

A Community Health Impact Assessment of the Santiam Canyon: One Year After the 2020 Labor Day Wildfires



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Prepared by

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Contents

Study team.....	3
Acknowledgments.....	4
Executive Summary	6
Introduction	8
Overall study questions.....	12
Data sources for this report.....	13
Environmental health	16
Housing.....	23
Mental and behavioral health	31
Food security and adequate healthy eating.....	38
Personal health.....	45
References	49
Appendices	55
Survey questions (as viewed in Qualtrics format).....	57
Quantitative survey results	65
Focus group interview questions	75
Clinic utilization review, pre- and post-fire	76

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Name	Position	Organization
Jody Christensen	Regional Solutions: Mid-Valley Region	Office of Governor Kate Brown
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Executive Summary

Santiam Canyon Community Health Assessment

Purpose: The 2020 Santiam wildfires were devastating to the communities of the Santiam Canyon. This community health assessment project was conducted to examine the ongoing physical and mental health needs of wildfire survivors in the affected communities, and to provide recommendations for addressing these needs.

Study Questions: We examined five major health-related areas of interest: environmental health, housing, mental and behavioral health, food security and adequate healthy eating, and personal health. For each area, we sought to determine what needs were created by the wildfires, how those needs have been addressed by government agencies and local organizations, and what needs still exist. We also developed recommendations for addressing those needs.

Data Sources: The information and data used in our analysis came from three primary sources. First, we conducted a range of key informant interviews with community leaders, agency contacts, and subject matter experts. Second, we conducted an online, web-based anonymous survey of Santiam Canyon residents (n=80). Third, we conducted three focus group interviews with residents (total n=23). In addition to these primary sources, we also reviewed a summary of healthcare utilization by Canyon residents, prepared by Samaritan Health Services.

Primary Findings

Environmental Health

- In terms of known environmental impacts on health, water quality and access were the most significant concerns. Important indicators included unsafe contaminant levels, duration of time with running water, amount of water available, and other factors.
- Detroit's drinking water quality and access was impacted most intensely for the longest time period because its treatment and delivery infrastructure was damaged and not functioning until 7 months after the fires.
- The impacts on health of air quality and exposure to other toxins are unknown but are also of significant concern to Canyon residents.
- Less is known about the overall impacts to soil from release of contaminants from a burned built environment.
- Heat-related illnesses were reported as being associated with extreme temperatures in summer 2021.

Selected key recommendations:

- Consider altering allowances for burning post-fire debris in fire-impacted areas.
- Sample and test ash and dust for toxic chemicals.
- Evaluate water sources and infrastructure not impacted by the fires for exposure and risk.
- Plan for post-fire dust mitigation needs early in disaster response process.
- Utilize the Pacific NW Quantitative Risk Assessment for prioritization of risk reduction activities.

Housing

- One year after the wildfires, only 13% of households case-managed by the Santiam Service Integration Team had entered permanent rehousing, while 87% remained in temporary living quarters. In our online survey, 86% of respondents had to move to temporary housing, of whom more than half (56%) are still living in temporary quarters.
- There was universal agreement from all data sources that primary impacts on families of housing loss include trauma, depression, and chronic stress and anxiety.
- Ongoing displacement has impacted physical health through shifts in diet, ability to exercise, reduced access to medical care and increased exposure to the elements.

- Many residents have encountered challenges in the rebuilding process due to being underinsured and unable to afford the high price of building materials.

Selected key recommendations:

- Identify steps in the rebuilding process (e.g., waiving permit fees, appraisals) which can be simplified or removed.
- Advocate for steps to reduce bureaucracy and redundancy and to streamline residents' experiences with regard to insurance and reimbursements.

Mental Health

- Mental health issues were the most frequently identified of all health concerns by study participants, ranging in severity from chronic stress to life-threatening. They also appear to be the most pervasive and complex type of health concern to address.
- Canyon residents' stress levels have been manifested through physical symptoms including digestive problems, headaches, and sleeping difficulties.
- The procedural aspects required to obtain different forms of aid have constituted a significant contributor to survivors' stress level.

Selected key recommendations:

- Address the shortage of mental health providers in the Santiam Canyon.
- Provide training on trauma-informed practices for responders and relief agencies.
- Advocate for more efficient and less bureaucratic processes to relieve stress.

Food Security and Adequate Healthy Eating

- The level of food insecurity in the Santiam Canyon is not directly known, because of a lack of coordinated, reliable data for geographic units smaller than counties. The Service Integration Team, which assesses food security as part of its intake procedure, has found that 12% of its clients (21 of 181) meet criteria for being food-insecure, which is not appreciably different from estimates for Linn County and Marion County as a whole.
- The four food pantries in the Canyon region, which mostly escaped structural damage in the wildfires, are still operating. They have not seen a need for increased levels of emergency food since the fires, which may be due to the reduced population in the Canyon.
- The most frequently occurring theme related to food was the added difficulty in storing, preparing, and obtaining food due to the housing displacements cause by the fires, which sharply reduces residents' ability to maintain healthy diets.

Selected key recommendations:

- Maintain and/or increase attention to the monitoring of food insecurity through multiple channels by local agencies and organizations.
- Support the operation of food pantries and other sources of food assistance.
- Support wildfire survivors in their efforts to rebuild or find permanent housing in the Canyon.

Personal Health

- The issue of physical safety hazards created by the fires was ranked 2nd by survey respondents as a significant ongoing issue for the Santiam Canyon community. Road safety, especially involving logging trucks, was frequently cited as a major concern.
- The most frequently occurring personal health issues reported by Canyon residents were ongoing respiratory problems and poor sleep quality.

Selected key recommendations:

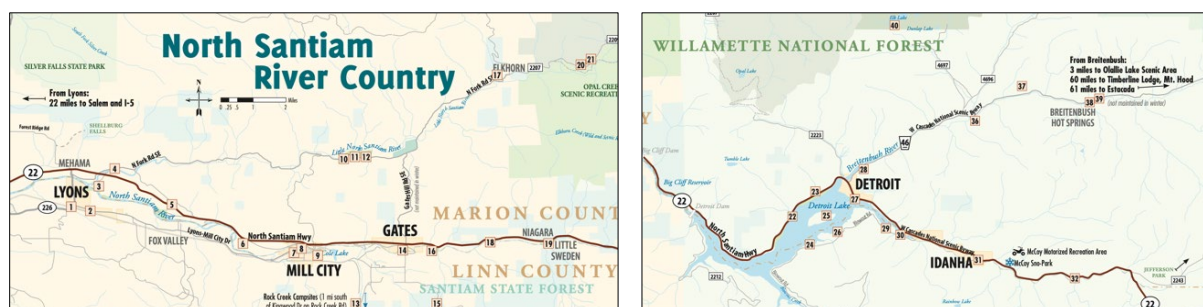
- Monitor and correct potential safety hazards on Highway 22 and other roads.
- Consider establishing a health registry to track the ongoing conditions of wildfire survivors.

Introduction

The 2020 Santiam wildfires were devastating to the communities of the Santiam Canyon. They strained the capacities of county and state agencies, local governments, community organizations, nonprofits, and other responding organizations that sought to deliver services and support to the people and businesses that were affected. This community health assessment project was conducted to examine the ongoing physical and mental health needs of wildfire survivors in the affected communities, and to provide recommendations for addressing these needs.

Santiam Canyon communities

Santiam Canyon lies east of Salem, Oregon, along Highway 22.



Above maps taken from the 2019 North Santiam Canyon River Country Guide.

Many North Santiam communities were founded in the late 1800's with the timber industry, mining jobs and construction of the Oregon Pacific Railroad playing important roles for residents throughout the 20th century. Over the past years, the North Santiam River and Detroit Lake have formed the backdrop of daily life in the region, with recreation on the water, camping, hiking and beautiful views all a distinct part of the culture. Mill City is the largest community in the region. Detroit transitioned to a popular tourist spot after completion of the dam, and the lake it created, in 1953. Idanha is the smallest of the North Santiam communities and highest settlement along the river (North Santiam River Country Guide, 2019).

Santiam Hospital in Stayton serves the entire area with quality medical services.

This table provides basic information for the towns impacted most by the Santiam Canyon wildfires, as of 2019, before the fires. Data are taken from *World Population Review* and the *Chamber of Commerce*.

