More Days With Haze:

How Oregon is Adapting to the Public Health Risks of Increasing Wildfires

ABSTRACT

This report identifies ways in which the public health system is adapting to the increasing number and severity of wildfires in Oregon and highlights opportunities for future climate adaptation. The information in this report is based mainly on interviews that took place in 2018 with key informants who work in Oregon's public health system at the state and local levels.

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December 2019

Oregon **Health** Authority

PUBLIC HEALTH DIVISION
Climate and Health Program

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Executive summary

This report identifies ways in which the public health system is adapting to the increasing number and severity of wildfires in Oregon and highlights opportunities for future climate adaptation. The information in this report is based mainly on interviews that took place in 2018 with key informants who work in Oregon's public health system at the state and local levels. References can be found in the full report and upon request.

Wildfires in Oregon

Wildfires are a part of a natural seasonal cycle and have always been part of Oregon's landscape. The lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt. Increased wildfire activity in the Pacific Northwest is partially attributed to human-caused climate change.

Public health risks

- Increased risk of cardiovascular and respiratory diseases.
- Increased risk of cancer with repeated chronic exposure.
- Irritation of eyes, nose, and throat.
- Decreased visibility, increased risk of vehicle accidents.
- Increased risk of mental health effects.
- Susceptible and vulnerable populations include people with existing chronic illness, children, pregnant women, older adults, and firefighters and other first responders.

The public health response

- Risk communication to various audiences.
- Cross-sector coordination among partners.
- Identifying and assisting vulnerable populations.
- Monitoring health effects and recommending interventions to mitigate risks.
- Providing health data to inform decision-making.

Adaptation in action: recent success stories

- Improved collaboration has increased organizational resilience.
- Public health-assisted evacuations reached vulnerable populations.
- New Clean Air Spaces were opened.
- Tools were updated and used more.

Wildfire projections: a look ahead

Air pollution from increased wildfire smoke is expected to increase risk of respiratory and cardiovascular illnesses by 160% by 2050.

Challenges identified

- Public health capacity and inclusion.
- Cascading and overlapping hazards.
- Addressing behavioral health effects.
- Risk communication regarding the use of masks.
- Clean air at home is generally better than traveling to a "clean air space."
- Risk communication fatigue and recommending realistic actions.
- Smoke blowing in from out-of-state.
- Accessing data for planning and response.

Opportunities for future adaptation

Many of the opportunities identified below require additional capacity, funding or changes in systems and policies. A next step will be to consider which policy areas are most important to prioritize in the coming years.

- **Invest in preparedness and response workforce** (e.g., increase protections for vulnerable workers; conduct joint training with emergency management partners on best practices in trauma-informed care; develop strategies for addressing staff burn-out).

- **Continue to improve collaboration across levels of government** (e.g., engage in more table-top exercises and scenario planning; explore mechanisms for increasing involvement of public health in law enforcement-led planning and response).

- **Increase proactive communication of data to decision-makers** (e.g., provide community partners and local media with pre-season briefings; work with partners to provide guidance on retrofitting facilities to serve as clean air spaces).

- **Standardize a tiered messaging strategy that addresses different phases of a smoke or wildfire event** (e.g., develop different communication tools for different phases; have regional health equity coalitions [RHECs] review).

- **Partner with coordinated care organizations (CCOs) to promote self-sufficiency among member populations** (e.g., provide CCOs with the guidance and evidence they need to promote home improvements such as air filters as "health-related services").

- **Take systematic approaches to assessing, identifying and creating clean air spaces** with a prioritization on promoting safe school facilities.

- **Connect new funding opportunities** (e.g., climate investments) to protect indoor air quality at the household level.

- **Increase surveillance and assessment** (e.g., more coordinated use of Oregon's syndromic surveillance system; work with academic partners on estimating health costs of specific events).

- **Engage and inform long-term planning in health and other sectors** (e.g., build staff capacity to engage effectively in other agency-led efforts; integrate hazard- and climate-related data and strategies into community health assessments (CHAs) and community health improvement plans (CHIPs).
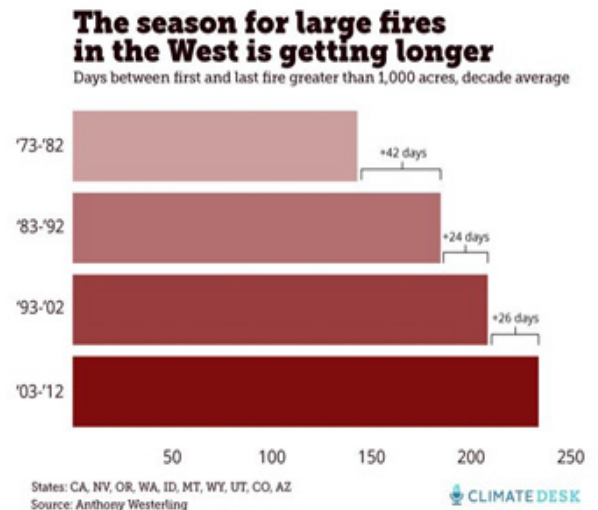
Wildfires in Oregon: Looking back

The graph below charts wildfires that burned 50,000 or more acres in Oregon in the past 100 years. Of all wildfires, 44% occurred in the past 10 years[i].

Oregon's Biggest Wildfires – Number of events by decade
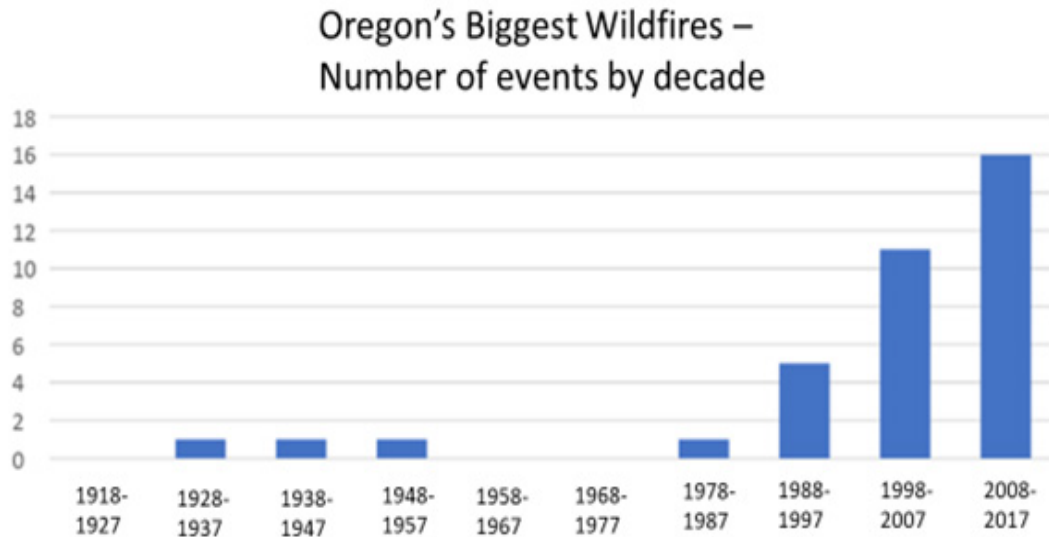
A closer look at the past 10 years

