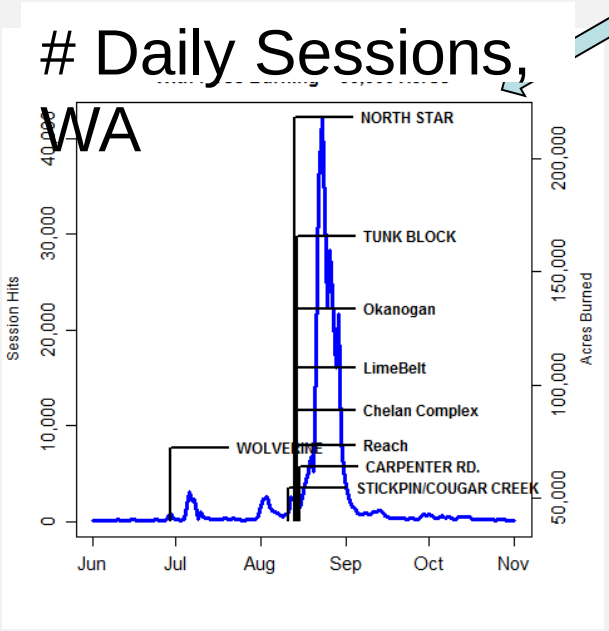
Smoke Sense

Citizen Science
Initiative
on Health Risk and
Health Risk
Communication
During Wildfire
Smoke Episodes