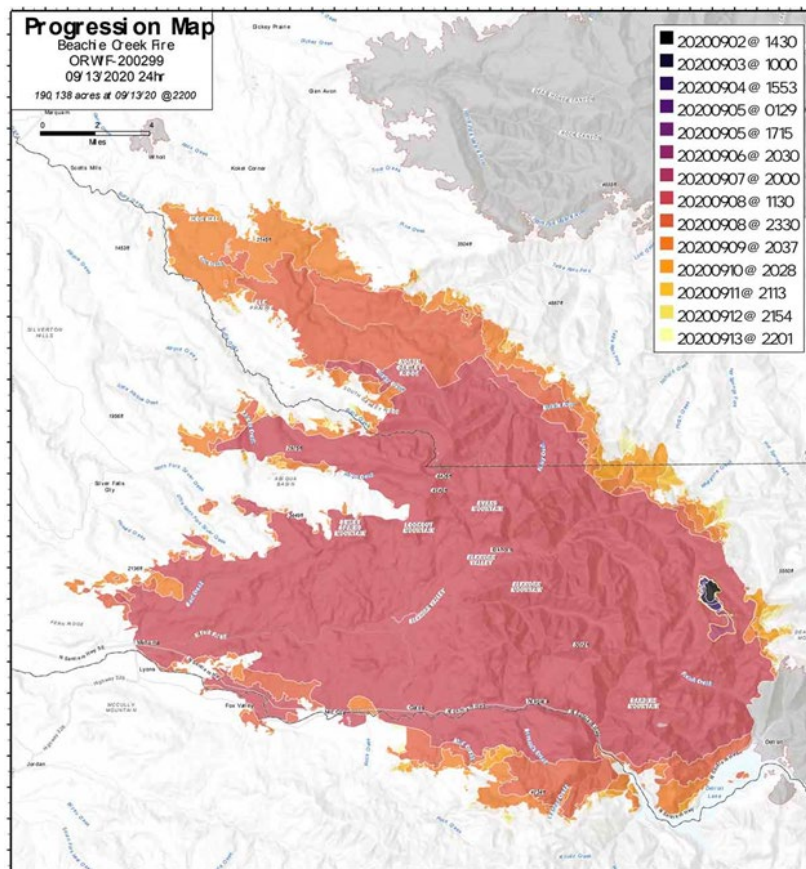
	Lyons	Mill City	Gates	Detroit	Idanha
County	Linn	Linn	Marion	Marion	Marion
Population	1,346	2,024	523	229	165
Businesses	210	149	71	43	18
Largest industry	Builders and Contractors	Government offices	Professional services	Government offices	Government offices
Growth rate, 2009-2019	15.93	9.11	11	13.37	23.13

The 2020 Labor Day wildfires

For most Oregonians, the 2020 Labor Day wildfires descended upon Oregon on Labor Day (Monday, Sept. 7) as smoke inundated the west side of the state. But by then, the situation was out of control. The impacts from historic wildfires in the Santiam Canyon resulted from three separate blazes — Beachie Creek, Lionshead and Riverside. The Beachie Creek and Lionshead fires had the most direct impact on Santiam Canyon residents.

On Sunday, Aug. 16, 2020, a lightning storm ignited multiple wildfires across the Cascade Range in a remote part of the Opal Creek Wilderness, 25 miles north of Detroit. These fires grew into the Beachie Creek Fire. On the same day, approximately 100 miles east, lightning started the Lionshead Fire near Mount Jefferson, 14 miles west of Warm Springs. Both the Beachie Creek fire and the Lionshead fire were situated in complex terrain and were very difficult to access. With competing fire priorities elsewhere across the state, crews took measures to contain the fires but were not able to eliminate them. They smoldered for weeks (Urness, 2020).

Entering September, weather conditions grew hot and dry, and the Beachie Creek fire tripled in size to 500 acres. The fire expanded but remained within the high ridges of the forest. The same conditions pushed the Lionshead fire west towards Breitenbush, 17 miles northeast of Detroit. By Sept. 5, smoke could be seen for miles fuming near Mt. Jefferson. This growth was very small compared to what would happen next (Urness, 2020). (See Progression Map.)



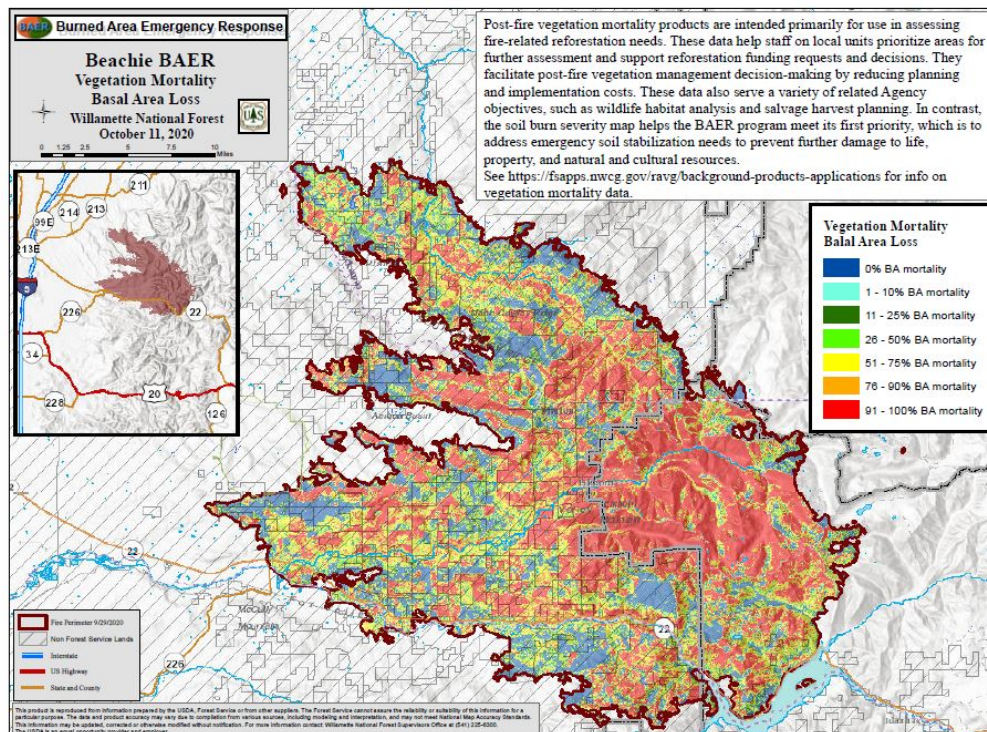
On Sep. 4, meteorologists from the National Weather Service were already warning of historic conditions for large wildfire growth on Labor Day (Profita, 2021). On the back of historic 65-mph winds, combined with warm temperatures and low humidity, the Beachie Creek Fire — which had covered 700 acres by Labor Day — burned more than 130,000 acres by the next morning, consuming 500 feet per second on its path (Thomas et al., 2020). Eastern winds blew the fire out of the high ridges of the Opal Creek Wilderness and into the canyons. The Lionshead fire also grew swiftly, exploding from Mount Jefferson all the way to Detroit overnight, and the two fires merged.

That same evening, strong winds knocked down power lines, igniting 13 spot fires between Detroit and Lyons along Highway 22 (Urness, 2020). Between 6 and 10 pm, 13 separate 911

calls came in reporting power line problems (Profita, 2021). The Beachie Creek fire crew evacuated Gates, and officers from the Marion County Sheriff's Office raced door to door, trying to get people out. Stories soon emerged from residents along Highway 22 who fled for their lives at different stages of the night (Thomas et al., 2020). By midnight, Labor Day evening in Gates, the area had gone from no evacuation notice to level 3 "go now" orders (Profita, 2021). By the next morning, all residents from Lyons-Mehama to Detroit and Idanha were on level 3 orders.

On Sep. 9, residents were allowed to take initial stock of the damage. Communities across the state lamented the loss of lives, homes and Oregon's iconic landscapes. Two weeks later, on Sep. 23, with five missing, nine dead and thousands of homes lost, a shift in weather conditions allowed crews from over 40 states to make progress containing Beachie Creek and Lionshead.

In October 2020, EPA crews, equipped with hazmat suits and respirators, worked to sift through damage, collect and properly dispose of acids, petroleum products and common household items such as paint and asbestos (Profita, 2020). Cleanup was broken into two phases: hazardous waste removal followed by the removal of hazard trees, ash and debris. Authorities emphasized rebuilding could not begin until both phases were complete. In December 2020, Phase One finished and Phase Two work began, led by the Oregon Wildfire Debris Management Task Force. In the wake of the wildfire, local organizations, volunteer groups, and religious organizations provided food and temporary shelter for evacuees. These efforts were turned over to Oregon Department of Human Services in January 2021 (Oregon Wildfire Response & Recovery, 2021).



The devastation caused by the fires is apparent in this vegetation mortality map. The Santiam Corridor experienced substantial amounts of high severity fire that killed 91-100% of the trees. Patches of low-moderate severity are also present where trees are likely to survive, mostly at lower elevations as the winds influencing the fire's movement lessened with terrain and vegetation type changes.

One year after the wildfires, the recovery efforts continue. Some residents have started rebuilding, while others remain displaced or have moved elsewhere. Recovery efforts have evolved from addressing immediate critical needs to supporting the Canyon communities over the long-term.

Toward this end, Marion County initiated and supported a number of projects and studies with the aims of identifying lessons learned from this wildfire experience, developing strategies for coordinating services, and formulating responses to future wildfires and other emergency events. The present study is directed toward assessing the long-term health needs of Santiam Canyon wildfire survivors, as well as providing recommendations for how those needs can be most effectively addressed by community and state agencies, nonprofits, and other responding organizations.