Wildfires are part of a natural seasonal cycle and have always been part of Oregon's landscape. The lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt(1). Recent wildfire activity in the Pacific Northwest is partially attributed to human-caused climate change[ii](2).

Large wildfire events increased suddenly in the mid-1980s[iii]. During the period 1984–2015, about half of the observed increase in fuel aridity and 4.2 million hectares (more than 16,000 square miles) of burned area in the western United States were due to human-caused climate change(3).

The season for large fires in the West is getting longer

Days between first and last fire greater than 1,000 acres, decade average

States: CA, NV, OR, WA, ID, MT, WY, UT, CO, AZ
Source: Anthony Westerling

CLIMATE DESK

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i   Oregon Department of Forestry

ii   Graphics retrieved from: Climate Desk (2016). This is How Much America Spends Putting out Wildfires. https://www.climatedesk.org/warming-world/2014/06/17/this-is-how-much-america-spends-putting-out-wildfires - based on peer-reviewed literature listed directly below with updates from authors.

iii   Westerling, A.L. et. al. (2006). Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science. Vol. 313, Issue 5789, pp. 940-943. DOI: 10.1126/science.1128834 https://science.sciencemag.org/content/313/5789/940.full

Wildfires and Climate Change

TEMPERATURES ARE RISING
Average annual temps in Oregon have increased almost 2°F since 1970.

SNOW MELTS SOONER
Winter snowpack melts up to 4 weeks earlier than in previous decades.

FORESTS ARE DRIER, LONGER
Conditions are primed for wildfires to ignite and spread.
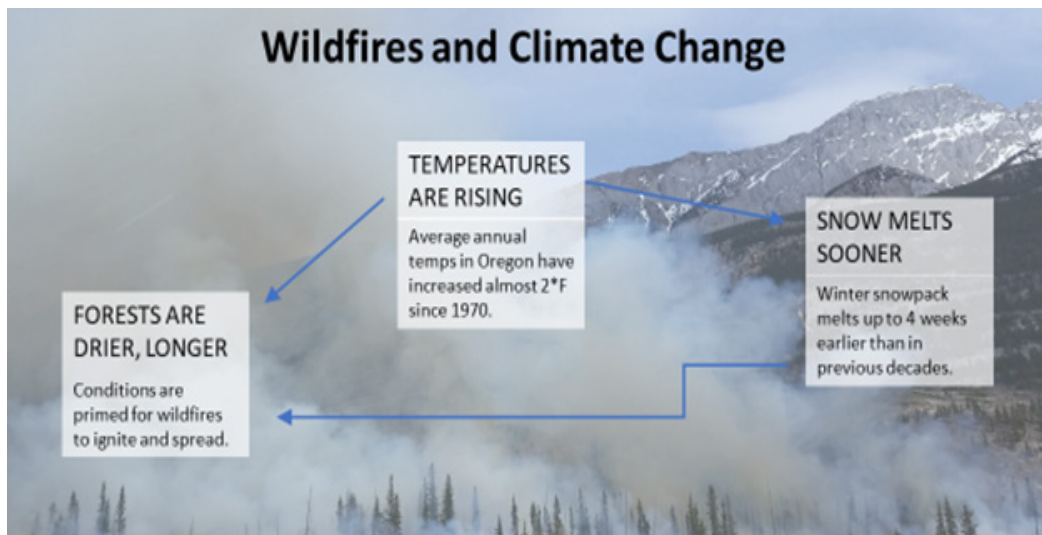
Public health risks

The probability of wildfire occurring and creating public health hazards is high(4). The consequences, however, vary from a catastrophic disaster (such as fire burning structures in a populated area) to a few hours of compromised air quality. In the 2017 Oregon Public Health Hazard Vulnerability Assessment, local public health authorities (LPHAs) both east and west of the Cascades ranked wildfire in their top five hazards, illustrated in the table below(5).

Table 2. Top 10 hazards posing the largest risk to public health infrastructure, by region. (1 is largest.)

	Western Oregon	Central/Eastern Oregon
1	Earthquake — Cascadia (3–5 minutes)	Winter storm
2	Public health emergency	Wildfire (with urban interface)
3	Flood — riverine	Flood — riverine
4	Winter storm	Public health emergency
5	Wildfire (with urban interface)	Drought
6	Earthquake — crustal (1 minute)	Windstorm
7	Landslide/debris flow	Hazmat release — transportation
8	Windstorm	Landslide/debris flow
9	Hazmat release — transportation	Earthquake — crustal (1 minute)
10	Hazmat release — fixed facility	Hazmat release — fixed facility

Particulate matter

Particulate matter (PM) in smoke poses the most common wildfire-related public health risks in Oregon. The potential health effects vary depending on the size of the particles. Particles larger than 10 micrometers usually irritate only the eyes, nose and throat. Particles smaller than 2.5 micrometers (PM2.5) can be inhaled deeply into the lungs, increasing the risk of cardiovascular and respiratory problems(6). Chronic repeated exposure to particulate matter in smoke from wildfires is also associated with cancer(7,8). PM exposure from wildfire smoke is a risk beyond the immediate area of the fire, since winds can carry the PM long distances. Increases in smoke are associated with hospital admissions for respiratory complaints, and long-term exposure worsens existing cardiopulmonary disease(9), bronchitis and pneumonia(10). Decreased visibility from wildfire smoke can also be a contributing factor to motor vehicle crashes(11).