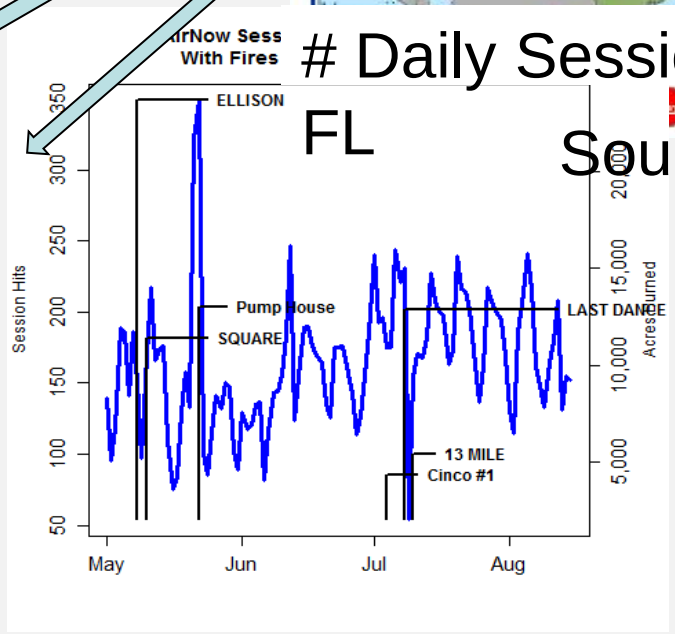
AirNow.gov



Daily Sessions, WA



Daily Sessions, FL



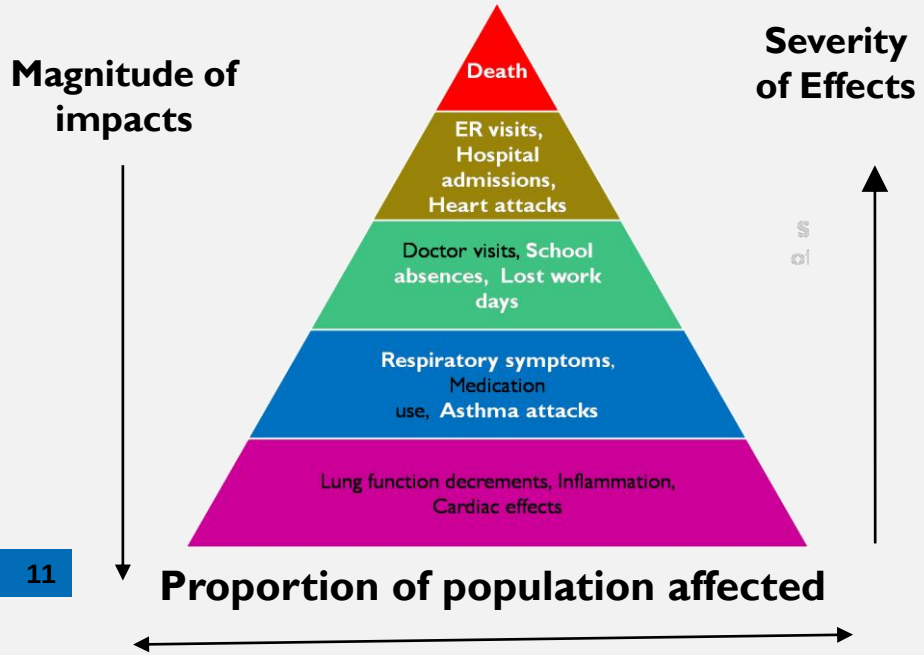
Source: AirNow

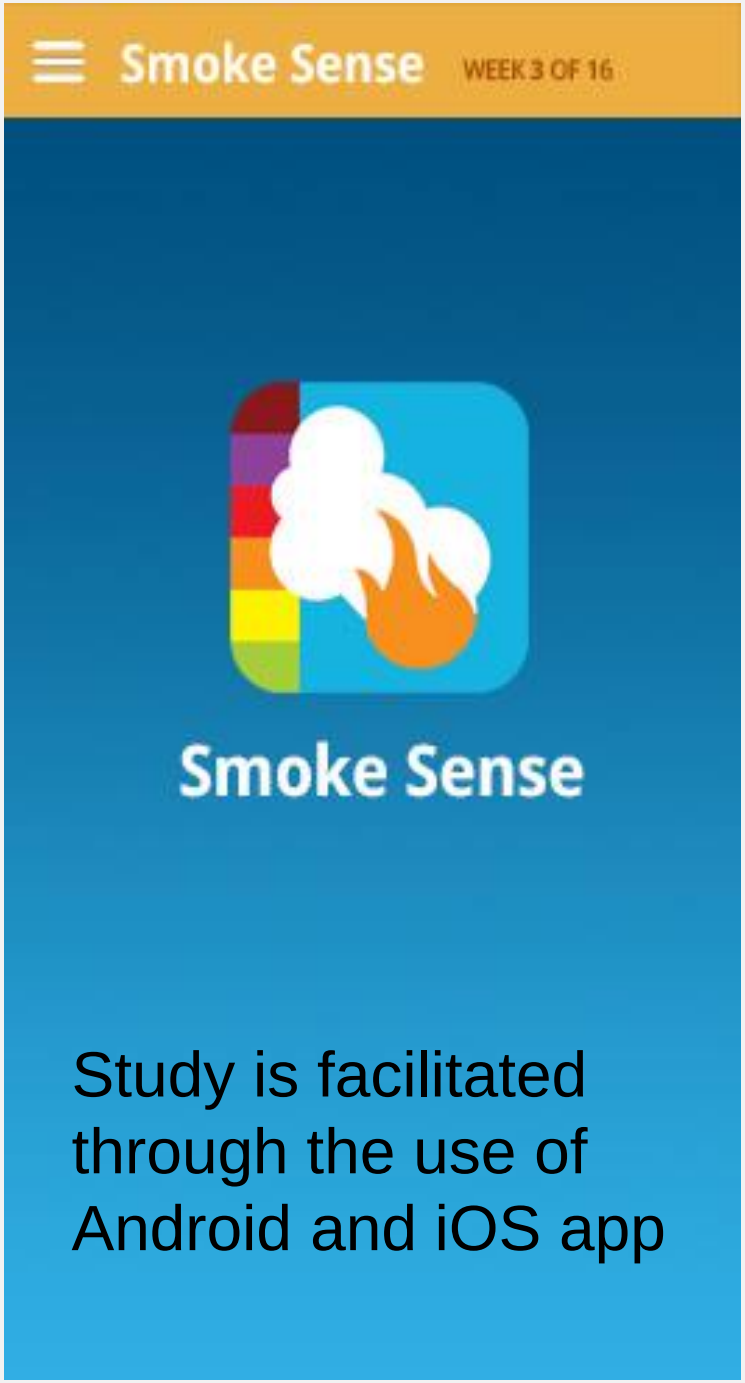
But it doesn't tell us about the likelihood of the impact, how long it will last, and how will it impact me!

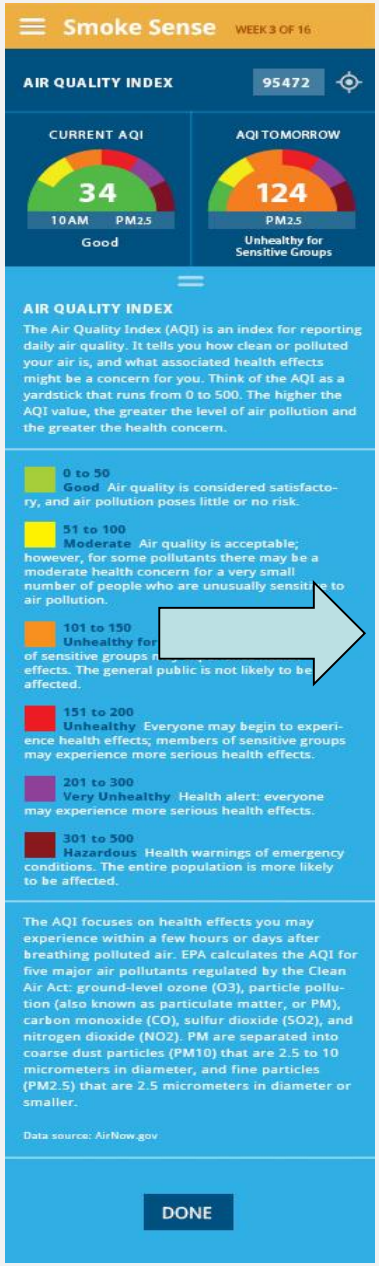
Smoke Sense

A citizen science study with goals to:

1) determine the extent to which exposure to wildland fire smoke affects health and productivity
2) develop health risk communication strategies that protect public health during smoke days