Overall Study Questions

We focused our inquiries on five general categories related to health:

Environmental health

- Water quality and access
- Air quality and respiratory issues
- Soil quality
- Exposure to other toxins (i.e., other than those related to water, air, and soil quality)
- Heat-related illnesses

Housing

- Housing stability; displacement or homelessness
- Shift from permanent to temporary housing (while remaining on own property)
- Availability of clean water and stable electricity
- Economic pressures; market influences on ability to rebuild
- Injury and physical safety
- Indoor housing quality

Mental and behavioral health; family cohesiveness and security

- Emotional stress
- Depression
- PTSD in parents and/or children
- Alcohol misuse / Drug use
- Children's psychological, emotional, and social adjustment (e.g., school performance)

Food security and adequate healthy eating

- Availability of affordable and healthy food from commercial sources
- Impacts on household-based food sources (e.g., hunting, gardening)
- Stresses on family finances affecting food security
- Safety of food storage and preparation

Personal health

- Physical safety and injuries
- Disruptions to sleep or regular physical activity
- Access to medical care, including one's regular primary care provider and necessary medical procedures for existing conditions
- Access to medication

For each of these areas we sought answers to the following questions:

1. What needs were created or exacerbated by the Santiam wildfires?
2. How have those needs been addressed by government agencies and local organizations?
3. What needs still exist?
4. What recommendations can be made for best addressing those needs?

Data Sources for this Report

We used several different sources of information in this investigation, as follows:

Key informant interviews

We conducted a range of key informant interviews to address our major study questions about the wildfires' ongoing health-related impacts. The key informants included community leaders, agency personnel, and subject matter experts. Most of the interviews were conducted over Zoom; a small number were conducted by phone or email. Altogether, 36 individuals were interviewed, with several engaging in extended correspondence.

Survey of Santiam Canyon residents

We developed a short, web-based survey for Canyon residents, to learn about their experiences in the year following the wildfires, their input and judgments about the most significant health-related problems for themselves and their community, and their recommendations for further action.

Survey recruitment

We publicized the existence of the survey and encouraged Canyon residents' participation through multiple channels, including email lists sent by organizational partners, social media posts, and flyers posted in public buildings in Canyon towns. In addition, a feature article about the health assessment study was published in *The Canyon Weekly* on Friday, Oct. 29, which contained information about how to access the survey. All of the communications sent potential respondents to our project's website, which contained the direct link to the survey.

Survey features

The survey was developed and implemented using Qualtrics, an online survey platform used by Oregon State University. The survey was completely anonymous.

Survey content

The survey included a mixture of short-answer questions and open-ended text-based questions. The content followed the general 5-part structure that we had adopted for the full study. Most of the questions were written specifically for the survey. A few questions came from other sources, including questions on food security and food sufficiency that were adapted from standard questionnaires for measuring those concepts. In the survey development process, drafts were sent out for review, comment, and editing suggestions to 6 external reviewers who were organizational partners based in the Canyon. Based on their feedback, revisions were made.

Respondents

The survey went online on October 19 and responses were received between October 21 and November 10. Altogether there were 80 respondents, which consisted of 66 complete responses (i.e., following through to the end of the survey) and 14 partial responses in which some but not all of the questions were answered.

Analysis

Survey responses were analyzed descriptively to record respondents' reports of their experiences, as well as to determine their priorities, opinions, insights, and recommendations for potential courses of action with regard to promoting individual and community health.

The survey questions, as they appeared in Qualtrics, are included as Appendix A. A full set of the results for the quantitative questions is included as Appendix B.

Focus group interviews

As another way to get perspectives directly from Canyon residents, we conducted three focus groups, with a total of 23 respondents across the three groups.

Recruitment

Recruitment was done jointly for both the focus groups and the surveys. As with the survey, the channels for publicizing the focus groups included email lists sent by organizational partners, social media posts, and flyers posted in public buildings in the Canyon. The Oct. 29 feature article in *The Canyon Weekly* contained information about the upcoming focus groups as well. As with the survey, these communications sent potential respondents to the project website, which contained a link for signing up for the focus groups.

We reimbursed each focus group participant with a \$25 Safeway gift card. The gift cards served a dual purpose: they were an incentive to participate and were also a way of thanking participants for their time and insights.

Procedure

The focus group sessions took between 60 and 90 minutes. They were held on two different days in early November. First, an in-person focus group was conducted in Mill City on the evening of November 2. The staff at the city hall graciously allowed us to use their council chambers as the site for the event. A focus group was also planned to be conducted by Zoom on November 4 at midday. The sign-up was larger than expected so we split the participants into two focus groups, which were conducted simultaneously over Zoom, moderated by two different team members. Altogether, there were nine participants at the Mill City focus group on November 2 and seven participants in each of the two Zoom focus groups on November 4.

Analysis

The focus group interviews were audio-recorded and a transcript was produced for each of the three interviews. The interview transcripts were reviewed by multiple team members, using the audio recordings for backup. To analyze the results and identify primary themes, we used a deductive thematic analysis approach, in which the data interpretation process, i.e., coding participants' individual comments and developing integrative themes, is guided by our overall study questions. This is a "top-down" rather than inductive, "bottom-up" approach to analyzing interview data (Braun & Clarke, 2006).

The focus group questions are presented as Appendix C.

Data on Linn County healthcare utilization

We requested from Samaritan Health Services (SHS) a data summary that compared different types of patient visits for the year prior to the wildfire and the year after, for Linn County zip codes specific to the Canyon. Only count data were used in the analysis and the Samaritan report.

The SHS analysis identified patients who met the following criteria:

- An address from the cities of Lyons, Mehama, Mill City, Gates, Idanha, Detroit and/or a zip code of 97358, 97360, 97346, 97350, 97342
- At least one encounter with any Samaritan clinic or hospital at some point between September 7, 2019 and September 7, 2021.

These criteria identified 330 people. For this population, the numbers of cases for various categories of health status and healthcare utilization were calculated for the one-year periods before and after the 2020 Labor Day wildfire (9/7/2019 – 9/6/2020 and 9/7/2020 – 9/6/2021, respectively). The summary reported the proportion of patients that increased, decreased, or had the same utilization over time in each of the different categories. All data were extracted from SHS electronic medical records via an SQL query of the Clarity Database. Cell sizes less than 11 were suppressed to prevent identifiability, in accord with SHS policy aligned with the CMS Cell Size Suppression Policy.

We sought a similar analysis to assess residents' utilization of healthcare services in clinics and other facilities located in Marion County, but those data were not available.

The results from this analysis are provided in Appendix D.



Environmental Health

Background

Environmental factors resulting from wildfires influencing human health primarily involve impacts to air, water, and soil. Wildfire smoke is the primary cause of air impacts, and while much is known about the human health impacts from smoke produced by wildfires (Reid et al 2016), few studies have been conducted to assess human health impacts in the post-fire environment from airborne contaminated ash and dust. Direct impacts to water affecting human health range from compromised infrastructure to water too compromised to treat, even with intact infrastructure. The risks to municipal watersheds and infrastructure relative to other values is heavily weighted in the Pacific Northwest Quantitative Wildfire Risk Assessment just behind people and property (Gilbertson-Day et al 2018) because of how directly water is threatened by wildfire on multiple levels. Soils are most commonly considered in their impacts to human health relative to post-fire debris movement after wildfire due to the potentially lethal nature of such events (Dowling and Santi 2014). Less is known about their receptivity to and potential as a vehicle for movement of contaminants. Exposure to other toxins and heat-related illness are to a lesser degree associated with post-fire environments. Most toxins released in a wildfire would affect human health via soil, water, or air. Temperatures in burned areas are higher than they would have been otherwise (Liu et al 2019) and could contribute to higher incidences of heat-related illness than would be reported otherwise.

Human exposure to potentially toxic elements released by wildfires burning through the built environment is not well-understood (Alexakis 2020). Ash that results from burning natural vegetation such as trees and grass is comprised of organic matter, charred organic material, and charcoal (Abraham, Dowling, and Florentine, 2018). Understanding of how ash particles enter the alveoli of the lungs and cause various health problems including increased risk of lung cancer is largely based on ash of this kind. Hazardous building materials, which are the primary source of residential ash that could release toxic elements into the environment during a wildfire, include hexavalent chromium found in treated timbers and concrete; lead paint, solder and pipes; mercury in fluorescent lamps, tubes, bulbs, batteries, thermostats and switches; cadmium, lead, nickel, lithium and manganese in rechargeable batteries; manganese in steel; and arsenic found in preservatives used to treat wood (Alexakis 2020). Far less is known about the release of toxic chemicals and elements from wildfires burning through suburban areas, in part because access to fire areas for research during and after wildfires continues to create barriers to gaining insights into the impacts of release and dispersion of toxic elements and chemicals from wildfires (Bernstein, 2019).

Findings

Of the environmental concerns identified in key informant interviews, the focus group interviews, and the survey, water quality and access were the most significant in terms of known impacts. Based on the survey and survivors' characterizations, environmental health concerns about unknown impacts to air quality and exposure to other toxins were most significant. Soil health and stability was not found to be substantial in terms of impacts given overall lack of landslides. Less is known about overall impacts to soil from release of contaminants from a burned built environment. Heat-related illnesses were reported as associated with extreme temperatures throughout the Pacific Northwest last summer and respondents reported concerns about exposure to toxins.

Water Quality and Access

Indicators of water quality and access include unsafe contaminant levels, duration of time without running water, amount of water available, number of wells tested as unsafe for drinking, number of violations of water quality standards, fire hydrant supply, water recreation, and algal blooms.

Survey results indicated impacts associated with water quality and access resulting from the wildfires for both respondents' families (n=23, 31%) and for the Santiam Canyon community (n=27, 37%; Appendix B, question 1). The total percentage of respondents reporting lack of access to safe drinking water within the past year was 54% (n=43; question 3).