Gases

Wildfire smoke contains precursors to ground-level ozone such as nitrogen oxides, volatile organic compounds, and other compounds(12). When these compounds are exposed to heat and sunlight, they can form ozone. At higher levels (10 to 20 miles) of the earth's atmosphere, ozone provides a protective layer that shields us from the sun's harmful ultraviolet rays. At lower levels it is considered a harmful air pollutant. In 2017 the Oregon Department of Environmental Quality attributed ozone levels above the National Ambient Air Quality Standard to wildfire smoke because of the precursor gases emitted(13).

Ozone, like particulate matter, can make symptoms worse for people with chronic lung disease. It has also been linked to coughing and pain when taking a deep breath, lung and throat irritation, wheezing and trouble breathing during exercise and outdoor activities(14). Ozone can affect anyone. People with chronic lung disease, older adults, people of all ages who exercise or work hard outside, babies and children are most likely to experience health effects caused by ozone(15).

Carbon monoxide also can be a problem for those closest to the fires, including residents and firefighters.

Mental and behavioral health

Any natural disaster can affect the mental wellness of community members who experience the disaster. Extreme weather events that disrupt normal life, change a familiar landscape, or increase perceived or real danger can increase stress and anxiety among those affected. Prolonged smoke events have demonstrated increases in fear, isolation and alteration of traditional summertime activities – all of which can affect health(16). Studies have also documented evidence of psychological impairment related to wildfires(17) and behavioral health effects including depression, increased substance abuse, and suicidal thinking(18).

> "I have anxiety about this — the unpredictability of smoke events and general protective measures that people can take — it's different than what we've seen in the past, especially west of the cascades. The fires in the Gorge in 2017 were kind of a wake-up call."
>
> *– County health officer in Oregon*

People with the highest risk of complications

Populations most vulnerable to smoke-related health complications include people with existing chronic illness, children, pregnant women, older adults, and firefighters and other first responders(19).

The public health response

When asked about whether the wildfire data reflect their personal experience on the ground, public health practitioners agreed that the need to prepare and respond to wildfire has increased over the past several years.

Many public health practitioners have roles that are "a mile wide and an inch deep." They are responsible for communicating health risks and actions that people can take to protect their health. They may serve as media spokespeople, lend their expertise to support partners in risk communication, and use a variety of channels including social media, press releases, and tailored communications to community partners serving vulnerable populations. They work closely with other agencies, community partners and the health care system to ensure that messaging is consistent, and that health-related information is being shared to inform decision-making. They assess health effects and advise state, federal, tribal, and local partners on health risks and potential public health interventions to mitigate it.

Public health practitioners often contribute to their jurisdiction's natural hazard mitigation planning and offer their public health perspective in emergency preparedness planning. Some are active participants in local air quality committees and some have joined neighboring jurisdictions for regional collaborations.

Public health epidemiologists monitor health system data and air quality data. When capacity allows, they retroactively study an event's health effects, to better understand the health burden of increasing wildfires in Oregon.

> "One thing is certain: the 2017 wildfire season in Oregon was one of the most visible examples of how a climate-related hazard can impact human health. Unfortunately, Oregon's changing climate conditions are increasing the likelihood of wildfires (2017 Oregon Climate Assessment Report) meaning we can expect more frequent and more intense smoke events in the years to come."
>
> *– Lillian Shirley, Oregon Public Health Division Director*
>
> *Climate Change Hits Home, guest blog post Keep Oregon Cool, Oregon Global Warming Commission*

Adaptation in Action: Recent Success Stories

1. Improved collaboration has increased organizational resilience

Over the past few years, long-term relationships have been strengthened among various agencies and partners. Their roles and responsibilities have become clearer. The Oregon Wildfire Response Protocol for Severe Smoke Episodes has helped to do this and is updated annually with input from various partners.

Some partners have noticed an increase in communications related to wildfire and have appreciated being included on various bulk emails, noting that more information is usually better than scant information. Throughout the interviews, strengthening relationships and professional networks were emphasized as an important factor in being able to plan and respond effectively. Knowing who to call for what increases efficiency and collective capacity. Through strong and trusting relationships, partners can share wildfire-related workloads and take turns with tasks that can benefit all those working on wildfire preparedness and response.

The state's Public Health Division has added and improved statewide messaging tools that are helpful for local health partners in their efforts to be consistent with messaging across the state. Local public health officials noted increased opportunities to share their experiences in their respective jurisdictions. These opportunities allow officials to learn from each other and collectively explore several different problems, understanding that there is no unique solution.

Local public health practitioners also noted that the state-sponsored smoke and wildfire conference calls have been very helpful and worthwhile in preparing for smoke events. The calls have become more appropriate for a broader set of participants, as facilitators and speakers increasingly communicate in plain language instead of technical jargon. Pre-season calls and post-season "hot wash" calls allow local, state and federal partners to discuss lessons learned. The season debrief includes prioritized actions for the coming year and any updates needed for the Wildfire Response Protocol for Severe Smoke Episodes. In the past year these included: (1) Identification of needs based on geography, (2) The need to better coordinate communication on the use of masks and respirators, and (3) Continued promotion of the Oregon Smoke Blog.

Organizational resilience

The capacity of an organization to use available resources to maintain its core purpose in the face of dramatically changed circumstances, and to adapt and transform systems and practices to anticipate and navigate future operational impacts.

"Over the past three years, we have seen a need for more coordination. We've seen more chronic smoke exposure in communities … longer periods of time and multiple events in one season."

– Surveillance and epidemiology manager, OHA

The Oregon Department of Environmental Quality is recognized as a very supportive partner. Local health authorities appreciated direct communication by DEQ when heavy smoke was expected to blow into their jurisdiction. The Oregon Smoke Blog, managed by DEQ, is widely regarded as a very important tool. DEQ improved the website to make air quality data more accessible and public health officials often use the blog to monitor air quality and inform the general public. Several local public health officials interviewed for this case study mentioned using the air quality app recently developed by DEQ.

> "Now there is more surge capacity ... As a region we are combining efforts and it wasn't always like that. It used to get overwhelming really fast, now we have a larger bandwidth. A fire is now not just the concern of one county, but considered a regional event. Due to wind currents, the fire doesn't necessarily need to be directly located in our county to create a hazardous situation for our vulnerable residents in terms of air quality."
>
> *– County health department emergency preparedness coordinator*

2. Public Health-assisted evacuations reached vulnerable populations

The U.S. Department of Health and Human Services "emPOWER" program identifies Medicare and Medicaid patients who rely on electricity-dependent medical equipment at home. During the 2017 Eagle Creek and Chetco Bar fires, public health officials assisted evacuation efforts by accessing "emPOWER" data to identify residents who were dependent on equipment such as oxygen concentrators and nebulizers. This information was shared with first responders and helped ensure that those who may have had difficulty evacuating were identified and assisted in a timely manner.