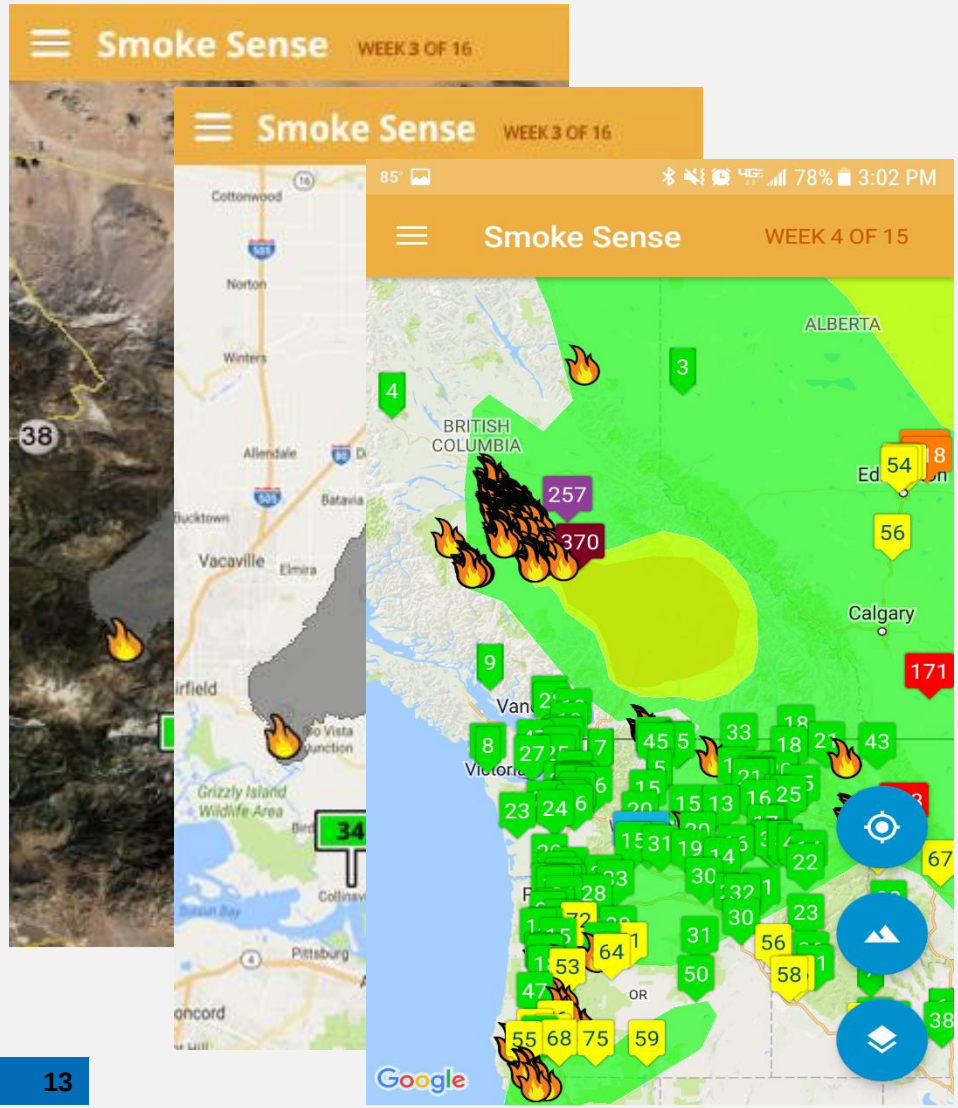
For participants:

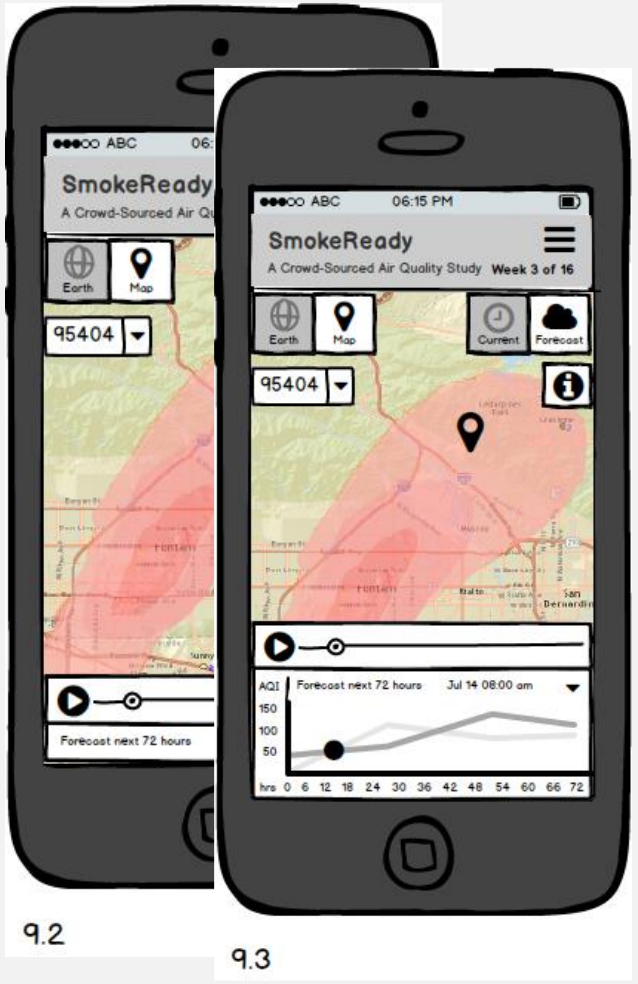
- Current and forecast air quality
- Satellite imagery of smoke
- Public health risk messaging.
- Gamification module to promote desired behaviors and air quality – issue engagement.

For investigators:

- Demographic profile of users
- Symptom and medication usage survey
- Behavioral survey
- App usage statistics
- Score card on compliance behavior from the gamification module.

Satellite images of smoke plumes hourly smoke forecasts,



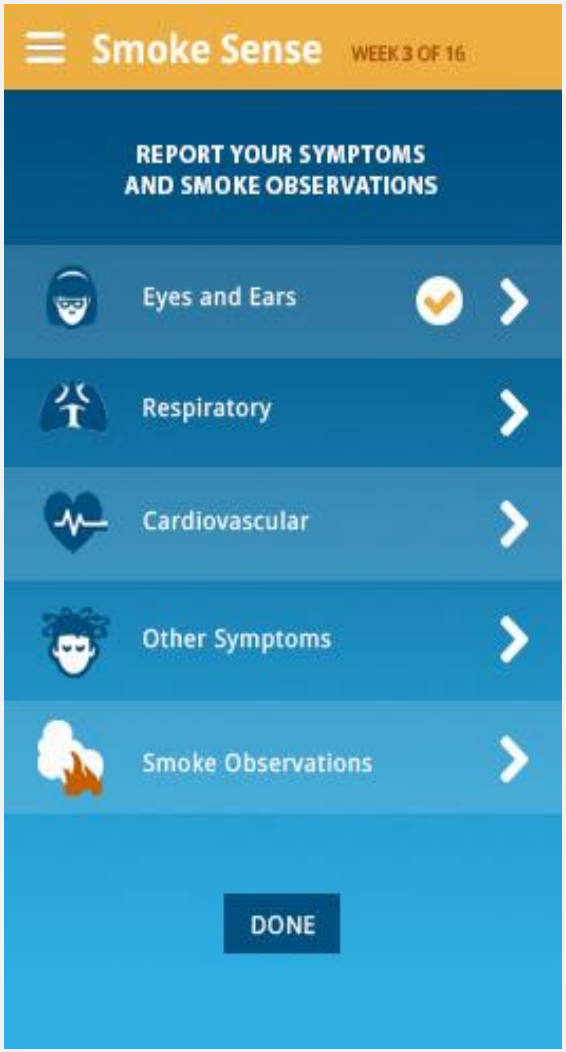


Surveys

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

Symptoms Survey –on Monday mornings participants will receive a notification on their device inviting them to complete the weekly survey on health symptoms (Yes/No).

