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LEARNING TO LIVE WITH SMOKE

**CHARACTERIZING WILDFIRE
AND PRESCRIBED FIRE SMOKE
RISK COMMUNICATION IN THE
OKANOGAN RIVER AIRSHED
EMPHASIS AREA AND
WESTERN COLVILLE
RESERVATION**

This report was produced as a collaboration of the Confederated Tribes of the Colville Reservation, the Okanogan River Airshed Partnership, and the University of Washington.



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Executive Summary

This report was prepared for leaders and practitioners working in tribal, local, state, or federal government and community-based organizations, as well as others interested in community-centered environmental hazard risk communication, to share our findings from the project "Characterizing Risk Communication in the Okanogan River Airshed Emphasis Area (ORAEA)". This project was jointly funded by the University of Washington Population Health Initiative and Earthlab and is the result of a partnership between the Confederated Tribes of the Colville Reservation (CTCR), the Okanogan River Airshed Partnership (ORAP), and the University of Washington.

The overall goal of this project was to learn from the experience and expertise of tribal and non-tribal communities of the ORAEA about how they approach wildfire smoke risk communication to share with other communities in the region who are similarly impacted by smoke. The specific aims of this project were to 1) describe and evaluate how the health risks of smoke are perceived and how information about smoke exposure is being communicated within the tribal and rural communities of the ORAEA; 2) identify trusted sources and networks for information sharing that are perceived by community members and leaders to influence behavioral modifications that reduce smoke exposure; and 3) discuss gaps in meeting local risk communication, and needs, and identify pathways for continued collaboration and community-academic partnerships to address these gaps.

We accomplished these aims through thematic analysis of qualitative data from seventeen key informant interviews and six focus group discussions with tribal and non-tribal community service agency staff, community leaders, and community members. Interviews were conducted over Zoom and focus groups were held in person in Nespelem and Omak.

Throughout these interviews and focus groups, participants spoke to the specific strengths within their communities and challenges their communities face in regards to wildfire smoke risk communication, centered around five themes specific to communities in the ORAEA: 1) perception of the health risks of smoke, 2) current ways of sharing information about smoke, 3) trusted sources of information, 4) gaps and opportunities, and 5) perceptions of prescribed fire. These themes were translated into six recommendations for practitioners and decision-makers around strengthening wildfire smoke risk communication and smoke readiness for other smoke-impacted rural and tribal communities in the Pacific Northwest region.

Background

Wildfires & Forest Management

Wildfires represent a growing public threat. As fire seasons are increasing in frequency and intensity across the western United States and the world, we must work to prepare affected communities. In 2021, over 7.1 million acres burned across the United States, and hundreds of thousands of people were exposed to dangerous levels of wildfire smoke (1). Extreme smoke events made national news in 2020 when wind blew smoke plumes into large cities such as San Francisco and Seattle which, for the most part, are usually spared from the effects of wildland fire (2). These extreme events have not only put a spotlight on megafires, defined as a fire larger than 10,000 hectares, but also on the local and far-reaching health impacts of smoke (3).

Historical trends demonstrate that current wildfire severity is due to a variety of factors including a warming climate and an accumulation of dead fuels caused by over a century of fire exclusion policies (4). Wildfires have always been a part of the landscape of much of the western United States (5). Acknowledging the essential role of fire in fire-adapted landscapes, tribes of the Western United States practiced burning as part of a holistic land management and cultural practice (5). European colonization, however, caused dramatic changes in population demographics and land management patterns (6,7,8). Firefighting efforts were centered around fire suppression and exclusion as, until recently, wildfires were regarded as only destructive rather than an essential component of ecosystems (9). These policies, along with intensive logging, grazing, and exclusion of burning by Indigenous peoples, have significantly altered many forests across the western United States (10,11). Future projections indicate that both the extent and severity of wildfire in western forests will continue to increase, which will subsequently increase smoke production (12).

To lessen the negative impacts of high severity wildfires on both human and forest health, fuel management strategies such as prescribed burning are being used more frequently in recent years in the west (13). Prescribed burning is highly regulated to limit smoke emissions; however, for rural communities and those at the wildland urban interface, managing fire with fire increases the frequency of smoke outside of fire season, regardless of regulations (14).

With the increasing frequency and intensity of wildfires and concurrent efforts to scale up the implementation of prescribed burning, there is a growing urgency to mitigate the potential impacts of an inevitable influx of smoke. Wildfire smoke exposure is associated with a range of health impacts in both children and adults, including but not limited to, exacerbation of existing respiratory diseases such as asthma and chronic obstructive pulmonary disease, worse birth outcomes, and cardiovascular events (2, 15, 16). To prepare communities for longer smoke seasons and improve the social license to burn, public acceptance of prescribed burning practices, we must work to improve communication and education around both the benefits of prescribed burning, and the negative health impacts of smoke exposure from all sources (17).

Risk Communication Around Smoke

There is no “one size fits all” approach to risk communication; however, effective risk communication can support individuals in engaging in protective behavior change by providing

tools and information to do so (18,19). There are few evaluations of wildfire risk communication, and those that exist are primarily focused on emergency messaging around fire, rather than long-term preparation and response for smoke (20). Research on environmental health risk and hazards in rural and tribal communities has shown that communication delivered through a trusted channel or source improves uptake of information and willingness to take action. This supports the idea that effective communication is determined not just by what is being communicated but by whom (21).

Federal and state government organizations, scientists, and mainstream media are all conventional sources for smoke and fire risk communication. However, evidence suggests that some of these sources may not be perceived as the most trustworthy or credible, thus undermining the salience of information contained in its messaging (22,23). This is especially true for rural and tribal communities, who, due to a number of reasons, including systemic discrimination and historic marginalization, may be hesitant to extend trust to certain federal and state government organizations. Significant gaps exist in identifying alternative trusted sources of information and channels for disseminating information, especially around smoke. Thus, more research is needed as to who could act as trusted sources of information, and whether information received through trusted community channels has a greater influence on the perceived risk of the health impacts of smoke, the benefit of individual behavior change, or self-efficacy than current standard sources of smoke risk information.

Project Setting

The public health crisis of increased smoke exposure is pervasive across the western United States. This report covers findings from one such affected region, the Okanogan River Airshed Emphasis Area (ORAEA), which includes tribal and non-tribal land within and around the towns of Omak and Okanogan, as well as the western Colville Reservation. The region has been impacted by multiple very large wildfires in the last decade. The region is home to roughly 19,500 people, most of whom are clustered in or around the towns of Omak and Okanogan. 56% of people living in the ORAEA identify as White, 25% as American Indian or Alaska Native, 14% as Latino, 4% as two or more races, and less than 1% Asian or Black (24). This area includes the western region of the Colville Reservation, where most people are enrolled members of the Confederated Tribes of the Colville Reservation, descending from one or more of the 12 bands whose traditional territory extends past the ORAEA and are shown in Figure 1.

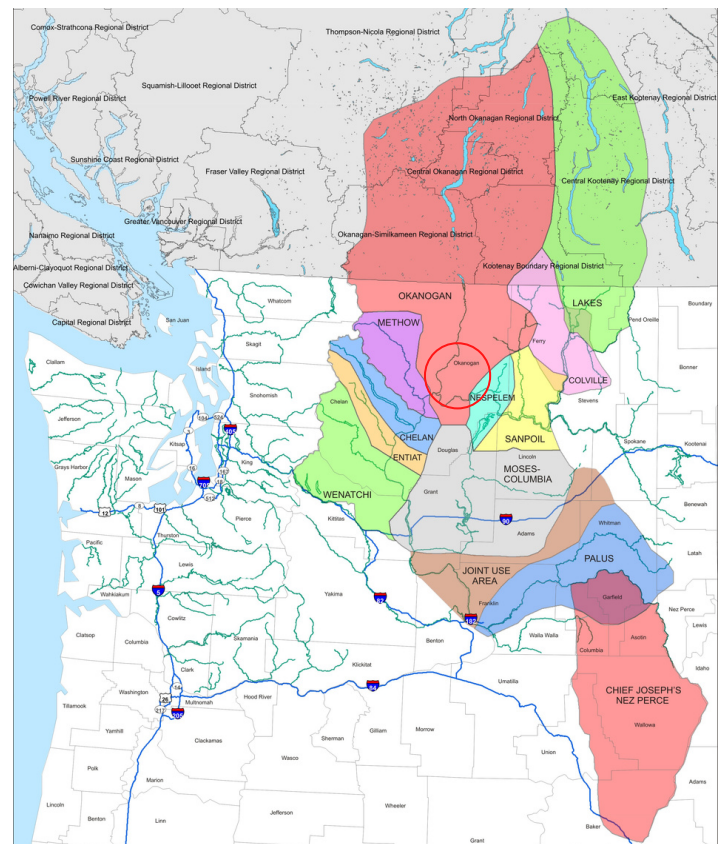


Figure 1: ORAEA (circled) and the precolonial territory of the CTCR. Used with permission from the Confederated Tribes of the Colville Reservation, History & Archeology Department (25).