This was a new practice that needs process improvement. "emPOWER" data are confidential and only accessible to public health officials in emergencies. In the future, local public health officials may need to access these data and state public health officials can help with this. Public health officials are important partner advocates on behalf of those who may be harder to reach or evacuate. In the past few years, we made good strides in outreach to vulnerable populations by using the "emPOWER" data, interfacing with the medical system and medical transportation services, and establishing backup sites.

3. New clean air spaces were opened

New Clean Air Spaces (CAS)(20) were established and opened during the Eagle Creek and Chetco Bar Fire events. OHA was able to purchase new mobile air filters that can be used to open temporary clean air spaces. These spaces were also named "Safe Air Shelters" to facilitate understanding of their purpose. It was noted that calling them "spaces" rather than "shelters" was better received by the general public and may make people more likely to use them. Some people associate the word "shelter" as a place to stay overnight (such as those set up by the American Red Cross).

Clean air spaces have been opened at several locations across the state including community spaces such as public libraries, senior centers and transitional housing shelters.

Clean air space

A facility that has public access (such as a school, fire station or hospital) with tight-sealing windows and doors, a ventilation system that can significantly reduce or even eliminate the intake of outdoor air, and a high-efficiency filtration system.

4. Tools were updated and used more

Over the past couple of years, OHA's toolbox for messaging around air quality and wildland fire smoke has expanded and improved. Local health officials appreciate having multiple resources to draw from and official communication materials help to increase their credibility. Counties that haven't traditionally been heavily affected by wildfires are now doing more planning.

Community partners are increasingly asking public health authorities for guidance. For instance, schools and sport organizations were requesting guidance on when outdoor activities should be cancelled. OHA created new public health guidance for school outdoor activities during wildfire events and supported the Oregon School Activities Association in developing its own guidance for school athletics.

Wildfire projections: A look ahead

Oregon's climate is expected to warm 2–5°F by the 2050s. Extreme heat and extreme precipitation events are expected to become more frequent. 2015 was a notable year in its record warmth and drought. It resembles what climate model projections indicate may be normal conditions by the middle of this century[21].

Air pollution from increased wildfire smoke is expected to increase risk of respiratory and cardiovascular illnesses by 160% by mid-century[22]. Below is a map of projected increases in number of "smoke waves[23]" across the Western states.

Smoke waves

A smoke wave occurs when the concentration of PM2.5 is at least 20 micrograms per cubic meter for two or more consecutive days. For perspective, this level of $PM_{2.5}$ falls within the moderate range of the EPA Air Quality Index, so it is not uncommon, and one study found that 46 million people in the Western U.S. were exposed to at least one smoke wave between 2004 and 2009[23].

Projected Increases in Wildfire Smoke Exposure[22]:

Present Day (based on 2004-2009 data)

Number of smoke waves over 6 years

	0 (no SW)
	1-2
	3-4
	5-6
	7-8
	9-10
	11-13
	14-16
	17-20
	21-24
	25-29

(a)
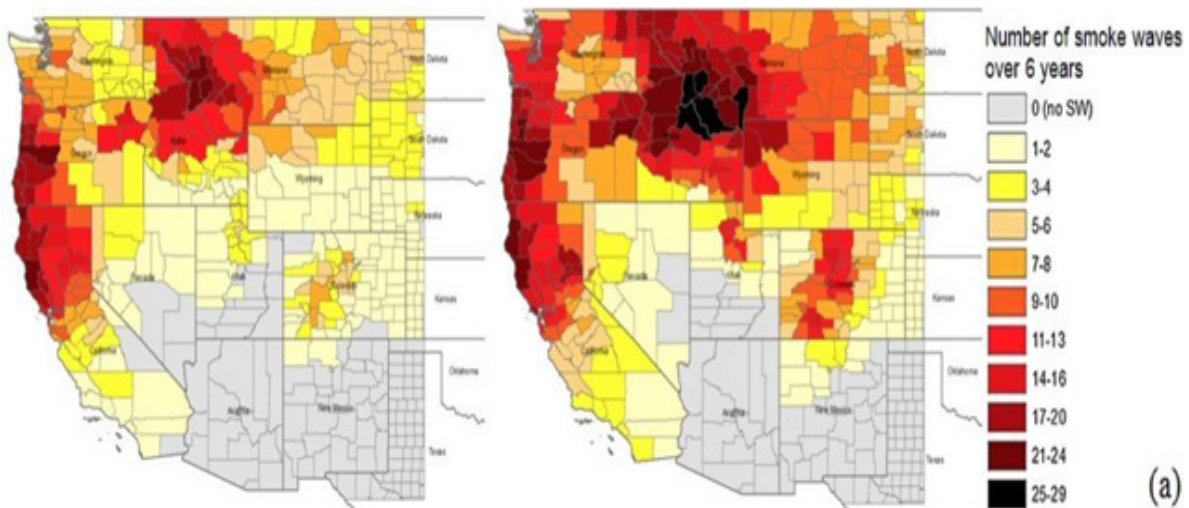
Challenges Identified

1. Public health capacity and inclusion

If a critical member of the team is away at a training or on vacation, it can have a considerable effect on the team's ability to respond during a wildfire event. Public health officials wear so many hats that it is often difficult for them to leave their posts and come to the assistance of neighboring jurisdictions seeking additional support during an emergency, especially if their own jurisdiction is also at risk of smoke intrusion.

By late summer, emergency response staff have often logged overtime hours with back-to-back events. This was especially noted in 2017 when public health preparedness teams experienced staff burn-out due to the simultaneous and consecutive emergency events in the summer months.

Some have heard complaints that a health department is not doing enough, from partners such as local city jurisdictions that are not aware of these capacity challenges. In some cases, partners have wanted to know exact thresholds for taking certain actions, which may not be as simple as it seems. Choosing thresholds for action (such as when to cancel events or open cleaner air spaces) is not an exact science; one of the things that public health authorities have to communicate is that thresholds are different for different populations.