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



Gamification - Participation 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.

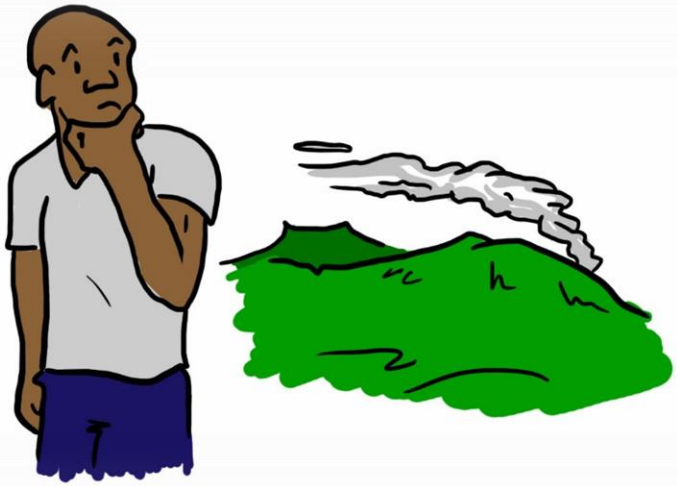
Knowledge Badge – for expanding air quality knowledge with a weekly air quality 101 lesson.

Smoke Explorer Badge – for exploring fire and smoke maps.

Gamification - Education component

Weekly Air Quality 101 module:

Week #8 Question:
"Kai is healthy and young.
Can he assume that the smoke from the wildfire won't affect him?"



Answer:

NO. High concentrations of smoke can trigger a range of symptoms even in healthy individuals. Common symptoms include burning eyes, a runny nose, cough, phlegm, wheezing and difficulty breathing. Smoke may also reduce your lungs' ability to protect against inhaled substances such as pollen, bacteria or viruses. If you have heart or lung disease, smoke may make your symptoms worse. Learn about the health effects from smoke at https://go.usa.gov/xXa8c

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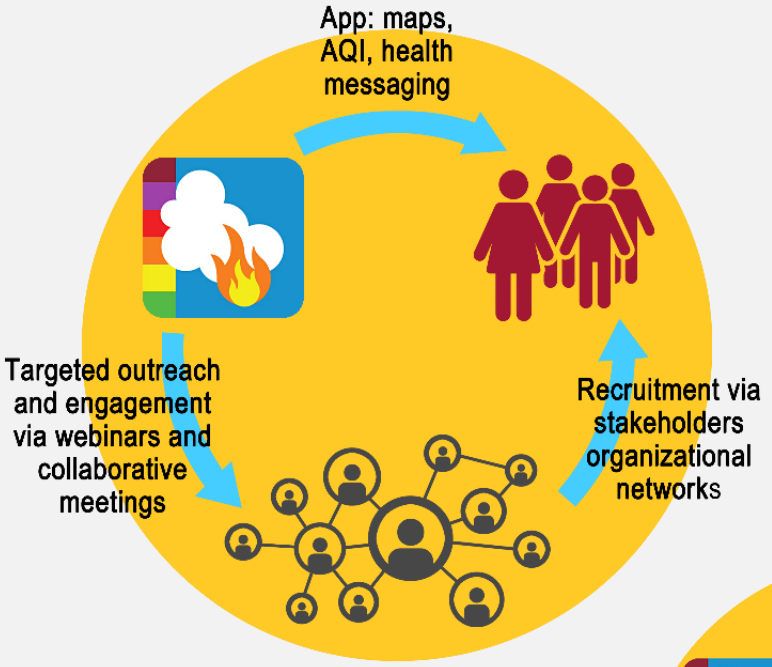
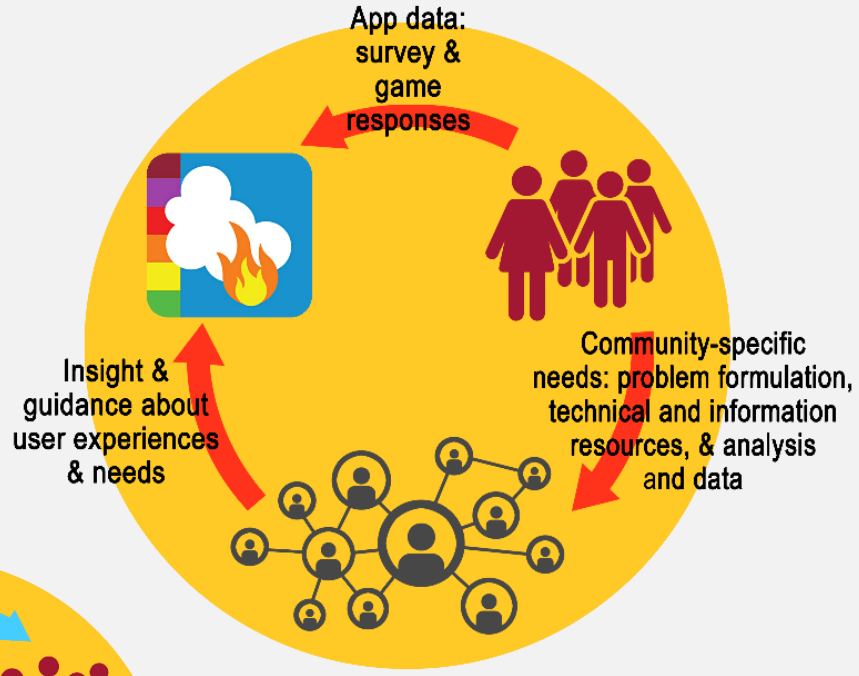
Feedback to the Users