Communities in the ORAEA experience smoke year-round. In recent years, the region has been inundated with smoke from wildfires from June through September. During the winter months, smoke from wood burning stoves, which are commonly used to heat homes, settles throughout the valley. Additionally, under the 20-year Forest Health Strategic Plan for the Washington State Department of Natural Resources (WA DNR), ORAEA is a high-priority region for increased prescribed burning in the Fall and Spring (26). The 10-year Fire Protection Plan by WA DNR predicts the area burned by wildfire in this region to quadruple over the next 40 years (27). In September of 2020, the Cold Springs fire, sparking near Omak, WA, and the nearby Pearl Hill fire burned more than 400,000 cumulative acres, blanketing the region with smoke and reaching air quality index levels of more than 400 in Omak. The western edge of the Colville Reservation begins across the river from downtown Omak and encompasses 1.4 million acres of land. Over the past six years, 700,000 of these acres have burned in wildfires – 140,000 acres in 2021 alone. Due to the geography of the area, the ORAEA is impacted not only by smoke from local fires, but also by fires across the region and as far as British Columbia and California, and frequently experiences poor air quality for several weeks at a time.

Although communities in this region are routinely exposed to smoke from frequent wildfires and prescribed burning, limited air quality monitoring and resources restrict the availability of accurate, locally relevant air quality information. Lack of air quality data in rural communities is a barrier to effective communication when it comes to smoke. Even if a government-regulated monitor is present in a county or similar regional area, these monitors do not have the spatiotemporal resolution to provide neighborhood level, or incidental data (28, 29). This leads to information that is inaccurate or not specific enough to allow community members to make informed decisions with regard to their own or their family's health. This region, approximately 1200 square miles (28), has a single government-run air quality monitor in the town of Omak, and only three community-run monitors that provide publicly available data.

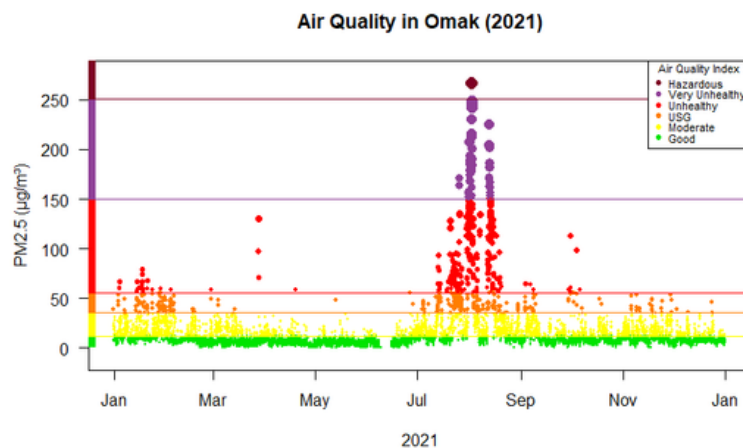


Figure 2: PM2.5 Concentrations in Omak, January-December 2021

Aims and Scope

Between May 2021 and April 2022, we formed a team of University of Washington researchers and community-based partners from the CTCR and the Okanogan River Airshed Partnership (ORAP) to characterize risk perception of the health impacts of wildfire and prescribed fire

smoke and risk communication channels within tribal and non-tribal communities in the ORAEA. This report describes project aims and methodology, reviews themes in the data and finishes with a list of recommendations for other rural and tribal communities impacted by wildfire smoke in the Pacific Northwest region.

The ORAEA has been hit consistently and hard by smoke from wildfires over the past 10+ years. These exposures have taught community members and leaders meaningful lessons when it comes to preparedness. With this project, we aimed to identify and understand lessons learned in order to be able to share resources, tools and guidance with other smoke-impacted communities. We also set out to characterize community perceptions of prescribed fire as a potential tool for mitigating the impacts of wildfire smoke on communities in the ORAEA. We accomplished this by working alongside community partners to address the following aims:

Aim One: describe and evaluate a) how the health risks of smoke are perceived and b) how information about smoke exposure is being communicated within the tribal and rural communities of the ORAEA.

Aim Two: identify trusted sources and networks for information sharing that are perceived by community members and leaders to influence behavioral modifications that reduce smoke exposure.

Aim Three: discuss gaps in meeting local risk communication, needs and identifying pathways for continued collaboration and community-academic partnerships to address these gaps.

Positionality and Acknowledgement of Bias

With any research, it is important to examine where we are coming from when we start a project. As the two lead authors of this report, we are both cis-gender women in our late 20s and early 30s who do not identify as Indigenous American or members of any tribal nation. While we both have spent significant portions of our lives in rural communities, we currently both reside in Seattle, Washington.

We are both affiliated with the University of Washington, as a postdoctoral fellow and graduate student, and have researched the health impacts of wildfire and prescribed fire smoke for several years through a number of projects. We view health through a social determinants of health lens, believing that our environments and experiences shape our health, which are in turn shaped by our socially-constructed identities.

We believe that these identities also influence, in part, how we perceive others and how others perceive us. Throughout the project, we attempted to identify and account for biases through reflexive practice and open communication with our project team. We acknowledge that we are limited in our understanding of some of the lived experiences shared through this project.

Methods

Recruitment

To begin recruitment for interviews, our full project team worked together to identify a list of stakeholder categories and determine a target number of participants within each category. CTCR and ORAP co-investigators then identified potential contacts for interviews and facilitated introductions between potential interviewees and the UW project team, who followed up to coordinate and facilitate interviews. The distribution of interviews is shown below in Table 1.

Stakeholder Sector	Target # of Interviews	Actual # of Interviews (Tribal)	Actual # of Interviews (Non-Tribal)	Total
People with significant work and/or volunteer experience in local/tribal government leadership	2-3	1	2	3
People with significant work and/or volunteer experience working with elders	2-3	1	2	3
People with significant work and/or volunteer experience at schools and/or youth organizations	2-3	1	1	2
People with significant work and/or volunteer experience working in public health or healthcare	1-2	1	2	3
People with significant work and/or volunteer experience communicating about air quality	1-2	1	2	3
People with significant work and/or volunteer experience in emergency management	1-2	1	1	2
People with significant work and/or volunteer experience working in agriculture and/or forestry	1-2	0	1	1
TOTAL	~16	6	11	17

Table 1: Target and Actual Interviews, by Stakeholder Sector

We used purposeful sampling and convenience sampling to recruit focus group participants. The first two focus groups were with CTCR employees at the tribal government center in Nespelem and were roughly divided by age – with one group emphasizing younger people under the age of 25 and one group composed of people of mixed ages and generations. A CTCR project co-investigator supported the recruitment and facilitation of these focus groups. A second set of focus groups were held in Omak and were similarly divided by age, with a younger group and a mixed ages group. We recruited for these focus groups by posting flyers around the towns of Omak and Okanogan and posting on several local Facebook groups. A third set of focus groups was held over lunch with tribal elders at a senior meal site in Nespelem. The number of participants in each focus group is shown below in Table 2.