At some interagency meetings on wildfire, public health authorities may be absent due to either limited capacity or not being invited to the table. When public health is at the table, they may feel unprepared due to lack of advance communication and coordination. Sometimes those leading the meetings aren't aware that public health has already developed messaging and materials, and with advance notice public health officials can provide partners with these tools and briefings. There are often agreements made by fire chiefs about how to proceed with engaging the public, and it was expressed that these agreements now need to include public health administrators. Historically, a typical fire response focused on coordinating evacuation (which is led by law enforcement), but now it is recognized that communities need to plan more for other kinds of actions that may be necessary before evacuation. Usually the joint information centers are set up primarily to coordinate evacuation information and haven't addressed broader public health risks, mainly smoke protection. Some public health officials have said that this collaboration is getting stronger in their jurisdiction and in some cases public health partners were able to retrieve important medical data to share with their law enforcement partners to assist in the evacuation of vulnerable populations.

> "These aren't necessarily new challenges, just existing challenges happening more. Historically most wildfires were contained to forests and wildlands, but now they are encroaching more often into populated areas. A main challenge is that people still see wildfires as a need for only a 'fire fighting' response. However, law enforcement is needed to lead evacuation and public health leads health and safety risk communication and coordination among organizations serving the whole community, including people with access and functional needs."
>
> *– Public health preparedness liaison*

2. Cascading and overlapping hazards

Related to capacity challenges, climate change is also increasing the number of cascading or overlapping hazards. For instance, in the summer months communities may face poor air quality from wildfire smoke and extreme heat at the same time. This poses a problem for people who may not have access to air conditioning (over 40% of Oregon households) and who would normally open all their windows to ventilate and mitigate heat. In 2017 Portland Public Schools canceled the first days of school because their school buildings were not equipped to protect children from both heat and smoke. During times like these, public health authorities receive many questions from school districts and other public entities attempting to understand the safety of their facilities and best practices for protecting the health of occupants.

Other common overlapping events include increased risk of water contamination during and after a fire. In 2017, during the Eagle Creek Fire, the town of Hood River had a "boil water notice" because of an incident in which the Crystal Springs water system lost pressure. For a time, firefighters and other first responders were without drinking water. Other water security issues can occur due to harmful algal blooms, contamination, or after-fire landslides and flooding. If there is already an Emergency Operations Center (EOC) set up for responding to the wildfire, it is challenging to enlist the additional staff needed to address drinking water emergencies when they are already addressing wildfire-related public health emergencies. There is the potential to have two Incident Management Teams (IMTs) activated, dividing public health operations to address both the wildfire and water concerns, but in reality most LPHAs would have a single person responsible for both a wildfire and water emergency, and would rely on state assistance.

Cascading Hazards

A sequence of 'cascading' events triggered by an initial event that results in interconnected effects and/or failures. Climate change increases the risk of cascading natural disasters due to the causes and effects of lower snowpack, drought conditions, higher temperatures, more extreme precipitation events, etc.

"Emergency response never happens in a vacuum."

– County health officer

At a national level, extreme weather events are increasing in frequency. For instance, several hurricane events have occurred at the same time as wildfires and heat waves, causing national partners (such as the American Red Cross and firefighters) to invest resources at the first or worst events, even as new events unfold in other parts of the country. Public health officials have noticed an increase in the need for surge capacity. If fires are burning across the West, there are limited crews, many of them working daily 12-hour shifts.

3. Addressing behavioral health effects

As communities experience an increase in hazardous events – especially those that result in high alert or home evacuation situations – the behavioral health effects can be acute and long-lasting, resulting in anxiety, chronic stress and post-traumatic stress disorder (PTSD)(24). Communities affected by long periods of smoke intrusion are also at risk of behavioral health effects due to lack of normal sunny days or summers, high anxiety about nearby wildfires, and the need to remain indoors for prolonged periods of time, foregoing normal outdoor activities and exercise. Even an increase in media attention on emergencies happening elsewhere can raise anxiety for some who are contemplating anticipated risks and their future safety.

Those who work in the emergency response field, including public health workers, first responders and firefighters, are also at increased risk of behavioral health effects. These result from multiple exposures to disasters, high levels of work demand, and separation from home and loved ones during major events. Workers can experience sleep disturbances, worry, anxiety and even PTSD(25).

4. Risk communication regarding the use of masks

When community members experience anxiety about wildfire and smoke, or are experiencing physical symptoms, they want to do something to protect themselves and their families. Face masks often are among the first things people turn to in their attempts to limit the amount of smoke particles they are inhaling. Communication about the use of masks has become a major challenge for public health officials.

Paper "dust" masks commonly found at hardware stores are designed to trap large particles, such as sawdust, and will not protect lungs from smoke. Specially designed air filters worn on the face, called respirators, also are commonly available. If a person chooses to use a respirator, a NIOSH certified P100 or N95 respirator is recommended. However, respirators have limitations and may lead to a false sense of security if not properly worn. They are not available in children's sizes and facial hair can cause the mask to not seal correctly. Respirators may make breathing more difficult, particularly for those with heart and lung conditions. They also do not offer protection from gases often found in wildfire smoke.

5. Clean air at home is generally better than traveling to a clean air space

One thing that public health officials can do is promote community readiness for establishing temporary "clean air spaces." Recent experiences with this intervention have been met with appreciation. However, for those who are able to do so, in general it is much better to stay indoors where they already live, work and visit, rather than to rely on temporary public clean air spaces.

The ideal situation is for community members to maintain cleaner air in their homes. This can be done through adequate air filtration systems and behaviors that maintain proper indoor air quality (such as keeping the home sealed). In some cases, home air filters have been covered by Medicaid or Medicare dollars through coordinated care organizations (CCOs) for people with pre-existing health conditions. However, this has been done on a patient-by-patient basis and is not widely prescribed by health care providers. Some public health officials voiced an interest in understanding ways to increase the number of home air filters and other "health-related services" available to residents that would allow them to stay safe at home. Some of the officials interviewed were unclear about whether that is a public health authority's role.

Temporary public clean air spaces equipped with portable air filters may lack resources such as an adequate amount of water, restrooms, and electrical outlets. They may also be crowded, which can increase the spread of infectious disease. All of these factors could be bad for the health of susceptible and vulnerable populations.