In the focus group interviews, participants described issues with both drinking water and water recreation:

"I'm worried about drinking water."

"I'm on a community well and we're in the process of working with SIT. We had some well issues before the fires but the fires have made them worse, and there's an ongoing risk for VOCs, as we've seen down in California."

"And also I'm wondering how much contamination there's going to be in water. Because where we live, in Niagara, our water source was the creek. And with what's happened up there I wouldn't drink the water coming from the creek."

"They finally got a temporary water plant and now we have potable water. A lot of people still won't drink it."

"Well, I live right up the Little North Fork, and we've already seen stuff on the runoff coming down...and it's muddying up the water. This watershed's not gonna be the same for a decade at least. All the runoff, all the mud that's gonna come down from these rains from all this timber, and the timber that's still there, just waiting for a good rainy day to let loose along the river and float down and cause mayhem."

"We still have people that want to go swimming in rivers closed to the public. And then they get called because they get stuck or, you know, their lives are on the line and they're holding onto tree branches."

Key informant interviews indicated that Detroit's drinking water quality and access was impacted most intensely for the longest period of time because its water treatment and delivery infrastructure was damaged and not functioning until beginning 7 months after the fires, and many did not have running water until just over a year after the fires. The main challenge in restoring running water has been in replacing contaminated lines. The slow sand filtration system used to treat Detroit's water does not deal well with turbidity associated with wildfire impacts to watershed conditions, and a membrane system that deals with turbidity more effectively was constructed, with additional plans to repair the old slow sand system, which generally works well in the absence of turbidity. All of the contamination reported thus far has been system-driven rather than source-driven. Total dissolved organic carbon increases after fire (Uzun et al 2020), which leads to contamination in the form of byproducts associated with the interactions between disinfection agents and organic carbon (Tak and Vellanki, 2018). Public perception is also reportedly driving testing above what is required to instill confidence in

the water system in part because the sampled levels of methyl tert-butyl ether (MTBE) which are considered safe in Oregon would be considered toxic in California. Two properties tested positive for acutely toxic levels of benzene, and chloroform, styrene, and methylene chloride were also detected prior to water running. Detroit's fire hydrant supply is considered sufficient according to one informant and sufficient for the current but not projected population according to another. The size of mainlines and storage capacity for water is being increased overall from 190,000 to 527,000 gallons. Water recreation and its impacts on the economy were reported, with loss of fishing and swimming opportunities, and higher potential for cyanobacteria associated with the post-fire environment due to less shade and influx of nutrients.

Gates was without water for three days during which the water was not safe to drink due to VOCs detected in the lines. After the lines were flushed, the water was tested and determined to be safe to drink. The 10-year old membrane filtration system and associated delivery infrastructure were not damaged or lost during the fires. Homes that burned allowed contaminant to enter the Santiam River, however most of the 100+ samples collected were below minimum contaminant levels despite the influx of materials associated with burned buildings. Only one algal bloom has been detected which was surprising and thought to be potentially because of the release of something into the water from the fires that inhibits algal blooms. There has been a slight (4%) decrease in water consumption since the fires and no anticipation of issues associated with availability of water in the future. Gates is the only city in the Santiam Canyon identified in a recent wildfire exposure analysis of public water supply areas as one of the top 25 areas in Oregon for wildfire exposure as measured by percentage area burned in 100 years (Day, Ringo, and Ager, 2021).

Private wells are not regulated in Oregon, so it is difficult to assess results of well testing post-fire, but resources were provided through Oregon DEQ for testing of wells impacted by the 2020 Labor Day Fires.

Air Quality

Indicators of air quality and respiratory issues include Air Quality Index (AQI) as measured by PM 2.5 concentrations, number of respiratory complaints post-fire, increased ash and dust in air (likely contaminated), and smoke inundation of buildings. Overlapping impacts from 2021 wildfire smoke with dust and ash in the air pose challenges in parsing out root causes of human health impacts from degraded air quality.

Survey results indicated overall that 72% (n=55; Appendix B, question 3) felt they had been impacted by issues associated with air quality within the last year. Both indoor and outdoor air quality were of concern, with outdoor air quality ranking 7th as a significant health issue for the Santiam Canyon community (n=21, 28%; question 1).

Focus group participants and key informant interviewees spoke of experiencing or witnessing more outdoor than indoor air quality impacts:

"I gasp for air coming out my small hill from the back property. I never use it anymore."

"I think everybody's lungs took a huge hit too. I know my lungs are awful. I haven't felt well since the fire, literally. Our house didn't burn. But I have air filters in there that I change every other week that are black. And I am breathing that."

“It’s affected people’s eyesight too. My eyes feel like they’re constantly puffy. Every morning I wake up and my eyes are all watery. My vision’s gotten a little bit worse. Getting older too, so...”

“And my livestock’s lungs have been hammered. My goats, every one of them now coughs more than they used to. They’ve had to walk around in the ash, and now that the rain’s back, mixing the soil. They’re all black and everything. It’s not brown dirt, it’s black. So it’s still there, and all the toxins and everything, and they’re having one heck of a time.”



The Santiam Canyon was evacuated during the fires followed by rains that stopped the fires and hence smoke from the 2020 Labor Day Fires was not a factor. Air quality issues are largely associated with post-fire smoke inundation of buildings and contaminated dust according to key informant interviews. Convective wind created through heating of exposed areas once covered by forests that did not heat and cool so readily stirred up dust during the dry season. Dust control on gravel roads provided by the county helped, but it was well after impacts had been experienced. Vegetation returning to mitigate soil movement through the air will ultimately make the difference according to one key informant. Reports of health issues associated with breathing contaminated dust include swollen lymph nodes and sore throats.

There is a lack of information linking post-fire air quality impacted by contaminated dust with human health. Current air quality monitoring is not

set up to detect volatilized chemicals from burned buildings and vehicles being transported through the air and into people’s lungs. Capturing PM 2.5 concentrations does not meet that need.

Soil Health and Stability

Indicators of soil health and stability include landslide occurrence and issues associated with collapsed septic systems. Despite the high erosion potential in many areas burned, no landslides have been reported. Stabilization efforts were reported as being performed on National Forest System lands as part of Burned Area Emergency Rehabilitation efforts.

Watersheds recently burned by wildfires are prone to debris flow occurrence, particularly within the first 2 years following wildfires (De Graff 2018). Debris flows are less likely over time due to

recovery of vegetative cover and soil infiltration associated with restored hydrological function (De Graff 2018). Burned drainage basins with forest cover represent an exception, where a secondary period of increased susceptibility to debris flow due to fire-induced tree mortality and root decay leads to infiltration-triggered landslides 3-10 years or more after the fire (De Graff 2018).

The towns of Detroit, Niagara, Gates, Mill City, Mahama, Cascades Sport Camp and Detroit Lake State Recreation Area are considered to be at high risk from debris flows, rock fall or landslides (FEMA 2020). Past debris flow fan deposits are found beneath portions of communities and facilities throughout the Santiam Canyon (FEMA 2020). There is a very high risk at North Fork Park, on North Fork Road SE, and along the OR-22 corridor from rock fall and rolling debris (FEMA 2020).

Soil Burn Severity (SBS) as mapped for the initial purposes of Burned Area Emergency Response serves an additional purpose in providing a data point that serves as a metric for estimated vegetative recovery period as measured in years that is sufficient to reduce runoff and erosion potential to pre-fire conditions. Plant association group, aspect, soil type, and SBS all impact vegetative recovery periods. Areas burned at low severity will generally recover within two years, with areas burning moderately severely recovering within 3-5 years. High SBS in areas of conifer stand-replacement fire with loss of overhead canopy, ecosystem recovery can take up to 2-3 decades. Most of the areas immediately adjacent to the Santiam Canyon experienced low-moderate burn severity (see Figure 1) which bodes well for projected natural recovery periods.