Focus Group #	Age Group	Location	Tribal or Non-Tribal?	# of Participants
1	Mixed Ages	Nespelem	Tribal	7
2	Youth	Nespelem	Tribal	14
3	Youth	Omak	Non-Tribal	3
4	Mixed Ages	Omak	Non-Tribal	3
5	Elders	Nespelem	Tribal	3
6	Elders	Nespelem	Tribal	3
			TOTAL	33

Table 2: Focus Group Participants

Data Collection: Interviews and Focus Groups

Data collection began with a series of key informant interviews between June and November 2021. We conducted seventeen total interviews with tribal and non-tribal community leaders, as well as public agency staff. To bring in additional tribal and non-tribal community member perspectives, we held six, in-person focus group discussions in Nespelem and Omak. Each interview and focus group participant was offered a \$50 gift card as compensation for their participation. UW IRB and CTCR Tribal Council approval were acquired before participants were contacted and all participants provided verbal and/or written consent prior to participation.

Each interview lasted roughly one hour and was facilitated remotely over Zoom or phone by a member of the UW project team. Interviews were audio recorded in Zoom or Google Voice and

transcribed by professional transcription service TranscribeMe and checked by a member of the UW project team. Focus group discussions lasted approximately ninety minutes and were facilitated in-person by a member of the UW project team, and in a few cases, also by a co-investigator for the project who worked for CTCR. Focus groups were audio recorded in Audacity and transcribed verbatim by a member of the UW project team into a written document. For both interview and focus group data, we removed all personally identifying information prior to analysis. Additionally, a member of the UW project team took notes at each interview and focus group discussion for later reference.

Analysis

A codebook for analysis was developed using a combination of deductive and inductive approaches, basing codes on themes identified in notes and transcripts and on the Health Belief Model, which explains the reasons why people do not adopt disease preventative strategies, and the Theory of Planned Behavior, which helps predict an individual's intention to engage in health behaviors (30, 31). These behavioral models have been applied to disasters and emergency preparedness to help mitigate the impacts of disaster (32). Four transcripts were co-coded by two members of the UW project team and the codebook was subsequently revised to minimize discordance between coders. The remaining transcripts were coded by a single UW project team member using NVivo qualitative analysis software and analyzed for recurring themes, which are included in this report.

To check for accuracy and cultural relevance in the interpretation of themes, we integrated opportunities for feedback at multiple points in the analysis process. As co-investigators, CTCR staff and ORAP leadership provided guidance and feedback throughout data collection and analysis. Additionally, after each interview, we sent a summarized version of notes from each interview to each interviewee for clarifying their review and feedback regarding the accuracy of our interpretations. Of seventeen interviews, five sent additional clarifying feedback and several others responded affirmatively with no further comment. We also presented our preliminary findings at the bi-annual ORAP community meeting in December 2021. This meeting was attended by multiple interviewees and provided us with feedback which was then integrated into the final analysis.

Limitations

This project attempted to provide a sample of perspectives from community members, community leaders, and public agency staff from around the ORAEA and is not necessarily representative of other rural and tribal communities and regions in the Pacific Northwest. Because our project used purposive and snowball sampling for data collection, there is likely some sampling bias that must be acknowledged in this report.

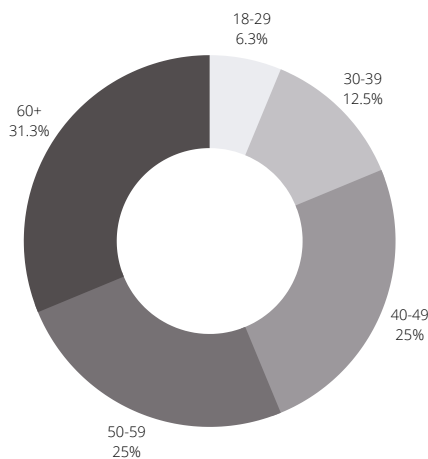
Additionally, there is a significant agricultural worker population in the ORAEA that was underrepresented in our data; possible reasons for this include the exclusive use of English in recruitment and data collection and a lack of targeted outreach to agricultural workers. There is current work, however, happening through the UW Pacific Northwest Agricultural Safety and Health (PNASH) Center to investigate the specific burden of wildfire and prescribed fire smoke on outdoor agricultural workers and to identify appropriate channels for risk communication that can fill this gap.

Participant Demographics

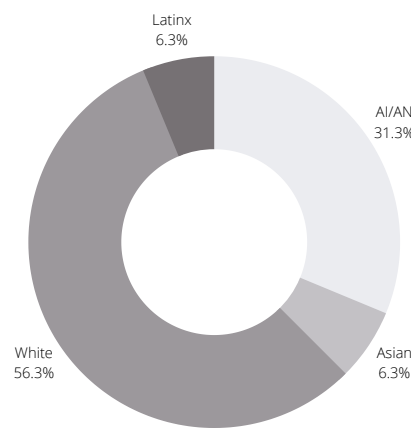
Interviews

Over the course of the project, we held a total of seventeen interviews. Of the interviews, two participants did not respond to requests for demographic information and one interview had two participants; demographic information is reflective of the sixteen participants for which we have available data and is summarized in the figures below.

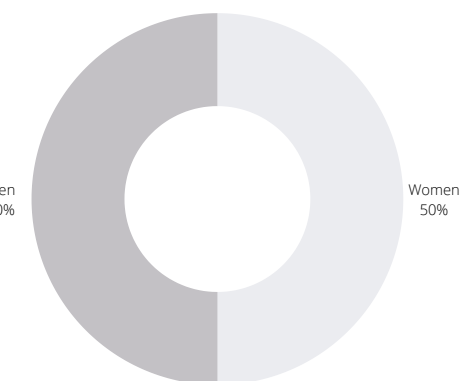
Age



Race



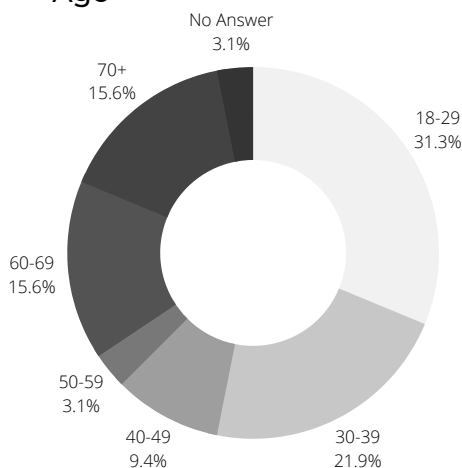
Gender



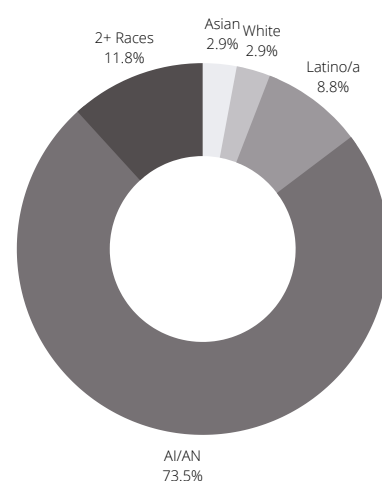
Focus Groups

Over the course of six focus groups, we recruited a total of thirty-three participants. Demographic information for these participants is summarized below.

Age



Race



Gender



Results

Over the course of this project, we asked participants to describe how they perceive the health risks of wildfire and prescribed fire smoke and how information about those health risks is shared throughout the community. Results of these conversations are synthesized into the themes in Table 3 and discussed throughout this section.