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

Engagement at Individual & Community Levels





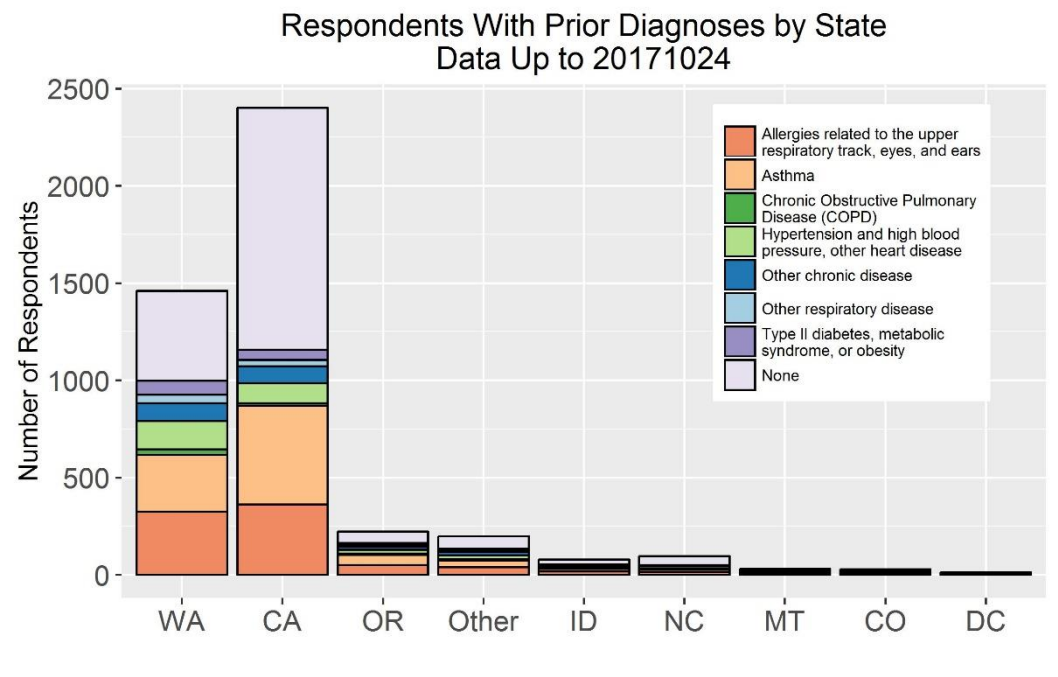
Where we want to be…

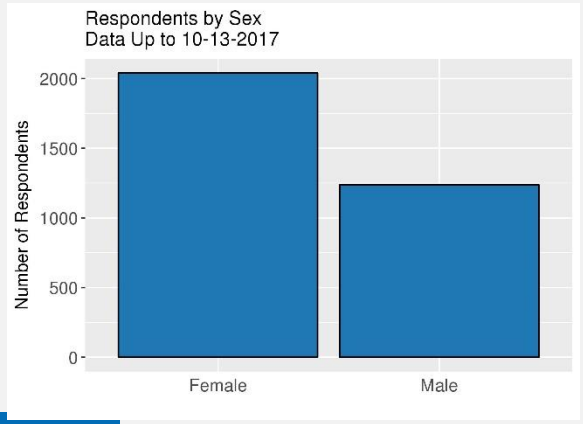
Results – 10/13/2017

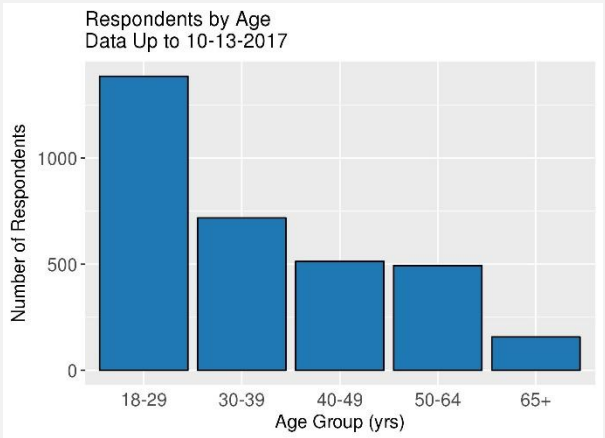
Large smoke events in WA, OR, CA

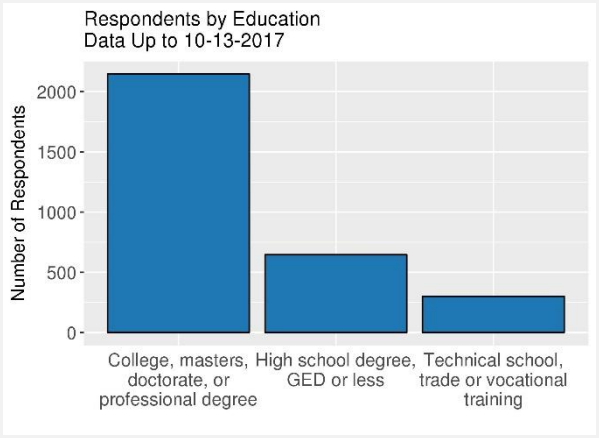
4,500+ users