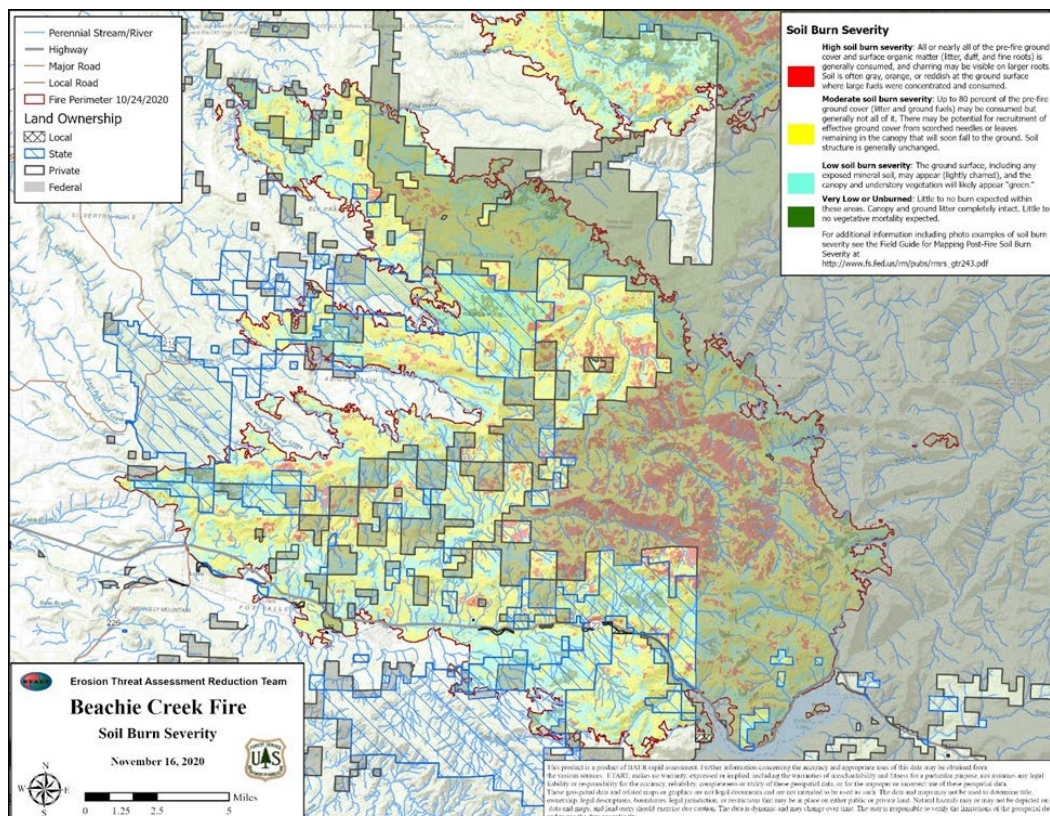


Figure 1 Map Source: Beachie Creek Erosion Threat Assessment/Reduction Team (ETART) Extended Report

One focus group participant indicated soil testing that was encouraging but had concerns about glass in the soil:

“And through our cleanup and soil testing, we feel good about that, but the reality of it is, you will always have little shards of glass. Originally I could stick my hand into the soil and dig wherever I wanted to. Now, this an impact zone on my property, and I’ll always be wearing gloves or whatever to make sure I don’t have a glass shard.”

Heat-Related Illnesses

Indicators of heat-related illness include reports of higher temperatures causing health issues that would otherwise not be experienced in the absence of tree canopy and other cooling vegetation. US Forest Service employees experienced heat stress symptoms during the unprecedented heat dome in summer 2021, and received direction from their leadership to stop going into the field when temperatures exceed 100 degrees thereafter. Due to the exceptional heat experienced last summer, it is difficult to ascertain whether heat-related illness would have been experienced otherwise. A “normal” summer would have provided a more comparable set of conditions to evaluate whether increased ambient air temperatures within the fire areas caused heat-related illness.

Focus group participants spoke of discomfort associated with heat in the changed environment:

“It is hot and there's no shade anymore. “

“There’s difficulty getting away from the heat because when we have the higher temperatures the campers are really exposed. So they’re struggling to keep things at a reasonable temperature.”

“It’s hot, it’s stressful, I mean 115 degrees in an RV? The AC does not work and you have nowhere to hide... It’s just going to be quite hot for a while. Even if you don’t have those scorching degree temperature days like Detroit, or the canyon goes back to normal where it’s more like it reaches 104 and then it goes back down to 90 and 80.”

“Clearly, the microclimate in the canyon is going to be different for the rest of our lives, and adjusting to the expectations of heat, the lack of shade, what it means for the fish – there’s a lot of environmental change. And so adjusting our expectations to that is a really big part of it. There’s a deep sort of mental health component to this for me.”

Exposure to Other Toxins

Indicators of exposure to other toxins are varied. Survey responses indicate that exposure to other toxins are a concern, but specifics about the nature of concerns and vehicles of exposure other than water, air, and soil are not available. This speaks to the impacts being identified in focus group interviews and surveys including swollen lymph nodes, shortness of breath, red eyes, and sore throats that cannot clearly be tied to one single cause, and may be caused by exposure to something yet to be identified.

	%	Count
Yes, I believe that we have been exposed to toxins or contaminants related to the fires over the past year	52.78%	38
No, to my knowledge we have not been exposed to toxins or contaminants related to the fires over the past year	47.22%	34
Total	100%	72

Recommendations

1. **Consider the impacts of smoke created by burning post-fire debris and consider altering allowances for burning in fire-impacted areas.**
2. **Sample and test ash and dust for toxic chemicals.**
3. **Consider the impacts to air quality from impacted soils and mitigate with intentions similar to those used in mitigating interactions between water and soils in post-fire debris movement.**
4. **Evaluate water sources and infrastructure not impacted by the fires for exposure and risk.**
5. **Plan for post-fire dust mitigation needs early in disaster response and recovery process.**
6. **Utilize the Pacific Northwest Quantitative Risk Assessment for prioritization of risk reduction activities (Gilbertson-Day et al 2018).**
7. **Recommend post-fire mitigation measures in forested terrain including stabilization measures to address the primary risks within the first two years posed by debris flows caused by progressive entrainment, such as seeding, mulching, directional felling, wattles, and haybales.** Subsequent and simultaneous mitigation for later debris flows in forested terrain involves timely reforestation of areas where fire damage and decaying roots compromise soil strength (De Graff 2018).

Housing

Housing as a Social Determinant of Health

Housing is one of the most researched, well-established social determinants of health. Published literature about housing's relationship to health affirms at least four key pathways through which housing bears a direct impact on health and well-being: stability, conditions (indoor), affordability (financial), and neighborhoods (environmental and social characteristics). Stress associated with unstable housing can lead to substance abuse, depression, and psychological distress as well as loss of employment. Frequent relocations prevent families from maintaining strong relationships in their community and complicate everything from practicing health-promoting behaviors (e.g., proper storage of medication) to maintaining regular access to care. Insecure housing often further leads to delaying doctor visits and poorer health outcomes (*Social Determinants of Health - Healthy People 2030* | *Health.Gov*, n.d.). Substandard conditions impact health through a variety of ways including exposures to extreme high or low temperatures and cramped living quarters. These conditions affect mental health, stress levels, relationships, and sleep (*Housing and Health*, 2018; Swope & Hernández, 2019). Smaller spaces also impact one's ability to store food, leading to reliance on store-bought, high-calorie alternatives which negatively impact health and well-being (*Social Determinants of Health - Healthy People 2030* | *Health.Gov*, n.d.).

When families spend more than 30 percent of their income on housing, they are “cost burdened”; at more than 50%, “severely cost burdened.” These circumstances reduce the ability to purchase sufficient supplies of healthy foods, maintain a prescribed medication regimen or save for a future housing option in neighborhoods with health-promoting features such as schools and parks. Indeed, neighborhood characteristics such as proximity to grocery stores, safe spaces to exercise or public transport options are correlated with improved health outcomes. Living next to roads with intense traffic increases likelihood of respiratory diseases. And less visible community attributes such as measures of segregation, crime and social capital also influence health by way of determining access to schools, jobs and health care (*Housing and Health*, 2018).

Published literature about wildfire recovery confirms that the devastation of losing one's home contributes to PTSD and depression through the disruption of community ties, instability, and feelings of lost identity (Agyapong et al., 2021; Paveglio et al., 2015; Pazderka et al., 2021). One study which surveyed 588 individuals six months after a wildfire in Canada demonstrated suffering property damage increased odds of PTSD by 1.6 (Agyapong et al., 2021). A 2007 study in California showed a 3.4 increase in odds — more than a loved one being injured (3.25) or thinking one's own life was in danger (2.9) (Marshall et al., 2007). Psychologically, personal property is related to an individual's identity. And the traumatic stress experienced when this is gone is so powerful — one professional / personal account explains — survivors do *not* possess the option *not* to change (Stamm, 2017). Community support, often strong initially, frays over time, making evacuated residents increasingly vulnerable to stress, anxiety and depression (Rosenthal et al., 2021).

Displacement from one's primary residence to temporary can impact physical health through shifts in diet, ability to exercise, reduced access to care and increased exposure to the elements. The cumulative stress collected over time, moving between rentals, hotels and shelters creates or exacerbates physical health issues. Furthermore, physical damage to

pharmacies, road closures and increased distances to travel mean residents encounter difficulties accessing prescription drugs. Cramped conditions in temporary shelters make daily routines of exercise and cooking healthy meals more difficult to manage (Felix & Afifi, 2015; Rosenthal et al., 2021; Stamm, 2017).

Natural disaster recovery literature affirms the conditions for the above health impacts. In particular, response to natural disasters by federal agencies such as FEMA and HUD are often slowed by bureaucratic red tape, perpetuating situations of prolonged displacement following disaster (Bozick et al., 2021; *Housing and Health*, 2018).

Our health assessment affirmed the above-cited literature. Although one could make the case that Santiam Canyon residents are experiencing negative health impacts through all four pathways identified above, the assessment revealed that the stability and conditions pathways may be the most pertinent. In this section, we lay out the major themes that emerged regarding how the loss of housing has impacted, and continues to impact, Santiam Canyon residents' mental and physical health, ongoing needs, and recommendations to address those needs and improve future wildfire responses.