THEME	SUB-THEME
Perception of the Health Impacts of Smoke	Participants shared concern and uncertainty about the various health and lifestyle impacts of smoke.
	Compared to fire, however, smoke is generally considered to be less urgent of a concern.
Current Ways of Sharing Smoke Information	Most residents of the ORAEA are getting their information primarily from local sources.
	Facebook is by far the most commonly used channel for information.
Trusted Sources of Information	Local and tribal agencies are generally more trusted than state or federal government.
	Political ideology influences which channels people trust (non-tribal).
Gaps and Opportunities	Staying indoors is the most common strategy for protecting against smoke; however, effectiveness is limited by access to clean indoor air.
	There is a need to shift towards preparation and smoke-readiness in advance of smoke season.
Perception of Prescribed Fire	Poor forest management and fire exclusion are perceived as exacerbating wildfires.
	Prescribed fire is viewed as relatively safe and beneficial.
	While prescribed fire is appreciated for its role in mitigating wildfire risk, smoke impacts to communities need to be acknowledged.

Table 3: Summary of Themes and Sub-Themes

Perception of Health Impacts of Smoke

Participants' perceptions of the health impacts of smoke and the risk of these health impacts were varied and complex. Participants shared concerns about the immediate physical symptoms they had experienced during smoke, as well as uncertainty around long-term effects, impacts to mental health, and impacts to their communities and lifestyles. At the same time, however, the competing urgency of damage and destruction from wildfires complicated that perception. These sub-themes are explored throughout the following section.

Participants shared concern and uncertainty about the various health and lifestyle impacts of smoke.

"Well what most concerns me is the health impact on my wife and children and myself. Because like this last summer with our house sitting in 120-degree heat and I'm at a depression in the valley that happens to have all the smoke from the Cub Creek fire pouring into it." Healthcare Interviewee, Non-Tribal

Both tribal and non-tribal participants expressed significant concern about the health impacts of wildfire smoke. Many participants shared stories of their own experiences during smoke events, including difficulty breathing; irritation of the eyes, nose, throat, and lungs; exacerbated respiratory illness; or delayed recovery from other illnesses from breathing smoke. While many told personal anecdotes, most participants expressed the greatest concern about other people in their communities that they viewed as especially vulnerable to the impacts of smoke: elders and older adults, children, people who are unhoused, outdoor workers, and people with asthma, COPD, or other respiratory conditions that puts them at higher sensitivity to smoke.

"I know for some of our elders that have breathing issues, we actually have to move some of them out of the valley just so they can actually get the clean air to survive." Emergency Management Interviewee, Tribal

Many participants noted uncertainty and concern about the long-term impacts of smoke exposure and what the future health implications of prolonged, repeated exposure to high levels of smoke might be. Participants also expressed concern about firefighters, as many participants had fought fires themselves, or have family members who fight fires. Additionally, participants reported uncertainty around the toxicity of smoke from burning structures or other artificial materials, often judging toxicity based on the color of the smoke released.

"I don't know if we've actually seen all the effects of what it could be doing to us health-wise." Leadership Interviewee, Tribal

In addition to the physical health impacts of smoke, many participants expressed concern about the mental health impacts of living through prolonged smoke events. Several participants noted that because of the scale of wildfires in the region, most people in the

ORAEA have either had to evacuate, been placed on evacuation notice, or have close friends or family members who have had to evacuate their homes in the past few years. Participants noted that the smell of smoke can incite fear, anxiety, and other feelings associated with those experiences.

"PTSD is often the label that gets slapped on it. I don't know that anyone's really carefully looked at that. But it feels very fitting that because of that ongoing repeated trauma of having to deal with wildfires and wildfire smoke-- they're difficult to tease apart." Air Quality Interviewee, Non-Tribal

Participants also shared how smoke had impacted the lifestyles of people in the ORAEA, including limitations on their ability to exercise, recreate, and spend time outdoors, contributing to a sense of restlessness, feeling 'cooped up,' and other mental health impacts. Participants were especially concerned about the impacts of staying inside on children and what future summers may look like for young people. Tribal participants expressed concern about impacts on cultural activities, like the ability to spend time outside and gather huckleberries and other first foods and medicines, as well as the impacts of fires on the ecosystems on which these practices depend. Many participants noted the community-level impacts, such as closing businesses and tribal services during periods of heavy smoke, and the canceling of community events such as sports competitions.

"It interrupts your ability -- I have small children so they want to be outside. We lose the ability to go out and do things with them. You just get cooped up. You get forced to expose yourself to the elements." Mixed Ages Focus Group Participant, Tribal

Exacerbating the health impacts of smoke is the co-occurrence of multiple disasters, such as extreme heat and the COVID-19 pandemic. Participants described the difficulties of staying inside, closing windows, and wearing masks to protect themselves from smoke during the summer of 2021's heat wave. Similarly, COVID-19 and its associated economic impacts have strained community resources, such as shelter needs, hospital beds, and other resources to meet basic community needs.

"And so we are seeing the same needs, the same shelter needs, the same basic needs from our families, most likely from the pandemic, but exacerbated due to the wildfires." Elder Care Worker Interviewee, Non-Tribal

Compared to fire, however, smoke is generally considered to be less urgent of a concern.

"I just think the biggest thing is that -- not that we don't think smoke is a bad thing -but I just feel like if it's between saving your home and staying near the smoky area, or saving your home and trying to do a fire line, most people will choose to just risk their health and try to save their property." Youth Focus Group Participant, Tribal

Almost all participants noted the growing intensity and frequency of large wildfires and smoke over the past 5-10 years, noting the 2014, 2015, and 2020 fire seasons as particularly destructive. In conversations with elders and people who had grown up in the ORAEA, several noted that while there have always been wildfires in the area, they had never experienced fires like they have over the past decade. Participants described how smoke seemed to be 'getting worse' over time, with longer, more intense smoke episodes. Although smoke is growing as a community concern, at the same time, smoke was generally viewed as less immediate and threatening of a concern than the destruction or damage caused by wildfire.

"We didn't see these kind of soaked in situations, but very rarely before, and oftentimes, not more than a day or two, right. Now we're seeing it for days on end where you just don't see the sun." Emergency Management Interviewee, Non-Tribal

Many participants described feeling a sense of lack of control around smoke - that there's not much that can be done about smoke. Participants described a need to continue with their daily lives. Many people in the ORAEA work outside, whether it be in forestry or agriculture, or must spend significant time outside to maintain their lifestyles and livelihoods, taking care of livestock or other animals, or looking after their property. Some participants noted that feeling a lack of control and wanting to maintain normalcy can act as a barrier to taking protective action to mitigate the impacts of smoke.

"And it's really difficult to focus on smoke because once the smoke is here, there's really nothing you can-- I mean, I hate to say it, but there's nothing you can do but live with it." Youth Worker Interviewee, Tribal

When asked about how smoke ranks as a priority in the community, many participants responded that they perceive it ranked highly during periods of intense or prolonged smoke. That concern, however, was viewed as fading quickly when the smoke dissipated. Participants explained that this is due, in part, to competing priorities in the community that are seen as more urgent or that happen year round. Participants also explained that because smoke is so pervasive during the summer months, people don't want to talk about it or think about it after it fades.

"I think that it ranks very high when it's around and it ranks fairly low when it's not. People tend to forget about fires and smoke when it's not fire and smoke seasons." Youth Worker Interviewee, Non-Tribal

Especially in non-tribal interviews and focus groups, many people referenced the perceived cultural attitudes around "toughness" and resiliency associated with a rural lifestyle as relevant to how people respond to smoke. In describing communities in the ORAEA, many participants used words like 'self-sufficient' and 'independent,' and said that worrying about smoke or health, or taking precautions to protect one's health may be viewed as being 'not tough enough' to withstand the smoke. Many people in the ORAEA have worked or volunteered as fire fighters, where exposure to high levels of smoke is common and familiar, further influencing their perception of the health risk of smoke.

"I used to be a logger as well and there's a lot of times when I was in a lot of dust or even smoke when we were fighting fire, and there's all that sort of independent, macho attitude that kept me from protecting my own health and I think that's relatively common amongst rural folks that work outdoors." Leadership Interviewee, Non-Tribal

Current Ways of Sharing Smoke Information

Participants shared that they sought from a variety of sources. Participants preferred information received through CTCR, local government, and informal networks to sources from outside of the region. Facebook was used by many to share information quickly with a lot of people. These sub-themes are described in more detail below.