As with cooling centers during extreme heat events, the general sentiment among those interviewed is that clean air spaces are not fully utilized and can seem like a superficial response. This is because the spaces may not always be accessible, culturally appropriate or realistic for people to use for prolonged periods of time. They require people to travel to and from the space at a time when you may not want many people on the roads (due to poor visibility or other related issues). One public health official said that warming shelters during cold winter weather may be easier to implement because they only require buildings with adequate heat, whereas clean air spaces require both air conditioning and air filters, which are not as common in Oregon. Some mobile air filters have been purchased and are now available to set up in temporary community spaces, although resources are limited and the general sentiment is that it is far better to retrofit public facilities so that they provide clean air all the time, not just during air quality events.

6. Risk communication fatigue and recommending realistic actions

For some communities in Oregon, wildfire smoke throughout the summer is becoming a fact of life. In these cases, communities can start to hear the same messages repeatedly and may begin to tune out communications about the risks. Public health officials find it a challenge to keep community members engaged, especially if they do not feel that there are realistic actions they can take. For instance, it is not always realistic for people to leave town and some people's jobs require them to be out in the smoke throughout the day.

Risk communication is recognized as one of the most important services that public health authorities can provide, but with smoke there are few prevention measures and protections that can be recommended.

7. Smoke blowing in from out of state

At the population level, there are few interventions for smoke, which can blow in from fires occurring hundreds of miles away. Fires throughout the Pacific Northwest (including British Columbia) and beyond have affected air quality in Oregon. For most hazards, we have evidence-based interventions, but there are few actions to take when it comes to smoke from distant fires.

Another concern about smoke blowing in from far away is that the particulate matter is considerably smaller. In general, smaller particles pose the biggest public health risks because they can more easily permeate barriers and reach our lungs; however, the particulate may be in lower concentrations.

"Seems like we have a 'new normal' that has established over the last five years. The end of July just always seems like 'deja vu'. Fires in Northern California blow up and have a big impact on our community. We feel stuck."

– County health promotion program manager

8. Accessing health care data for planning and response

Although accessing medical data to assist in evacuations of susceptible populations was seen as a success story, it also introduced some challenges. These data are confidential and protected and were made available only due to the state of emergency. There are questions about when an emergency reaches the threshold of needing to access the data, and once these data are accessed there are questions about liability, confidentiality and expectations about how the data will be used.

Preparedness planners have a general idea of the number of people dependent on medical equipment in their respective jurisdictions, but they do not know exactly where people are located. The use of these data has raised questions about whether it could be accessed pro-actively, so that public health preparedness planners have advance time to plan, but there is a sense that these data will not necessarily be current and accurate. A better solution might be to invest in relationships with local agencies (such as home health and hospice providers, care facilities, Aging and People With Disabilities, and CCOs), and develop a system in which LPHAs have quick access to data on people with access and functional needs. These data could be shared via secure email or the partner organization could have a representative at the Emergency Operations Center meetings triage level of care needed, and inform response actions. This would allow public health authorities to access the most recent data and provide partners with a concrete way to engage, thereby expanding the collective capacity to respond.

Opportunities for Future Adaptation

1. Continue to improve collaboration across levels of government

As wildfire events continue to increase, collaboration will be key. Mechanisms that provide regular sharing of information among local, tribal, state and federal partners will continue to be important. Leaders can emphasize the value of two-way information sharing (both top-down and bottom-up) and preserve designated time for local updates. Local partners can learn from each other, especially from those who have had to navigate sustained fires annually.

Real-time updates can be helpful for understanding statewide contexts. Knowing the number of current fires and where they are, and receiving updates from each region, all are helpful. As soon as something in the state happens, local partners would like to know. Partners don't need a full scientific analysis of the fire, but they would like to know its trajectory, and receive updates on the response and a list of engaged stakeholders. Understanding where clean air spaces are already established and what messages have already been delivered to the public is important

even if the actions are in another region. One way to increase this kind of information sharing would be an online platform where resources could be updated internally before public release.

Local public health officials would like to continue building relationships with state partners in the Public Health Division and other agencies. Several of those interviewed expressed a need for strengthening partnerships and better integrating systems among state agencies. It was acknowledged that each agency has its own culture and that working within emergency preparedness and response requires a high level of interpersonal skill. In some cases people are stretched thin, burnt out or operating in ways that can limit collective problem solving. In general, collaborative leadership and trauma informed approaches[iv] seem to be important. components for equipping Oregon's wildfire response system, which ultimately is made up of people and could be an area for future training and workforce development.

Trauma informed approach

CDC's Office of Public Health Preparedness and Response highlights six principles that guide a trauma informed approach:

1. SAFETY
2. TRUSTWORTHINESS & TRANSPARENCY
3. PEER SUPPORT
4. COLLABORATION & MUTUALITY
5. EMPOWERMENT VOICE & CHOICE
6. CULTURAL, HISTORICAL, & GENDER ISSUES

Additional priority areas of collaboration discussed included: 1) Expedited sharing of "after action reports" between agencies, possibly even before they are officially released so that partners can access lessons learned, 2) Inter-state collaboration and 3) The need to increase capabilities for potential mass population movement.

2. Standardize a tiered messaging strategy

Standardized messages across the state can help to reach a broader audience and avoid conflicting information. These standard messages need to be relatable and supported by science. It was expressed that there can "never be enough risk communication" tools and that ideally, these tools are used not just by public health emergency preparedness coordinators, but also public health administrators, other practitioners, and trusted messengers in the community such as doctors, pharmacists and school principals. Infographic-style tools are generally well received. As we continue to adapt, proactively connecting local messengers to these tools and standard messages will be important.

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iv   https://www.cdc.gov/cpr/infographics/6_principles_trauma_info.htm

Public health professionals said it's important to have a tiered approach to choosing messages, based on an event's status. For example, the messages that are used in the first few days of a smoke event are different than those that will likely be most effective in the second or third week of a sustained smoke event. As a community faces more poor air quality days, the need grows for risk reduction communication and presenting options. For example, outdoor workers might not be able to stay indoors and would need recommendations on how to reducing exposure to smoke while working.

Standardized messages and protocols for communicating about prescribed burns also were brought up. Local public health authorities said they would like to be involved in the implementation of prescribed burns to support the health and well-being of their community members. Since the time of the key informant interviews, OHA engaged with the DEQ and the Oregon Department of Forestry (ODF) on an update of the state's Smoke Management Program that involves engagement with LPHAs when prescribed burns are anticipated to exceed certain smoke thresholds(26).

> ## Prescribed Burns
>
> These are planned fires, also called "controlled burns," used by fire experts under specified weather conditions to decrease wildfire danger by reducing hazardous fuel loads and managing the landscape.