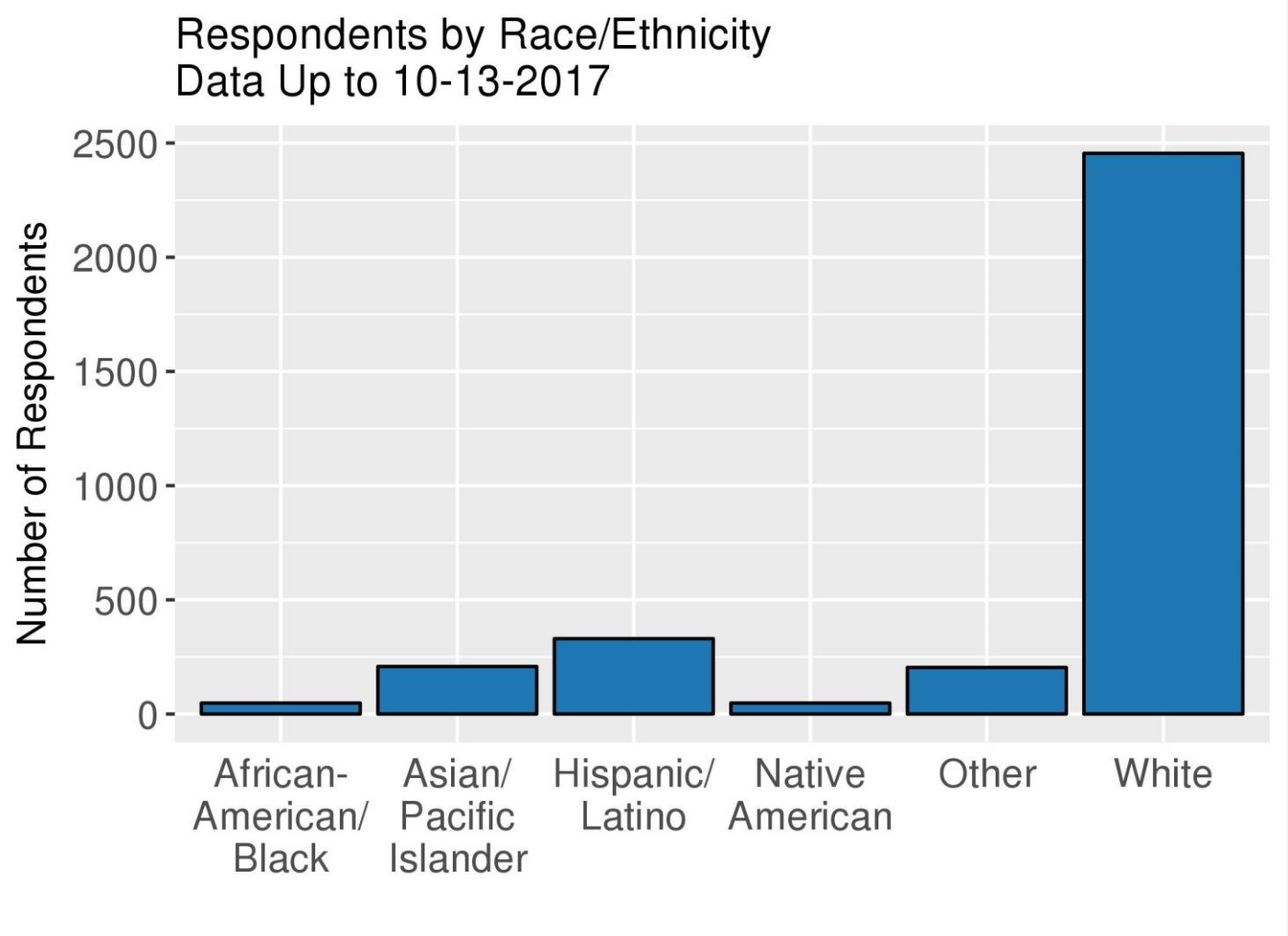
Android – August 1st
iOS – Oct 5th










Respondents by Race/Ethnicity
Data Up to 10-13-2017
Number of Respondents
2500
2000
1500
1000
500
0
African-American/ Black
Asian/ Pacific Islander
Hispanic/ Latino
Native American
Other
White

10/13/2017:

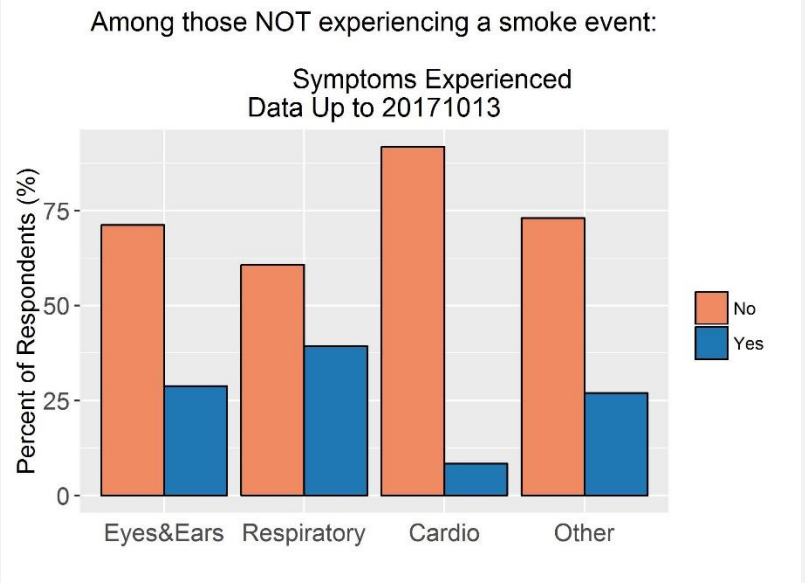
"Did you experience symptoms such as:

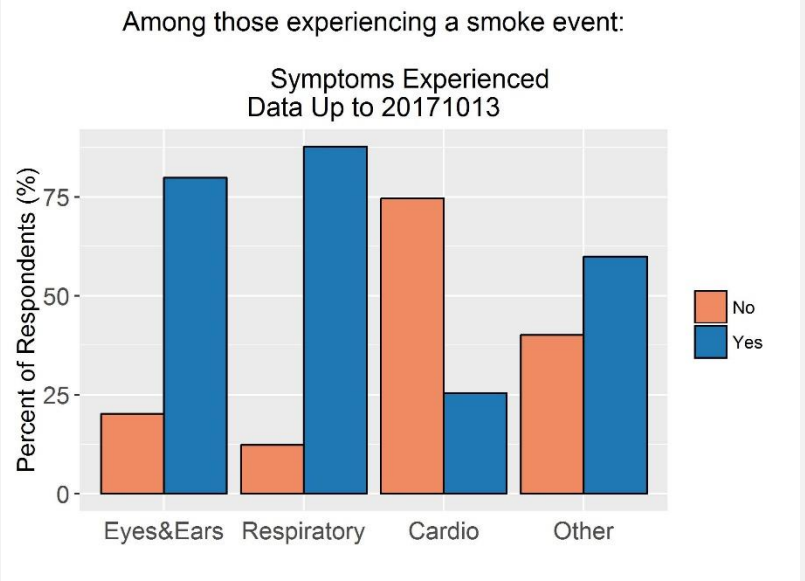
[Eyes&Ears] stinging, itchy, or watery eyes, ear infection, allergic symptoms, or similar?

[Respiratory] runny or stuffy nose, scratchy thought, irritated sinuses, coughing, trouble breathing normally, shortness of breath, wheezing, asthma attack, allergic symptoms, or similar?

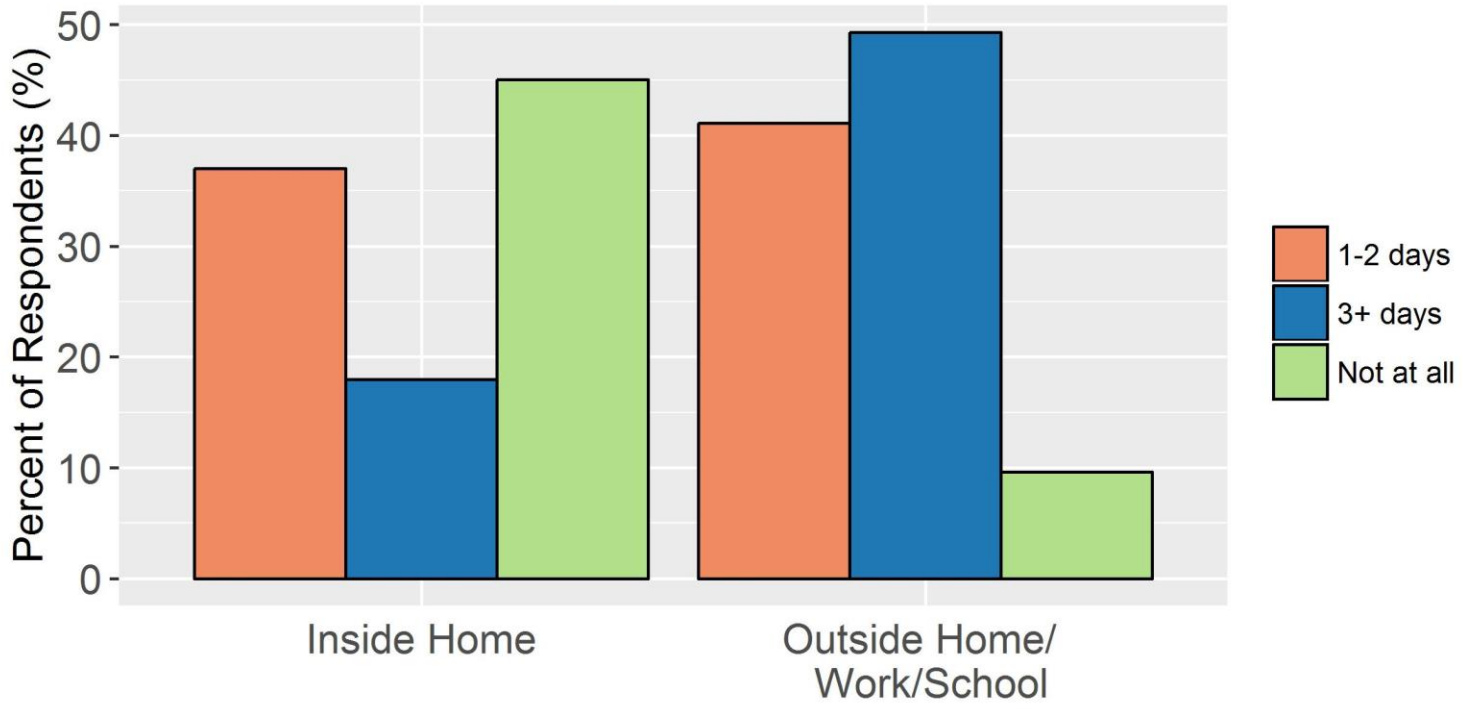
[Cardio] fast or irregular heart rate, pain or tightness in the chest, high blood pressure or similar?