Most residents of the ORAEA are getting their information primarily from local sources.

"The messaging, if it's tailored correctly, and if it's local, tied into and accurate for these various communities, and put out by the tribes, it's generally well accepted." Healthcare Interviewee, Tribal

Participants overwhelmingly described local and community-based channels as their main sources of information on smoke and the health impacts of smoke. Tribal participants primarily described receiving information through the various CTCR departments, specifically looking for information from the Environmental Trust Department and Mt. Tolman Fire Center. Other sources of information for tribal participants included tribal broadcast emails, which are sent to all CTCR employees; community information boards; local and tribal news; friends and family; weather apps; and social media, which is explored in greater detail later in this section. For non-tribal participants, sources of information tended to be less centralized, and included local government agencies such as conservation districts, schools, and fire districts; community-based organizations; friends and family; local news and media; and social media.

"I know at least for our local tribal members and residents, they get a lot of information from our local departments that work in conjunction with the state and others on air quality and tracking that." Leadership Interviewee, Tribal

Many participants emphasized the strength of informal networks – groups of friends, family, and neighbors – within communities and the potential of leveraging these word of mouth communication and community networks to reach a wide range of people with smoke risk communication messaging. In particular, these networks are effective at reaching people living in more remote, rural areas in the ORAEA or who are living off-the-grid and are not connected to internet or phone service. Several participants described a sense of community in the ORAEA, where people look out for one another and neighbors will often go out of their way to share information. Many participants reported having conversations with friends and family

about smoke and fires.

"I think this county is a great place to live in particular because if something does go down, if I was his neighbor ten miles away, he's hopping in his truck and driving to my house and telling me." Mixed Ages Focus Group Participant, Non-Tribal

Many participants shared challenges for communicating in the ORAEA, including remoteness, lack of bilingual information, and poor internet and phone connectivity in the region, which in some cases are exacerbated by the destruction of signal towers during wildfires. To accommodate this, CTCR departments and local non-tribal agencies use a variety of strategies to reach community members, including physically posting information on community boards; posting on social media; leveraging local radio, TV, and newspapers; and partnering with other local groups, such as ORAP or Clean Air Methow, a community-based organization in a nearby area focused on air quality.

"It's a really diverse place, in that we have a fair amount of population that only seeks information online. We probably have an equivalent amount of the population that rarely looks online. And they're only looking at physical postings at the post office or the grocery store and listening to the radio." Air Quality Interviewee, Non-Tribal

Facebook is by far the most commonly used channel for information.

"Facebook honestly, like that definitely seems to be like the biggest, the biggest and quickest outreach method." Mixed Ages Focus Group Participant, Tribal

Repeatedly, participants shared that social media – in particular, Facebook – is used to share information quickly throughout the community by CTCR and other local government and community agencies. Several participants described the wide use of private citizen-run Facebook groups, such as 'Okanogan Highlands Fire Watch LLC', which post crowd-sourced fire and smoke information from the area. Participants also noted that community members often re-share information posted in groups, which then get shared with a wider audience.

"The community is really good about getting stuff out quick and fast that needs to go out and have, again, social media pages. It seems like everything's-- not everything, but most things are done by social media." Leadership Interviewee, Tribal

Several participants also raised concerns about the threat of misinformation on social media. They worried that what is shared is not always accurate and also mentioned misinformation in reference to COVID-19 and vaccines. Generally, participants felt that information shared by tribal and local agencies was accurate, as was information posted in fire watch Facebook groups, which are moderated by community volunteers.

"So there's a lot of people trying to provide a lot of information. And just because it's on the internet or on Facebook, it does not mean it's true or accurate, and so there are sometimes a need for the admin to circle back around or delete false information." Elder Care Worker Interviewee, Non-Tribal

Trusted Sources of Information

While participant responses varied, generally, participants perceived local sources of information, such as tribal or local government, or informal networks, to be more trusted than the state or federal government. In non-tribal interviews and focus groups, several participants described how political ideology influences which sources people in their communities trusted. These sub-themes are explored in more depth in the following section.

Local and tribal agencies are generally more trusted than state or federal government.

"Definitely people prefer local. I will say county-wide there is a general distrust of state and federal agencies as a whole." Healthcare Interviewee, Non-Tribal

When asked about which sources of information they trust most, participants stated a preference for local sources over information shared directly from state or federal government agencies. In part, this is determined by ORAEA residents' preferences for information that is locally relevant and accurately reflects the experiences of residents of the ORAEA. Additionally, participants stated their tendency to trust people and agencies with whom ORAEA residents have relationships and past experiences. For tribal participants, this is also related to a preference for information delivered through CTCR channels, which are viewed as looking out for the best interests of tribal members and are tailored to be culturally and contextually relevant. Several tribal participants described specifically seeking information from the CTCR Environmental Trust Department's Communications team, as well as Public Information Officers at the Mt. Tolman Fire Center, which are viewed as respected authorities on fire and smoke in the community. Both tribal and non-tribal participants identified firefighters and fire departments as well-trusted sources in the community, due to their authority on the topic of fires and their presence within communities.

"And one thing about the community is that they know the person that's providing the information, and that's one of the reasons why they trust me with the incident management teams is to have a tribal member working with the incident management teams so that people would be more trusting in what's being said and what's going on out there." Air Quality Interviewee, Tribal

For both tribal and non-tribal participants, trustworthiness was determined by the perceived credibility of the source, the quality of information, and the relationship with the source. Within these categories, tribal participants identified authority and expertise of the source, accuracy and timeliness of the information, and local and tribal relevance as most important when evaluating the trustworthiness. Non-tribal participants identified perceived political neutrality and transparency, authority, and respect as most important. Meanwhile, participants reported negative experiences with specific sources. They perceived these sources as untrustworthy and

characterized them as having a hidden agenda, a lack of transparency, and sharing poor quality information that wasn't relevant or accurate

"I think it's all about the messenger, or that's at least the hypothesis that I'm pursuing, is sort of it needs to come from, truly, a respected and trusted source. I think in some cases, they're health care providers, but more just kind of peer-to-peer." Air Quality Interviewee, Non-Tribal

Political ideology influences which channels people trust (non-tribal).

"I mean, it's no secret that Okanogan County is a fairly red county and so, yeah, I think people are starting to question more the validity of where information is coming from. "We can't trust the government. We can't trust the news outlets."" Leadership Interviewee, Non-Tribal

Several non-tribal participants shared the perception that political ideology plays a significant role in how people in the ORAEA determine which sources are trustworthy. Several participants described their perception that Okanogan County is a majority-conservative area, or 'red county,' and that government or media entities that are not perceived as aligned with residents' worldviews and experiences or are viewed as having a political agenda may be less trusted.

"Federal government, least, and state government, it's—we're a very red county and so whoever's in power in the legislature, if they're not red, they're not trusted at all. State agencies, there's a lack of trust for state agencies as well." Leadership Interviewee, Non-Tribal

Many non-tribal participants also highlighted the parallels between communication about COVID-19 and communication about the health impacts of smoke related to the political polarization of protective actions like masking and vaccinations. Several participants discussed the complication of community perceptions of public health agencies because of their association with COVID-19 for certain populations within the ORAEA, though they also emphasized that they imagined other populations viewed public health agencies as trusted sources of health information. Several participants also noted that wearing masks during smoke events has been more common over the past few years with the normalization of masking for COVID-19.

"Although we have these reliable resources that we work with and that others actually follow as well, we also have those that are on the other side of the fence when it comes to taking that information in for various reasons. And a lot of this has to do with, really, what we've been experiencing with COVID. And a lot of it is just misunderstood. There's a lot of personal opinions involved." Healthcare Interviewee, Non-Tribal

Many participants described the importance of personal relationships in determining trust within small, rural communities like those in the ORAEA. Several participants described how public figures within the community, such as local sheriffs or fire chiefs who live in the area and are well-known by many people, are perceived to be more trusted because of their earned respect and the perception that they are less likely to have a hidden agenda.