Many community members are ready to take individual protective actions but need clear guidance on what they can do. Communications research proves that people often need repeated messages from multiple sources before they act. Public health partners can help to amplify and increase the repetition of important prevention messages. Examples include echoing the importance of clearing fuel and debris around a home (cleaning gutters, addressing wood piles) and encouraging the use of "visibility guides[v]." And messages that encourage increased self-reliance by having back-up food and water supplies, for instance, can increase resilience across multiple hazards.

These types of preparedness actions help people remain safe in their houses, but what about those who are unhoused? Populations experiencing homelessness and migrant workers in temporary housing are two populations that are extremely vulnerable due to a lack of resources and opportunities to take protective actions. This is one area where public health officials must continue to raise health equity concerns.

Public Health partners can also continue to engage with OSHA and other organizations that represent vulnerable workforces, such as the Oregon Growers Association, to highlight risks and possible protections for outdoor workers and other special populations. OSHA will need to develop additional guidance for employers to ensure workplace safety for outdoor workers and first responders, for example.

These target populations may be supplied with N95 masks and fit-tested for them, but this is not realistic for most members of the general public as fit-testing is expensive in terms of both the equipment and time needed to perform the testing.

[iv] https://www.cdc.gov/cpr/infographics/6_principles_trauma_info.htm

Translating messages and tools into Spanish and other languages is important as is collecting feedback from diverse audiences such as regional health equity coalitions (RHECs) and tribal partners. Communication experts, who may even sit outside of preparedness, could also help finalize messages and tools. One resource to possibly engage is the Coalition of Local Health Officials (CLHO) communication workgroup.

3. Work with CCOs and other partners to build self-sufficiency and community capacity

CCOs are often viewed by the community as health leaders and may be asked to engage in wildfire response and communication activities. Yet few CCOs work directly with local health jurisdictions on preparedness or fully understand preparedness program protocols and priorities. One way to formalize this might be to include a relevant item in an existing contract between a CCO and LPHAs. A less formal approach would be for LPHAs to orient CCO representatives first-hand to what occurs during a wildfire or smoke event in their community.

In most cases, there is only one person at an LPHA working on emergency preparedness. Community preparedness requires the work and collaboration of many partners. CCOs are one set of partners identified in this case study for deeper engagement. CCOs can cover the cost of air filters and other protective equipment that can be life-saving for susceptible and vulnerable populations in their service area by indicating these investments as "health-related services." Public health can provide the evidence and guidance CCOs need to dedicate these health related investments in a systematic way.

CCOs also have the capacity to invest in population-level interventions to improve health. One possible area of exploration could be partnering with schools to improve the safety of school buildings. Most schools in Oregon do not have air conditioning and very few have sufficient air filtration. Often, schools mitigate heat by opening windows and doors, but this is not possible during poor air quality days. Air conditioning, therefore, is doubly important because extreme heat and wildfire events can overlap, as they did in 2017 when schools had to be closed in the Portland Metro area. The Public Health Division can continue to develop a strong partnership with the Department of Education to explore opportunities. One success story shared in an interview highlighted the school renovation project at Portland's Harriet Tubman school, which included installing a computer-controlled central HVAC system. Other sources of potential funding could include the proposed statewide Climate Investment Fund[vi] or possibly funds related to natural hazard mitigation planning[vii].

Other public facilities such as community centers, libraries, and senior centers are natural gathering places that could be retrofitted to serve as "clean air spaces." Public health authorities could develop guidance for partners interested in retrofitting their facilities. Communities that experience chronic smoke events each summer may need more indoor places to exercise. Providing community members with passes to local gyms or other indoor recreational facilities could help people to stay active, connected and healthy during long smoke periods.

[vi] 2019 HB2020: Proposed Oregon Climate Action Program

[vii] https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

As more programs work to promote home weatherization improvements, especially among lower income households, public health partners can work to ensure that these investments are considering additional factors that can make a home more resilient to poor air quality and other extreme weather conditions.

4. Engage in more table-top exercises and scenario planning

With the increased number of wildfire events over the past five years (in Oregon and neighboring states), public health partners recognize that it is time to plan for larger catastrophic events that could occur in more-populated areas. This includes introducing more table-top exercises and scenario planning. Below are a few suggested scenarios to consider:

PROPOSED SCENARIO: Work through a sustained smoke event (longer than a month). Walk through it week by week with partners at the table. Focus on how communications and actions might change from week to week (state and local).

PROPOSED SCENARIO: Engage with community partners (schools, CCOs, workplaces) and walk people through a smoke event and explain why the public health system does what we do and ask them what they need from us to be successful. Learn more about what we need to do for our partners. This could be done with a webinar.

PROPOSED SCENARIO: Hold a town hall kind of meeting involving the general public in a pre-season run-through. Give them a heads-up about current conditions (e.g., winter precipitation and water supply status) and remind them of preventive actions they can take before a wildfire occurs[viii].

PROPOSED SCENARIO: Conduct a Medicare-Medicaid workshop on identifying and reaching out to vulnerable populations during a wildfire event. Consider mass evacuation and mass sheltering. Who is in the community? Who do you need to reach? Who and when would emPOWER data need to be accessed? How can you work with organizations that serve seniors and people with disabilities, behavioral health providers, CCOs, and more.

PROPOSED SCENARIO: Explore actions that would be taken if a fire were to encroach on a forested urban park or municipal water system.

5. Expand actions to address mental health effects

OHA's Public Health and Health Systems divisions are leading a new project that uses Psychological Simple Triage and Rapid Treatment (PsySTART). This data-driven mental health assessment tool can be used by behavioral health responders to gain real-time situational awareness of mental health risks during disasters. Lessons learned from this pilot project could be shared widely and perhaps lead to expanded public health actions to address behavioral health effects.

[viii]   Lincoln County may have conducted something like this in the past.

In addition to psychological first aid, community health workers and other community based organizations could potentially be funded to support communities in recovering after a significant wildfire event. (This was found to be successful in British Columbia.)(27) This support would help build community resilience by facilitating dialogue and skill sharing, as well as connecting community members to existing behavioral health resources.

6. Increase surveillance and research

The syndromic surveillance system ESSENCE has been a great tool for near real-time monitoring of emergency department and urgent care visits across the state. We need more use of ESSENCE, including more set queries and a reporting template that includes an overlay of PM2.5. Local health authorities can continue to work on harmonizing their surveillance efforts with state and neighboring jurisdictions.