Findings

Displacement & Housing Instability

Over 700 families lost their homes (Oregon Disaster Housing Recovery Action Plan, June 2021) to the 2020 Labor Day wildfires, forcing thousands of Santiam Canyon residents to move into disaster sheltering. Affordable housing options were limited¹ and many eventually moved to non-congregate housing². One year after the wildfires, 12.7% (41 / 322) of households actively case managed by the Santiam Integration Team had entered permanent rehousing while 87.3% remained either in a hotel, temporary rental, couch surfing or living in an RV (T. Goettsch, personal communication, Sept. 28, 2021). As of late September, Marion County Housing Authority and The ARCHES Project assistance translated into permanent housing solutions (i.e. housing vouchers) for 10% (73) of the 724 homes impacted (A. Hamilton, personal communication, Sept. 28, 2021; C. Jamison, personal communication, Sept. 29, 2021). Eighty-six percent of residents responding to our survey reported having had to move to temporary housing because of the wildfires, of whom 56% are still living in temporary conditions.

Mental Health Impacts

When asked about the specific ways housing loss impacted health of Santiam Canyon residents, nearly every key informant pointed to trauma, depression, and chronic stress / anxiety. Some noted this further impacted day-to-day decision making and the ability to rebuild. Santiam Canyon residents described how prolonged temporary housing, the inability to start rebuilding, and the associated uncertainty contributed to mental health effects.

¹ Anecdotally, residents faced 1% vacancy rates when the fire hit (T. Goettsch, personal communication, Sept. 24, 2021). Two property managers running affordable housing units in Marion County confirmed 3-5% vacancy rates (J. Erikson, DevNW, personal communication, Oct. 11, 2021; C. Jones, Catholic Community Services Foundation, personal communication, Oct. 12, 2021).

² The easiest way to describe non-congregate shelter (NCS) is to juxtapose it with what is typical for disaster sheltering. A typical disaster shelter would be a congregate setting like a gym or large open area with cots and communal feeding locations like a cafeteria. NCS on the other hand, just refers to the universe of options available in order to shelter individuals and/or families outside of a congregate (communal) setting. Often this is hotels but can also be other non-congregate options such as dormitories, apartment-style settings, trailers, cabins, or other options. Individuals in these settings are typically provided food vouchers or are provided meals through a vendor (K. Lindsey, personal communication, Sept. 27, 2021)

“The health effects of that uncertainty and lack of stability contributes to a lot of people's depression and anxiety.”

“I would say undue overall underlying stress. Not having your home, not having a safe place to go. So all your security and everything is gone. That weighs a lot on people. I know it does.”

“PTSD has been forefront for me. The fact that I haven't been able to start rebuilding. I think that's added to it ...”

Loss of identity. Possessions form one source of identity which, when lost, may lead to a lessening of self. Similarly, one's home is more than a collection of objects — it is an environment where one feels comfortable and secure, representing a way of life (Sayre, 1994). Homes ruined by wildfire become spaces imbued with memory — of the fire itself, life prior to the fires and a once imagined future (McKinnon & Eriksen, n.d.). Santiam Canyon residents offered powerful descriptions of the trauma and grief associated with losing their home, possessions, and memories:

“The way I describe it is I feel like I've been erased.... I just look around where I'm staying now and I just feel like my whole life has been erased. Because I can't go back and tell any stories about where this came from, and this belonged to your great-grandmother, and you know, so what happened to my life? It's gone.”

“Lots of history. Lots of history that gets accumulated over the years. Because last Christmas Gloria was feeling really down because all these accumulated that the kids have made over the years and stuff, all that's gone. Personal effects that you may have inherited or whatever. So yeah, a lot of history has sort of disappeared.”

“Or you go to your house and you look at your property and you stand there, and all I can think is, I never lived here, because that's not what my area looked like. It didn't look like the dark side of the moon.”

Loss of Community Ties. While recovery efforts following disaster carry the potential to strengthen community bonds through people coming together to support one another (Carroll et al., 2005; Lalani et al., 2021), the drawn-out relocation experienced by residents who lost their homes resulted in reduced connections to neighbors and community, impacting mental health. Separated from neighbors and friends, residents were without an important source of support to combat stress. Santiam Canyon residents described this during the focus groups held in early November:

“The loss of community was the hardest. People talked to me about our home being gone, or stuff being gone, and I'll be honest ... we were close with our neighbors and they're still our friends, but they're not there. And it's like you're living in a different location right now and you're not next door to them anymore.”

“So social capital, the ability to have social ties and connections, got blown out of the water because people had to leave the community to go live somewhere... That's been huge... And so the ability to get folks back in the communities would ..decrease the social isolation and increase the social ties and I think that that has huge health impacts. And so they're all linked. There's this web of impacts... So housing to me is a king pin for them.”

Physical Health Impacts

Vulnerability during displacement must take stock of the varied ways in which health is impacted through reduced access to resources and a change in environment (Chase & Hansen, 2021). Santiam Canyon residents described how ongoing displacement is impacting physical health through shifts in diet, ability to exercise, reduced access to medical care and increased exposure to the elements — both hot and cold.

Shifts in Diet. Qualitative data collected during focus group interviews centered on how displacement led to the need to rely on alternate, unhealthy food sources:

“I'm still not in a permanent home. I'm still in a hotel. As far as health goes, my health has been decreasing steadily still. I'm in a wheelchair and it's been getting worse and worse as the months go on because living in a hotel you can't get proper food, you can't get proper exercise. You can't really do much because you are just trying to survive.”

“The other half of it is that our natural grown foods (are gone), so we're having to rely more on store bought foods which directly affects your mental health. Because there's a gut-brain connection. And so when we're having to eat more processed foods, or God bless the outreach has been there on the weekends and stuff with us, it's all high-carb food. It's not fresh vegetables and organic meats and grass-fed pigs that we're used to eating, organic.”

“..In the RV - the fridge is very small, so trying to store fresh fruits and vegetables for five people at all times was impossible. So we relied a lot on packaged food. We couldn't eat as healthy as we normally would.”

Quantitative data collected through our online survey demonstrated displacement impacts diet by way of reduced ability to store food: 40% of respondents confirmed their ability to access adequate healthy food had been impacted either by inability to store adequate quantities or inability to store food safely to prevent spoilage.

Exercise. Our survey found that 3% of respondents considered it very difficult to exercise prior to the fire, but 25% felt this way since the fires over the past year (Appendix B, question 12). Residents articulated this during focus group interviews as well:

“While in the camper, there is a reduced ability to exercise. When inside it's cramped.”

“And exercise: my husband used to walk North Fork all the time to get his exercise and he hasn't been able to do that and that's made a huge difference in his ability to cope. Not that it was that well to begin with, but it's worse, because he can't....”

“You know, our next-door neighbor is still living in her RV again this winter... And what she's told us about the lack of ability to exercise, living in a very small space, and just not having an outlet. Can't go to the gym right now because of the pandemic. And even if you had the money to do it, living in a very cramped environment has been very tough.”

Access to care. Residents participating in focus group interviews and an online survey outlined the struggles they faced to maintain a healthy care routine while at an increased distance from their provider and moving frequently:

“We started out in a hotel up in Portland and ended up in a rental in Sandy. And then they decided to sell our rental so we had to purchase a camper. So all that moving around made continuing with doctors’ appointments and staying up to date on things really challenging -- medications, moving pharmacies.”

“I had to temporarily move out of area and the trip was too far to see my Dr. I had to find new Dr. that we’re taking patients and that put me off my annual exams by quite a few months.” [survey response]

Exposure. Focus group participants articulated fears about their ability to cope with heat and cold while staying in temporary facilities which offer less protection from the outdoor elements:

“For those of us who lost our primary structures, we are living in RVs so we are concerned about the weather and being in cramped quarters; the snow which is supposed to ... and then the definite constant stress .. living out in the elements is rough. The winter is supposed to be harsh.”

“Well, we are expecting it to be harsh, harsh winter. And with not very many people living in the city right now, not very many neighbors and Detroit, I’m afraid we’re going to get forgotten about because it’s expensive to come clear snow for only the few people that live here. And, and if you’re in your RV, you’re going to have to watch out how heavy is a snow.”

Rebuilding

If losing one’s home contributes to mental health issues by way of the disruption of community ties, stability, and personal identity, addressing those issues is accomplished through the restoration of community ties, stability, and personal identity. The most obvious way to do this is through rebuilding. A document titled “Housing Planning Context” prepared by Oregon APA for Marion County, in August 2021, noted that the true extent of survivors still in need of permanent housing was not fully known and remained an issue statewide. Although not unique to the experience of Santiam Canyon residents (Eriksen & Vet, 2021; Greer & Trainor, 2021; Kramer et al., 2021), rebuilding efforts in the canyon have been slowed by administrative, financial, and social barriers — often creating additional layers of stress and anxiety.

Administrative. Septic and building permits constitute one indicator of rebuilding progress. As of Nov. 15, just 53% (371 of 694) of homes impacted by the wildfires in Santiam Canyon had been issued septic permits (Santiam Canyon Wildfire Recovery Report, Nov. 15, 2021), up from 50% in early September (B. Reich, personal communication, Sept. 3, 2021). 42% (301 of 694) had been issued building permits (Santiam Canyon Wildfire Recovery Report, Nov. 15, 2021), up from 37% in early September (B. Reich, personal communication, Sept. 3, 2021). For some Santiam Canyon residents, accessing assistance programs and services was made difficult because often those arrangements were not formally documented, making it hard to demonstrate or verify loss (K. Travis, personal communication, Sept. 24, 2021). An October 2021 brief prepared by Marion County on response and recovery confirmed this. The brief communicated those applying for assistance from the Federal Emergency Management Agency program but found ineligible had the possibility to appeal and receive assistance by supplying additional documentation or information (Santiam Canyon Wildfire Response & Recovery brief, October 2021). Santiam Canyon residents described administrative barriers in this way:

“It’s literally a roller coaster that you have to live 15 times over. Because each agency wants verification. ‘Oh, what happened? Now we’ve got to verify that you’ve lost your stuff. Now, show me documentation that you lost your stuff, and how much it was worth,’ and this and

that. And then, 'Oh, we need to see it again and again and again.' And I mean, you give up. You give up after the fourth time."