Gaps and Opportunities

Participants described existing gaps in access to resources or tools with which to mitigate the health impacts of wildfire smoke, as well as opportunities to address these gaps. Many of these opportunities centered around access to clean indoor air and smoke-readiness in advance of wildfire seasons and smoke. These sub-themes are explored below.

Staying indoors is the most common strategy for protecting against smoke; however, effectiveness is limited by access to clean indoor air.

"Stay indoors as much as possible. These are all things I would tell my family to do." Mixed Ages Focus Group Participant, Tribal

While participants shared a variety of strategies for minimizing the impacts of smoke for themselves and their families, the most common strategy was staying indoors on smoky days and limiting the amount of time spent outdoors. The effectiveness of staying indoors, however, is dependent on indoor air quality. Participants described the challenges of weatherizing homes to be smoke proof, as many of the homes in the ORAEA are older or do not seal properly, limiting the effectiveness of staying inside and cleaning indoor air. Some participants shared that they would run air purifiers or do-it-yourself box fan filters to clean indoor air, while others face fans out of windows to try to blow smoke out of their homes. Participants also noted that the high cost of air purifiers, masks, and new filters for HVAC or air conditioning systems may restrict community members' abilities to clean indoor air. Additionally, many people in the ORAEA don't have air conditioning and rely on opening windows to cool their homes.

"And it's tough because a lot of folks don't have air conditioning necessarily, so the standard way you cool your house down is to open the windows at night. And then, of course, if it's smoky, you're going to infuse your house with smoke too." Forestry Interviewee, Non-Tribal

Several participants also described barriers to staying indoors, such as the need to leave to run errands, go to work, and take care of animals or property outside. Participants expressed concern, especially for agricultural and forestry workers, who have no choice but to work outdoors, and are routinely exposed to high levels of smoke. Participants also shared the difficulties of keeping children indoors for long periods of time because of smoke. Several participants shared their concerns about the mental and physical health implications of limiting outdoor activity.

"[Orchard workers] still have to go outside and work. And so they maybe wear a mask or they don't because it's 100 degrees, and so they just breathe in smoke and that's okay, and they're tired." Youth Focus Group Participant, Non-Tribal

In times of extreme or prolonged periods of intense smoke, tribal participants described how CTCR would temporarily evacuate elders to areas with less smoke, sometimes as far as Spokane, which is several hours away. While this was successful in mitigating smoke exposure for elders, who may have health conditions that place them at higher risk of health impacts from smoke, participants described how these experiences were intensely stressful for elders or those who have limited mobility, who may be worried about damage to their homes or property during fires and burglary while they're away. In focus groups with tribal elders, several participants shared stories of evacuating Nespelem during the Chuweah Creek Fire and the emotional toll of leaving behind their homes and animals.

"I left my house ... and fortunately someone went out and watched it for me and then it started to catch fire, my deck started to burn. They hosed it down. Maybe if they didn't do that I would've lost it." Elder Focus Group Participant, Tribal

There is a need to shift towards preparation and smoke-readiness in advance of smoke season.

"We're going to continue to have wildfire smoke events. So just being prepared for that." Forestry Interviewee, Non-Tribal

Throughout the interviews and focus groups, participants emphasized the need to shift from emergency communication around fires to preparation in advance of smoke season, including ongoing education on the health impacts of smoke and how to protect one's health. ORAP and the CTCR Environmental Trust Department were credited by some participants with having helped advance conversations around preparation through their 'Smoke Ready Week' and work to integrate smoke readiness into tribal and county planning. Several participants described the need for tools to support personal and organizational risk assessment and preparation.

"Resources would be the ability to preplan. Instruction on preplanning. The ability to self-assess their risk of remaining in an area that is currently impacted by wildfire smoke." Healthcare Interviewee, Tribal

Participants also described a need for timely, locally accurate air quality information, including the ability to predict smoke levels and dispersion during wildfire events. One participant described how a lack of weather and air quality information specific to their area can undermine public trust in smoke messaging, as the information available is not always accurate.

"I think just more accurate and timely information. Like she was saying, the resources are kind of limited, by the time information comes out about the smoke, or what type of smoke it is, whether it's a structural fire or whatever, it's a little late." Youth Focus Group Participant, Tribal

Several participants noted the need to reduce non-wildfire sources of smoke in the ORAEA to limit the cumulative year-round exposure to fine particulate matter and other air pollutants.

Participants described efforts to reduce agricultural and yard waste burning through public chipping and composting efforts, which have been led by local governments and ORAP partners. Additionally, participants described programs through the CTCR Environmental Trust Department to exchange wood stoves in homes, which are many ORAEA residents' primary form of heating, to newer, more efficient models in an effort to reduce indoor air pollution.

"As far as in the valley's concerned, where we do have smoke problems, burning and education about burning is a really important thing." Leadership Interviewee, Non-Tribal

Perception of Prescribed Fire

Throughout interviews and focus groups, participants stressed the importance of fire prevention and forest management, including prescribed fire. Generally participants were appreciative of the benefits of prescribed fire, in regards to improving forest health, regenerating ecosystems, and mitigating wildfires. Some, however, cautioned against smoke impacts to communities from prescribed fire and emphasized the importance of taking action to minimize those risks. These sub-themes are discussed throughout this section.

Poor forest management and fire exclusion are perceived as exacerbating wildfires.

"I would say that prescribed burns, as far as I'm concerned, and this is my own opinion, do help. And I look forward to any kind of things that could help from these large fires from becoming such an issue as they have been in the past couple of years." Air Quality Interviewee, Tribal

When asked what potential solutions they see for mitigating the health impacts of smoke on communities, a majority of participants described a need to reduce out-of-control wildfires through fire prevention and robust forest management, including prescribed fire and thinning. Many participants shared the perspective that a buildup of fuels and poor forest health are exacerbating the effects of wildfires and that a combination of methods is needed to mitigate the impacts of wildfires and smoke on communities in the ORAEA.

"If you can control burn, that's fine for a reason. I think if they clean the forest a little bit more, they might not have such a terrible problem with fires." Elder Care Worker Interviewee, Non-Tribal

Tribal participants described a long history of burning as a cultural practice, using fire to manage landscapes and regenerate ecosystems and food systems at a large scale before the arrival of European settlers. One participant shared an anecdote about how, while burning was outlawed by the United States government's policy of fire exclusion, tribal members continued to ignite fires in secret, out of recognition of the importance of fire on landscapes. Participants emphasized that tribes, like CTCR, continue to practice burning informed by traditional knowledge, but are restricted in their ability to do so at an effective scale by 'red tape' from federal and state agencies and limited capacity to implement.

"I'm getting a point across is that we have the knowledge, and there's a reason why we burned, and under ideal conditions so that people understand that. It was outlawed and we weren't allowed to, because we wanted to suppress fire. Not us, but when the different way of thinking came. We learned that this is a fire habitat and you got to learn to live with fire. And use it as a tool, use it properly, and under the right conditions." Leadership Interviewee, Tribal

Prescribed fire is viewed as relatively safe and beneficial.

"Prescribed fires, if done in the land management, healthy, happy forest land management way, could definitely minimize the amount of wildfires that we experience." Elder Care Worker Interviewee, Non-Tribal

Most participants, but not all, viewed prescribed fire as a relatively safe practice in which the benefits outweigh the risks. Generally, participants described their perception of prescribed fire as more manageable and implemented under ideal conditions so as not to produce as much smoke or smoke that would intrude on nearby communities. Several participants described the permitting process as helping to ensure burning happens at times when the risk of escape is lowest; however, others described this process as restrictive and not allowing enough time to adequately plan or prepare after notification.

"Well [prescribed fires] ain't bad. Because usually it's up in the mountains. It won't affect you, you get the air flow." Elder Focus Group, Tribal

Participants also described several perceived benefits of prescribed fire, including mitigating the severity of wildfires and smoke by removing dead material and fuels, as well as improving forest health by clearing out diseased or dying trees. Tribal participants shared other benefits of regular fire, such as the regeneration of ecosystems and plants used for food and medicine, including huckleberries, which require some disturbance to regrow, and clearing areas to attract wildlife and game.