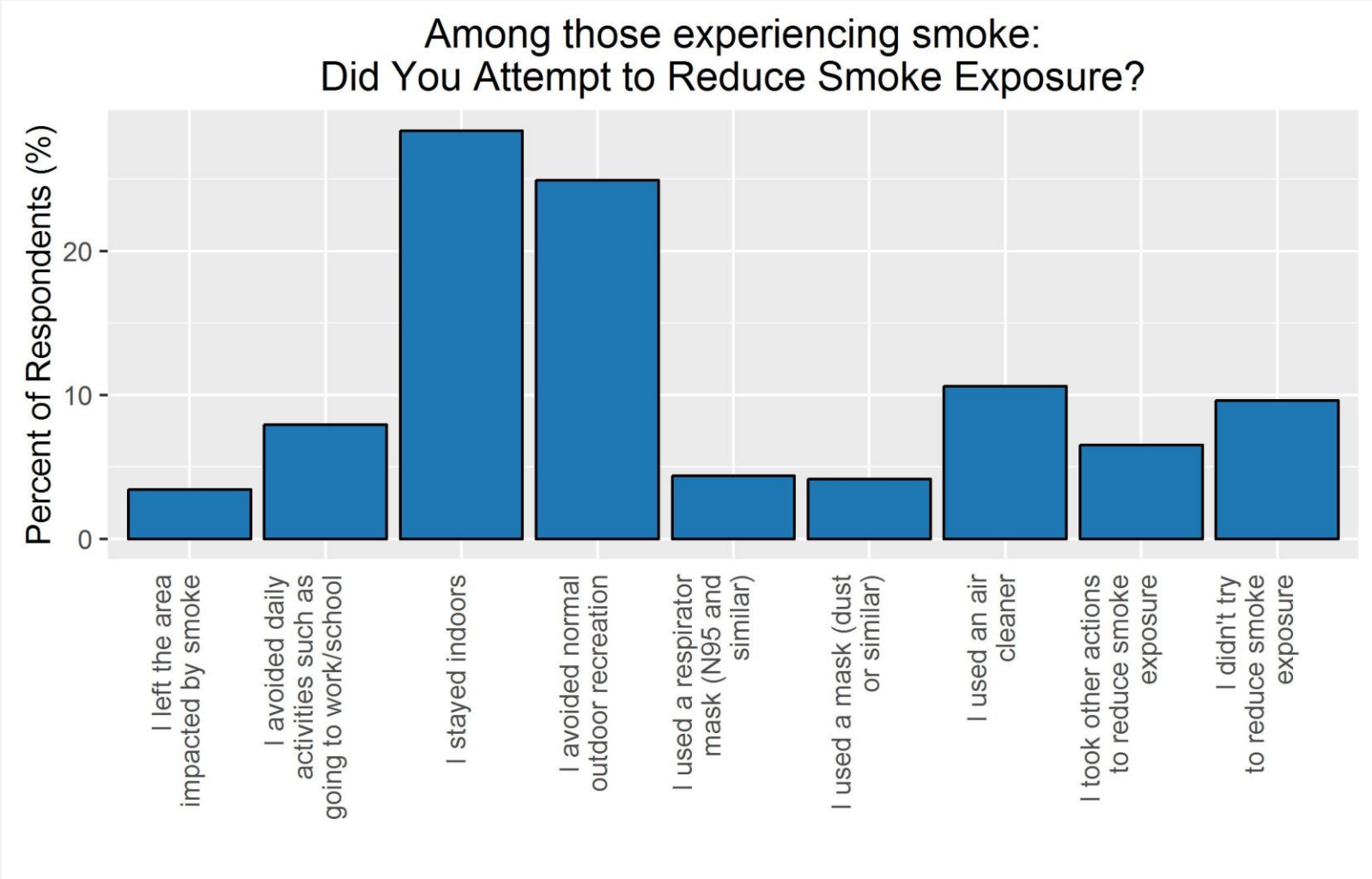
[Other] tiredness, dizziness, viral infections, or other?"





Among those experiencing a smoke event:




Among those experiencing smoke:
Did You Attempt to Reduce Smoke Exposure?
Percent of Respondents (%)
0
10
20
I left the area impacted by smoke
I avoided daily activities such as going to work/school
I stayed indoors
I avoided normal outdoor recreation
I used a respirator mask (N95 and similar)
I used a mask (dust or similar)
I used an air cleaner
I took other actions to reduce smoke exposure
I didn't try to reduce smoke exposure

Summary

Need a public health strategy to address air quality during these periodic and transient exposures:

- Smoke Sense – delivers AQ information to the users directly and facilitates engagement with the issue.
- Smoke Sense is reaching the affected communities and filling the gap in knowledge. 90% sessions are returning users.
- Vast impacts are experienced on low level symptoms and decreased productivity.
- Symptoms in all outcome groups double during smoke episodes.
- Symptoms and loss of productivity is present even when using recommended measures.

Smoke Sense – where we are and next steps

- Pilot season user participation will end soon but the app will remain delivering information to the users. User participation will start back up in 2018.
- We are summarizing results over the next few months. Findings will be shared on the website and publications.
- New features – hourly forecasts of smoke, personalized messaging, satellite streaming, crowdsourcing art and narratives, crowdsourcing experiences.
- Expanding Stakeholder engagement and community participation.
- Multiple languages.

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Thank you

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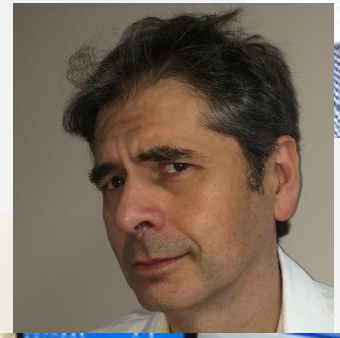



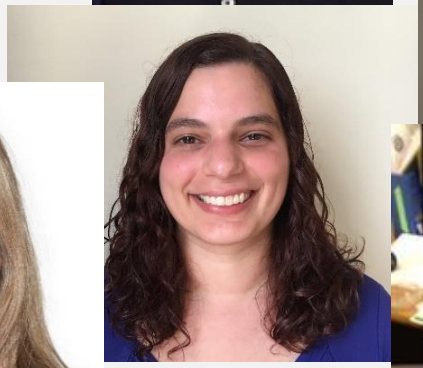



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