"The county waived building fees for primary residence permit, but not for outbuildings, and we lost every single one of ours. That's been a harder process. That was something we wish would be a program, outbuilding wise — for permits to be discounted or waived."

"It's hard to get through the permitting process. Usually there's a lot of no's and so you try and then you get told no. Basically you're not told how to do it first. We're all beginners. We're not builders. I think some guidance on the steps to take [would be helpful] because we took a wrong step and it set us back about seven months. So somehow, you know, the step-by-step."

One key informant noted some cannot rebuild because they can't get an appraisal. Appraisals are busy with the homebuilding boom and slowed in the canyon due to a lack of comparables because many homes are now gone (N. Harvey, personal communication, Sept. 5, 2021).

Financial. Key informants frequently noted the challenges of rebuilding due to being underinsured and the high price of building materials. While nobody this research team spoke to could quantify to what degree residents were underinsured, construction costs reportedly rose 25% since September 2020 (Oregon Disaster Housing Recovery Action Plan, June 2021, p.12). Of 189 (pre-fire) homeowners actively case managed by the Santiam Integration Team in late September 2021, 91% had home insurance. Of 125 (pre-fire) renters, 36% had insurance (T. Goettsch, personal communication, Sept. 28, 2021). However, home insurance policies often did not/do not cover items like wells or septic systems and many residents' policies lacked a "replacement value" provision (K. Travis, personal communication, Sept. 24, 2021). Santiam Canyon residents repeatedly described financial barriers in two ways: inadequate compensation and a process that was deeply frustrating:

"Nobody I've talked to has been fully insured and compensated. Everybody was underinsured. I haven't heard from anybody."

"I think dealing with the agencies and the insurance companies really causes a huge amount of stress. And you just feel like you are in a vacuum someplace. It's awful, truly is awful. You just feel like you're sinking all the time. No matter what you do, you can't fix it... I just literally shut down. I haven't finished insurance. I haven't finished with my FEMA stuff because I just can't move forward."

"Yeah, suicidal ideation, depression, anxiety, post-traumatic stress syndrome, and like for myself, dealing with an insurance company that's been mentioned a lot, I'm not going to say a name, but we all know which one I'm talking about. Um, emotional abuse has been horrific. Adjusters and the folks that you're talking with about doing your claims with."

"We were full steam ahead, we thought we had enough to start construction on our home in Detroit. So we did all the application process ..and I started really reading it and found out they were gonna take all of our insurance proceeds. So they were gonna give us a certain dollar figure to rebuild our home, but they wanted to take everything that we got from State Farm. The problem with that is it wasn't going to be enough with lumber prices going up 400% after the fire, there was no way."

Social. One key informant observed Santiam Canyon residents are very self-reliant, and some have never tried to access state or federal resources before. Some may feel uncomfortable having their name on a government list (K. Travis, personal communication, Sept. 24, 2021).

While research questions did not examine Santiam Canyon residents' willingness to have their names on a list, some acknowledged the independent streak of their loved ones which kept them from seeking community support and may have served as a barrier to seeking assistance (i.e. for rebuilding, and other forms of support) from county and state authorities. Participants also outlined how age demographics introduce unique barriers to push forward with rebuilding due to lack of motivation:

"My husband is 77. He refused to come to support groups for a long time because he won't ask for help, he won't seek help."

"Well, we had a lot of generational elderly populations that have roots here that I think a lot of people have overlooked. They feel like they're not going to be able to see the recovery. So that leads into an even deeper depression for them. A lot of our neighbors have lived there 20 plus years and they're still grieving over the loss. They can't even imagine moving on to the rebuild process."

Key informants also noted communication / coordination gaps as barriers to rebuilding whereby residents were uncertain where to go to locate services (T. Goettsch, personal communication, Sept. 27, 2021).

Recommendations

These recommendations address what local and state authorities can do to address mental and physical health needs at this time as well as what can be done to improve future responses to minimize such health challenges. Inasmuch as rebuilding carries potential to improve mental health through restoration of community ties and identity, and the possibility to strengthen physical health by way of a return to infrastructure and space which allows for daily exercise and meal routines, we submit the below recommendations for local and state authorities to consider:

- 1. Identify additional steps (e.g., waiving permit fees, appraisals) in the rebuilding process which can be simplified or removed without adding risk to the integrity and structure of a future home.** Remove them to facilitate a swifter, less tedious experience for affected residents.
- 2. Advocate for steps to reduce bureaucracy and redundancy and to streamline residents' experiences with regard to insurance and reimbursements.**
- 3. The months following a catastrophic wildfire may open a unique policy window for local communities to adopt fresh policies fostering resilience in social ecological and built environments.** Examples may include strengthening regulations (vegetation thinning, building codes enforcing use of fire-resistant materials, spacing requirements) and increasing education and awareness raising activities (Mockrin et al., 2015, 2016, 2018; Moritz et al., 2014; Schumann et al., 2020). Recognizing that extreme wildfire events are increasingly regular and wildfire-urban interface continues to expand, there is increasing

interest to build fire-adapted communities capable of coexisting with wildfire. The scope of the present report was not sufficient to assess opportunities present in Santiam Canyon, what policies have been considered, or provide an overview of current best practices. At the same time, the relevance of such considerations for the future is sufficiently strong to warrant mentioning here.



Mental and Behavioral Health

Background

Both domestic and international research suggests that populations experiencing wildfire, or any natural disaster, tend to have higher rates of mental health concerns as compared to control populations, for some years post-event. Mental health conditions may be experienced by as many as 24-41% of wildfire survivors (see summary by Finlay et al., 2012). The most common post-disaster conditions are post-traumatic stress disorder (PTSD), depression, and anxiety. In a large review of 160 disaster studies spanning two decades, Norris et al. (2002), identified that the most common psychological impacts following a natural disaster were (in order of decreasing prevalence): PTSD, depression, anxiety, non-specific distress (e.g., chronic stress), and psychosocial resource loss. Although rates tend to be much lower, the research also reflected upward trends in suicidality, alcohol abuse, and other behavioral symptoms of mental health challenges (e.g., Papanikolaou et al., 2011; Pietrzak et al., 2012). Research indicates that the prevalence of mental health conditions should decrease with time, as survivors naturally grieve and recover. For example, Norris et al. (1999) indicated that rates of PTSD tend to be “very low” 2-5 years after a natural disaster, but that, “psychological consequences can be evident for a very long time” (p.3). Pietrzak et al. (2012) conducted a 14-month longitudinal assessment of depression, anxiety, and PTSD in the populations of Galveston and Chambers counties in Texas after Hurricane Ike, found much higher rates of all conditions within the first 6 months after the hurricane, with PTSD being the most common. The study also found that rates of all three conditions declined over time.

Although the large majority of natural disaster survivors demonstrate resilience to long-term mental health issues, it is reasonable to expect that a not insignificant segment of the population will experience some type of psychopathology, often depending on several factors. For example, direct exposure to the disaster, evacuation experiences, and resources and support during recovery can all impact individual mental health trajectories among survivors. Mental health challenges and prolonged grief may be more frequent among those with direct exposure to disaster (Johannesson et al., 2011). Evacuation experiences can exacerbate risk perceptions and distress because of the high uncertainty and terror of the event; the resulting distress may also impact survivors’ coping skills (Bauer, 2015).

Survivors’ experiences in recovery, which can last for years post-disaster, may be more important in determining long-term mental health than the initial experience of life-threatening trauma (Norris et al., 1999). Overstreet et al. (2011) draw attention to the role of socioeconomic status or income loss after a disaster that can either impact recovery trajectories or function as a significant underlying stressor. Secondary stressors further tax survivors who are already vulnerable, hinder the return to normalcy and comfort, and can even serve as regular reminders of trauma. Persistent/recurrent threats can operate as additional background stressors, especially when these are seasonal or cyclical (Overstreet et al., 2011). For these reasons, secondary stressors pose a significant threat to mental well-being to survivors over the long-term (Overstreet et al., 2011; Sattler et al., 2002).

Social support can act as a buffer during times of extreme stress or hardship, but experiencing wildfire or natural disasters can disrupt the positive impact of buffering in many ways. The stress of displacement, income loss, or rebuilding can disrupt the family unit, threatening the mental health benefits of having a stable family life (Overstreet et al., 2011). Post-disaster mental

health issues may be greater in communities defined by wide social connection (Norris et al., 2002), especially in rural areas where residents depend so heavily on cooperative social networks. Housing displacement or significant community change can lead to “resource spirals” – wherein loss accumulates cross-sectionally and longitudinally, further contributing to chronic stress. Some research (Papanikolaou et al., 2012) has even pointed to a loss in faith in institutions, particularly government institutions and response agencies, which can further stress survivors and complicate recovery efforts.