"Wildfire was actually a good thing, especially in our community. The Natives when they would go out and gather, you know, medicine and food and everything in the Fall time, that once they got their gathering, generally as they're coming out of the mountains, they would actually start small fires in order to refresh the berries, and the fruits, and the medicines, and all of that so that everything would regenerate." Emergency Management Interviewee, Tribal

While prescribed fire is appreciated for its role in mitigating wildfire risk, smoke impacts to communities need to be acknowledged.

"[Prescribed fire] is a tool that also has the potential to have detriments to the population that's right there, and even though the tool might be good for the forest, we don't necessarily have control over the smoke." Air Quality Interviewee, Non-Tribal

While many participants viewed prescribed fire as generally beneficial, and not as harmful to health, several others were wary of the potential impacts of smoke from prescribed fires in addition to wildfires. Several participants shared concern about the impacts of cumulative and repeated smoke exposure of prescribed fire in the shoulder seasons of wildfire season, since both wildfire and prescribed fire smoke release particulates into the air. Participants also shared concern about the mental health impacts of continued smoke after a heavy wildfire season and the perception that residents may feel weary or resentful of smoke from prescribed fires in the fall after experiencing wildfire smoke during the summer.

"It seems sometimes we just got done having wildfires, then all of a sudden, they're out there trying to do prescribed burns. So it just flows in from one situation into the other, and it's a difficult thing to deal with. Sometimes you just want to-- you don't want to see smoke; you don't want to smell it; you don't want to be around it." Air Quality Interviewee, Tribal

To mitigate the negative impacts of prescribed fires on communities, participants suggested bolstering communication and preparation in advance of prescribed fires, similar to preparation in advance of smoke season. Additionally, one participant shared how improved communication from a federal agency implementing prescribed fire has helped improve the perception of both the agency and prescribed fire in the community.

"I think the key for the prescribed fire is just making sure that the word gets out and that people do have a good sense of what the alternatives are in terms of protecting their health, and then also to provide some supports for folks who need it." Forestry Interviewee, Non-Tribal



Recommendations

The following six recommendations were developed from the themes identified in the previous section. While rooted in the perspectives of ORAEA community members, they are intended to guide smoke risk communication for other rural and tribal communities in the Pacific Northwest that are also impacted by wildfire smoke. These recommendations are summarized below and explored in more detail throughout the following section.

The ORAEA is expected to spend 41% of the year in moderate or worse air quality categories (33). To prepare their community for this, ORAP and their partners at the Colville Environmental Trust Department are already embodying many of the recommendations put forward with this project. For each recommendation, we provide an example use case in the ORAEA.

RECOMMENDED ACTIONS:

1. Clarify what is known about the short-, medium-, and long-term impacts of wildfire smoke, including mental health impacts.
2. Clarify the actions people can take to mitigate the health impacts of smoke exposure.
3. Coordinate between local groups to ensure accuracy, consistency, and reach of risk communication.
4. Emphasize one's health and health of one's community as central to wildfire resilience.
5. Emphasize smoke-readiness and preparation.
6. Address and mitigate increasingly frequent and severe wildfires.

Recommendation 1: Clarify what is known about the short-, medium-, and long-term impacts of wildfire smoke, including mental health impacts.

There is a lack of communication in communities as to the long-term impacts of smoke exposure. In particular, there are concerns about how continued exposure to high levels of wildfire smoke will impact individuals and their communities over time. This information gap stems from the perception that wildfire smoke research is still a relatively new topic. While the long-term health impacts of wildfire smoke exposure or the health impacts of chronic or cumulative exposure have yet to be well-characterized in the scientific literature (15); we have enough information on urban and traffic-related airborne pollutants that supports taking protective action.

The literature suggests that the health impacts of wildfire smoke exposure are similar to the health impacts of urban and traffic-related air pollution, which have been studied extensively (34). This literature should be utilized for health risk communication with communities. Long-term, airborne pollutants have been linked to worsening respiratory disease and onset of both neurodegenerative and cardiovascular diseases (35,36). Exposure to wildfire smoke specifically has been linked with increased risk of respiratory disease, such as exacerbation of asthma, chronic obstructive pulmonary disease, as well as worse birth outcomes and cardiovascular events (37). We can also integrate information about the short- and long-term occupational exposures to smoke that are well-documented among wildland firefighters, though they typically have far greater exposure than the general public due to factors such as closer proximity to the source, different compositional exposure, and longer periods of exposure (38).

Additionally, there is emerging research that shows possible linkages between wildfire smoke exposure and impacts to mental health and emotional wellbeing during prolonged smoke events (39,40). Studies examining the mental health impacts of other forms of air pollution showed increased mental distress during episodes of poor air quality (41). When communicating about the health risks of wildfire smoke, acknowledging the possibility of mental health impacts of living with wildfires and prolonged smoke is essential.

In communicating about the health risks of wildfire smoke, it is important to acknowledge that each person and community has a different risk profile, and emphasize the high health risk for specific subpopulations who are more sensitive to smoke, such as older adults and elders, children, and people with existing health conditions (37,42,43). Similarly, communication should underscore heightened risk for populations with high smoke exposure, such as people experiencing homelessness, outdoor workers, and wildland firefighters (37,44-46). At the same time, communication should emphasize that wildfire smoke impacts everyone and there is no safe level of smoke exposure, regardless of one's sensitivity.

Put Into Practice:

Participants from the ORAEA highlighted different resources that could be used to communicate, such as refrigerator magnets with AQI information and recommended actions mailed out to tribal/ community members with annual burn permits. This would ensure the information is shared with everyone and is easily and prominently accessible during smoke season.

Recommendation 2: Clarify the actions people can take to mitigate the health impacts of smoke exposure.

Communication should emphasize that while smoke may be inevitable, there are actions that can help mitigate its impacts, and emphasize the efficacy of individuals and protective actions in protecting one's health. To be effective, actions should be tailored to an individual's risk level, risk perception, and context (47). Helping build capacity for assessing personal risk and understanding which actions can be taken for people at different risk levels (e.g. outdoor workers, elders) or different levels of smoke exposure can help encourage preparation before and action during smoke (48).

Most participants reported staying indoors as their primary protective action during smoke events; however, its effectiveness is limited by indoor air quality, which can reach dangerous levels during wildfires (49-52). Ways to improve indoor air quality during wildfires include:

- **Reducing smoke infiltration into homes and business:** This can be done by sealing exterior doors, windows, and unused vents using duct tape, plastic, and other materials, as well as through weatherization of homes prior to smoke season. Better sealing and increasing intake of clean air can create positive pressure, reducing the likelihood of smoke seeping into buildings; however, during cold weather this can increase moisture. This may be difficult in older homes or homes with leaks, which may not be able to seal properly. For homes without air conditioning, it may be dangerous to keep homes sealed during high heat; this risk can be reduced by opening windows for short periods at night or when the air quality index (AQI) has lowered to let in cool air and cleaning indoor air once windows are closed again (53).
- **Cleaning indoor air:** Using portable air cleaners or outfitting existing building HVAC systems with high-rated MERV or HEPA filters can be highly effective in reducing indoor air pollution during wildfires; however, this can be costly and requires electricity (50,51,53,54). There is anecdotal evidence suggesting the effectiveness of low cost, do-it-yourself box fan filters, which could potentially be outfitted to run on solar batteries; however, more research is needed (55). In situations with limited access to resources, creating a 'clean air room' within the home with a portable air cleaner or box fan filter can be effective in reducing overall exposure (56).