We also need retroactive studies, so we can better understand and communicate the effects of wildfires and smoke waves in Oregon. One LPHA was able to use ESSENCE data to show how asthma-related emergency department visits mirrored an increase in poor air quality in their region. They presented the information to county commissioners who found the data to be powerful. In general, public health is improving at using ESSENCE data to tell the public health story, but ESSENCE only captures health effects that lead to an emergency department visit. We need a better understanding of other health effects that do not rise to the level of emergency department room visits. One possible data set to explore could be inhaler prescription refills. Another is promoting the use of apps such as EPA's Smoke Sense that allow people to self-report sub-clinical symptoms.

DEQ announced the installation of 30 new monitoring sites in Oregon[ixi]. In addition to stationary monitors, there is an expressed need for more mobile air monitors that can be deployed and positioned strategically during poor air quality events for real-time monitoring and surveillance. For instance, mobile monitors could be placed where bigger outdoor events are occurring. It is recognized, however, that monitors require a lot of maintenance and have continual operating costs. Monitors can also be problematic because they are only reading the air quality at one specific site and can therefore miss the bigger picture of air quality in the region. For this reason, there's a chance that community members could over-rely on data that may not accurately reflect the air quality in their specific location. In some cases, communities might be better served by an investment in public education on PM2.5 and use of a visibility guide. Some of the public health officials interviewed said that visibility guides are user-friendly in comparison to reading Air Quality Index data and are therefore a more effective tool for many of the communities they work with.

We need better evaluation of wildfire and smoke interventions. Public health officials can help each other to start documenting wildfire related activities, interventions and outcomes at the beginning of the wildfire season — this could include recording when certain steps of an event or intervention occurred (e.g., when did the smoke come in? When did we release communications?). Recording data throughout the wildfire season can help with post-event evaluation and lead to more process improvement for the future and for integration into the

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[ixi]   https://www.oregon.gov/deq/aq/Pages/Air-Quality-Monitoring.aspx

statewide protocol. The Public Health Division could potentially offer LPHAs a template for the types of data that could be collected.

Other research needs identified by public health officials in Oregon include expanding on health outcome findings to estimate health care costs and economic impacts within a community — being able to point to health data and economic costs is very helpful when responding to decision makers and media. More research is needed when it comes to indoor air quality and the most effective interventions for maintaining safe indoor air quality during smoke events. There was also an interest in better understanding the longer-term environmental health effects to a community (such as impacts to mental health, water quality, and landslide risk).

The public health system has very little capacity to conduct research; therefore, many of these studies will require collaboration with academic partners and acquisition of supplemental research funds.

7. Engage and inform long-term planning

Within the public health system, community health assessments (CHAs) and community health improvement plans (CHIPs) are avenues for further integrating preparedness priorities. CHAs can be a place to integrate more hazard and climate-related data and CHIPs can prioritize strategies that achieve preparedness goals that overlap with other public health focus areas.

Often public health officials can help to ensure that planning efforts in other sectors incorporate health equity considerations. This includes more public health engagement in land use planning such as comprehensive plans, climate action plans, natural hazard mitigation plans, or forest management plans. Engaging in long-term planning projects can not only help integrate more public health preparedness priorities, but also serve as important cross-sector partnership development opportunities. In some cases, having public health priorities represented in plans could lead to eligibility for future funding (such as the accessing FEMA funds for strategies included in natural hazard mitigation plans).

Reviewing how Oregon's public health workforce engages with cross-sector planning and policy could help identify gaps. "Engaging" doesn't necessarily entail serving on a formal advisory group. It could include proactively offering technical assistance and consultation to partners. There is a need to deepen and broaden planning and policy engagement among the workforce to ensure public health's involvement across sectors. Equipping public health preparedness planners with forthcoming Regional Climate and Health Equity Profile Briefs[x] could help to serve as a tool for proactive engagement with other planners. Assigning staff or creating new positions as designated "health integrators" similar to the Oregon Housing and Community Services "housing integrator" positions, could help the public health system more effectively engage with cross-sector partners and build internal expertise and capacity to integrate health and health equity into plans led by other agencies.

Other policy areas brought up in the interviews include indoor air filtration regulations, which could be further explored to protect public health, and informing broader climate change policy and planning as a long-term strategy.

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[x]   OHA's Climate and Health Program intends to share draft briefs in a series of regional climate and health workshops by early 2021.

Conclusion: Potential policy priorities

Many of the opportunities identified above require additional capacity, funding or changes in systems and policies. In summary, potential areas for future adaptation include:

Adaptation Opportunity Areas	Example Actions
Invest in preparedness and response workforce	• Increase protections for vulnerable workers • Joint training with emergency management partners on best practices in trauma-informed care • Strategies for addressing staff burn-out
Continue to improve collaboration across levels of government	• More table-top exercises and scenario planning • Explore mechanisms for increasing involvement of public health in planning and response
Increase proactive communication of data to decision makers	• Provide community partners and local media with pre-season briefings • Work with partners to provide guidance on retrofitting facilities to serve as clean air spaces
Standardize a tiered messaging strategy that addresses different phases of a smoke or wildfire event, for diverse communities	• Develop different communication tools for different phases of an event • Have RHECs review • Evaluate effectiveness of messages and methods
Partner with CCOs to promote self-sufficiency among members and build community capacity to stay safe during smoke events	• Formalize agreements between CCOs and LPHAs • Provide CCOs with the guidance and evidence they need to promote home improvements such as HVAC systems as "health-related services"
Take systematic approaches to assessing, identifying, and creating clean air spaces	• Prioritization on promoting safe school facilities • Best practices for infectious disease control in emergency safe spaces.
Connect new funding opportunities	• Climate-related; energy efficiency-related • CCO investments that can protect indoor air quality at the household level — HVAC improvements, air conditioners
Increase surveillance and research	• More coordinated use of ESSENCE • Provide LPHAs with a template for evaluating wildfire response • Work with academic partners on estimating health costs of specific events
Engage and inform long-term planning in health and other sectors	• Build staff capacity to engage effectively in other agency-led efforts • Integrate hazard and climate-related data and strategies into CHAs and CHIPs

These opportunities are not in any particular order. Some are shorter-term actions and some will require years to advance. A next step will be to prioritize opportunities and to consider which policy areas are most important to focus on in the coming years.

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