Other actions that can be taken to reduce overall smoke exposure include:

- **Temporary evacuation from smoky areas:** Leaving a smoky area can be highly effective in reducing smoke exposure. Important to note, however, is that the stress of evacuation may also hold risks, especially for more at-risk populations, such as older adults and elders, people with limited mobility, and people with existing health conditions (56,57).
- **Reducing physical activity and exertion outdoors:** Reducing the rate of breathing and stress can be effective in limiting the amount of smoke inhaled over short periods of time

(56,58). At the same time, there are negative health impacts from limiting exercise for long periods, and alternatives to outdoor exercise should be explored (59,60).

- **Wearing N95 masks:** Well-fitted N95 masks are highly effective in reducing the amount of particles inhaled during periods of wildfire smoke (56,60). They can be especially useful for outdoor workers or others who are unable to access clean indoor air. Important to note is that N95s must be fitted properly to be most effective in filtering particles and work best when the wearer is clean-shaven (61). Surgical masks and cloth masks, like the ones commonly used to prevent the spread of COVID-19, are significantly less effective in filtering particles than N95 masks (61).
- **Reducing other forms of air pollution:** This can include replacing wood stoves with higher efficiency models or taking precautions to ensure that wood burned is dry to reduce smoke output and indoor air pollution, or using filters to reduce particulates (62-64). Similarly, investing in community chipping or composting programs to reduce outdoor burning can be effective in reducing overall ambient smoke.

Recommendation 3: Coordinate between local groups to ensure accuracy, consistency, and reach of risk communication.

A centralized source of information and coordination between groups ensures smoke risk messages are needed and are being shared widely throughout communities. It is common for agencies to re-share and amplify messaging from other agencies; however, this process could be formalized to ensure that accurate, vetted information and consistent messaging is being shared. Using risk communication frameworks in planning smoke risk communication can be effective in supporting this. An example of this is the SALT Framework developed by the Environmental Protection Agency. This framework incorporates four stages of planning: strategy, action, learning, and tools, and is designed to support local groups and agencies in developing risk communication plans (65).

Within a risk communication plan, expectations for sharing and resharing information can be decided in advance and extended to include stakeholders not already involved. Potential partners include emergency management services, who are able to communicate quickly and directly with community members through their text alert system, as well as fire departments, who are viewed as trusted sources of information about fires, and by extension, smoke. Additionally, community stakeholder groups similarly may consider involving moderators of community Facebook groups to leverage their wide reach in the community.

Within the ORAEA, this is already being done to a certain extent by ORAP, the CTCR Environmental Trust Department, and Clean Air Methow, a community-based air quality organization based out of the neighboring Methow Valley (66-68). Additionally, Washington state has made strides to centralize smoke risk communication through the Washington Smoke Blog, which provides current air quality information and state-wide reports on air quality conditions and predictions.

Recommendation 4: Emphasize one's health and health of one's community as central to wildfire resilience.

Perceived 'toughness' and a high cultural tolerance for smoke can be barriers to taking protective action against the health impacts of smoke. However, communities also take pride in being 'self-sufficient,' 'independent,' and 'resilient,' which can be productive in motivating action to protect against the health impacts of smoke. Messaging around the health impacts of wildfire smoke must emphasize that caring for one's health is not a quality of weakness, but rather a central element of continued resilience in the face of ongoing wildfires and wildfire smoke.

Risk communication research in rural and tribal communities has found that messages must be compatible with local context and culture (22,69,70). Moreover, leveraging trusted individuals and groups from 'within the community' can help ensure successful delivery and reception of messages by communicating in a way that resonates with community members' culture and experiences (22,70). Potential partners for this type of messaging identified by participants are local and tribal firefighters and fire departments, who are generally perceived as trusted members of the community and who experience high exposure to smoke and high rates of health impacts themselves (69,71).

An example of this during the Cold Springs Fire of 2020 was described by one interviewee:

"We had one wildfire that makes me think about that, the Cold Springs Fire, and the fire chief is also a rancher and we assembled at his ranch to talk about the fire. He emphasized the health issues, rather than the COVID issues, because of the stigma about how people are responding to the COVID. But he did make a statement that no matter what, your health is important for being resilient in recovering from these fires." Leadership Interviewee, Non-Tribal

Recommendation 5: Emphasize smoke-readiness and preparation.

There is a need for more and year-round planning for smoke season. Smoke readiness entails preparation in advance of fire seasons to ensure that communities and individuals in communities are prepared to the best of their ability to weather prolonged smoke events (72).

There are a number of strategies that local and tribal agencies can take to prepare for smoke season in their communities, including:

- **Shorter term strategies:** Distribution of portable air cleaners, HEPA filters, or do-it-yourself box fan filters to community members at high risk of health impacts or who experience other barriers to accessing clean indoor air resources; building awareness through community engagement and outreach; and setting aside resources and planning for temporary evacuation of vulnerable community members.

- **Longer term strategies:** Assessment and weatherization of homes and buildings, reduction of other sources of air pollution and smoke in the community, and investment in community clean air spaces.

Important to note, however, is that strategies must be tailored to the specific organization or household, as everyone has differing levels of risk and capacity to prepare. A key component of this is increasing access to relevant, timely information for decision-making. Rural and tribal communities may have limited access to nearby air quality monitors, limiting members' ability to monitor current conditions in their area. Relating to Recommendation #3, integration of locally-owned air quality data with risk communication planning can support timely and wide dissemination of current, local air quality conditions.

Within the ORAEA, the CTCR Environmental Trust Department, ORAP, and Clean Air Methow already prepare smoke ready checklists for community members and local agencies and promote a 'Smoke Ready Week' on social media early in the summer. Clean Air Methow has worked to add a level of preparedness by implementing a network of low-cost sensors deployed in or around community members' homes to fill gaps in local air quality data and spur community conversations around air quality (73,74).

Recommendation 6: Address and mitigate increasingly frequent and severe wildfires.

The increasing frequency and intensity of large, out-of-control fires must be addressed in order to reduce the source of smoke for their communities. Evidence suggests that forest management strategies, including thinning, pile burning, prescribed fire, and managed fire, may reduce the intensity of wildfires and reduce overall smoke output in certain landscapes and environments (75,76). These strategies; however, with the exception of thinning, produce additional smoke that can impact the health of nearby communities (77). In recognition of this, there is a need for enhanced communication before, during, and after prescribed fire, managed fire, or pile burning; and investment in smoke readiness to mitigate the impacts of smoke from these sources on vulnerable community members.

Creating opportunities for tribal leadership in forest management would make room for the practice of countless generations of accumulated knowledge around fire and smoke in a way that minimizes impacts on communities. Additionally, communicating the comparative manageability of prescribed fire, differences in smoke production and concentration, and contributions to wildfire risk reduction could improve social license to burn and reduce anxiety for community members.

CTCR has positioned themselves as a leader in tribal forest management and prescribed fire advocacy at multiple scales, including a leadership position on the Intertribal Timber Council. They have been active in conversations with the State of Washington and the United States federal government in support of expanded tribal jurisdiction and resources for prescribed fire.

Conclusion

Exposure to wildfire smoke is inevitable across the Pacific Northwest. Throughout the summer, rural communities are often inundated with smoke not only from local fires, but also from fires burning hundreds, if not thousands of miles away. Smoke season is becoming longer and more intense each year, and work is needed to prepare affected communities.

Results from this project demonstrate that preparedness for smoke exposure varies across age and demographic groups, and that individuals feel an uncertainty surrounding the health impacts of smoke and how much they should be concerned. When it comes to avoiding smoke, the current strategies are often hard to build into daily life, and others are financially unrealistic for certain populations. Risk communication around smoke exposure revolves around social media, and is all about the local trusted source. Although learned from residents of the ORAEA and Western Colville communities, these broad themes and other recommendations made in this report are translatable to other smoke-impacted communities across the Pacific Northwest. As fire and smoke seasons continue to worsen, the number of communities and people affected will only increase.

The recommendations introduced in this report are meant to be utilized by practitioners working in tribal, local, state, or federal government and community-based organizations, as well as others interested in community-centered environmental hazard risk communication. Our results and the example set by the ORAEA and Western Colville reservation demonstrate that preparedness can improve the livelihoods of affected communities throughout the smoke season.



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