Another aspect of recovery from wildfires is a natural grieving process. Grief is expected for any loss (e.g., ways of life, treasured possessions, animals, loved ones and friends), especially after a natural disaster. Harms et al. (2015) found that loss of friends (perhaps because of displacement) or community was more impactful on mental health than the traumatic event itself. Grief trajectories vary; one study of Swedish citizens impacted by a tsunami estimated that about 11% of respondents struggled with chronic or prolonged grief after a natural disaster (Sveen, Johannesson, Cernvall, & Amberg, 2018). Some survivors may experience complicated or prolonged grief, which is a concern because of its association with mental health conditions. Solastalgia is a unique form of grief that may be particularly relevant to communities recovering from wildfires; solastagia can be described as “the feelings of distress and anger experienced by people who had lost their solace and place attachment toward their home and territory because of environmental degradation” (Warsini et al., 2013, p.87). Eisenmann et al. (2015) found that environmental changes after a wildfire were a significant source of mental distress for affected community residents.

Findings

Of all the health concerns identified in key informant interviews, the focus group interviews, and the survey, mental health concerns were the most frequently identified concern. Based on survivors’ characterizations, mental health concerns also appear to be the most pervasive, and the most complex. Concerns range from chronic stress to life-threatening mental health conditions, with variation in between.

Chronic, Emotional Stress

Survey results indicated that emotional stress was the most significant health-related issue resulting from the wildfires for both respondents’ families (n=55, 74%) and for the Santiam Canyon community (n=46, 62%). Survey respondents also reported more frequent physical symptoms of stress since the wildfires. As shown in the results for question 12, the percent of respondents reporting *some difficulty* or *a lot of difficulty* with digestive problems increased from 34% (n=22) to 48% (n=29); headaches increased from 32% (21) to 61% (n=37); and sleeping problems increased from 44% (n=28) to 82% (n=50). In the focus group interviews, participants described the stress as always present and unrelenting.

“It stresses you out. The stress is just horrific. You know, you have to fill out one more application and you have a complete emotional breakdown and you feel like you’re crazy. Because you wouldn’t normally be like that. Like I’m highly educated and to do this stuff, I was losing my cookies. Because it’s just one more and one more and try and pull these together, the stress and then in your marriage and your relationships it takes a hit because you just can’t deal with it.”

“I would say undue overall underlying stress. Not having your home, not having a safe place to go. So all your security and everything is gone. That weighs a lot on people.”

“Rebuilding is a full-time job in and of itself, surviving in rebuilding and then we both work full time. So not a lot of good sleep . . . Definitely an ongoing issue and related to the PTSD. But I think it's just, you're mentally stretched then there's not much downtime. It's always thinking about the next thing that has to be done to keep the process moving forward because it does require constant tending to keep that rolling.”

The sources of stress identified by focus group participants were varied and numerous. Assistance and response agencies were often identified as contributing to stress, especially within the context of confusing or frustrating bureaucratic processes.

“It's literally a roller coaster that you have to live 15 times over. Because each agency wants verification. ‘Oh, what happened? Now we've got to verify that you've lost your stuff. Now, show me documentation that you lost your stuff, and how much it was worth,’ and this and that. And then, ‘Oh, we need to see it again and again and again.’ And I mean, you give up. You give up after the fourth time.”

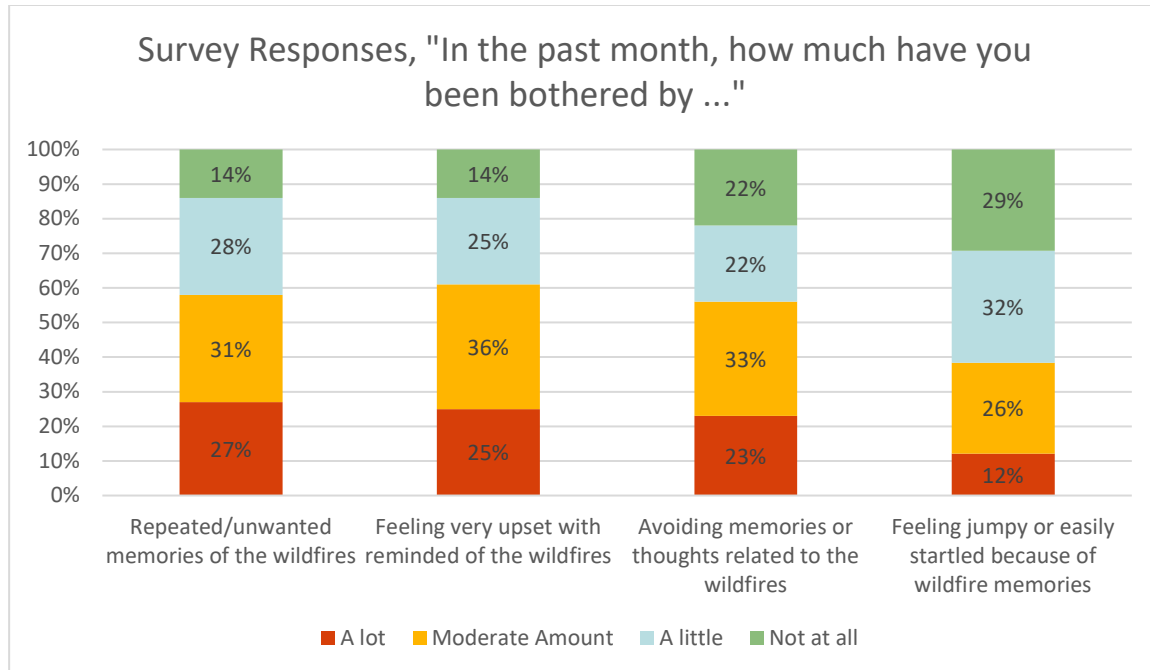
“The emotional abuse has been horrific. Adjusters and the folks that you're talking with about doing your claims with. I mean initially just trying to get reimbursed for my displacement, because we had to pay all this money for hotels to stay in and food, and run out and get some clothing, and all that stuff went on our credit cards. We go to turn in the receipts and then the negotiation wars are on. And they don't just pay you back on your receipts. I had a 3-hour phone call with the guy, I cried hysterically all the way through the phone call, . . . We still don't have our contents money.”

And similar to factors identified in the literature review, participants described the accumulation of stressors:

“You have to do all this stuff with a full-time job. Most people can't handle that. They can't handle working full time and going home to nothing or going home to a trailer or an RV. So they lose that job. And then food is gonna become a whole other thing. So I think there's a lot of that going on, that's going to touch on a lot, and it doesn't get spoken about.”

Trauma and Mental Health Challenges

Survey results indicated that mental health challenges were ranked third among participants' concerns for the Santiam Canyon community (n=32, 43%; Appendix B, question 1). Survey results likewise indicated that a significant percentage of respondents reported symptoms consistent with PTSD (question 13).



Focus group participants and key informant interviewees spoke of experiencing or witnessing PTSD, depression, and suicidal ideation/attempts. Of all the specific conditions mentioned, PTSD was the most frequent. This focus group participant summarized the issue well:

"I have to say that my observation so far, Post-Traumatic Stress Disorder. . . I've noticed a lot of hypervigilance and related relationship to the PTSD. Depression and anger have been mentioned, the generalized anxiety . . ."

According to the Oregon Office of Rural Health (2021), the Santiam Canyon area has no mental health providers. Focus group participants felt the lack of support acutely, and spoke of their frustrations in the unavailability of mental health services:

"They're like, so if you want to see counseling we can offer you counseling. And it's like four months out to see somebody, but it wouldn't have been in person, it's zoom."

"So I said, Honey, I want you to get on the suicide prevention hotline and call somebody. I want you to talk-- . . . So she gets on the hot line. And it was just a couple of minutes of a conversation, no referral, nothing. And she said, Well, if you think you're going to harm yourself, call us back. And of course I about came unglued because . . . it was no help at all."

"Pretty much if you don't say you're suicidal or you're gonna hurt yourself or somebody else, you're not gonna get help."

Grief and Loss

Medical experts generally agree that the grieving process varies from person to person and with different types of loss. Key informants and focus group participants alike identified aspects of the grieving process that is still ongoing. Focus group participants in particular exhibited all the stages of grief (denial/isolation, anger, bargaining, depression, and acceptance). Two major

themes emerged about grief and loss; first, survivors were still coping with the magnitude of their losses:

“I can tell you that depression is one of the major items because everything you have, with the fire, like it's gone it 60 seconds. So hard to get your head around. I mean, All your memories. All your photos. So it's a head trip here.”

“The way I describe it is I feel like I've been erased. . . I was the collector of the family heirlooms. . . . And I just look around where I'm staying now and I just feel like my whole life has been erased. Because I can't go back and tell any stories about where this came from, and this belonged to your great-grandmother, and you know, so what happened to my life? It's gone.”

Second, where survivors are in the grieving process may be impacting decisions about rebuilding or contributing to how individuals are coping, as these two quotes demonstrate:

“Well, we had a lot of generational elderly populations that have roots here that I think a lot of people have overlooked. They feel like they're not going to be able to see the recovery. So that leads into an even deeper depression for them. A lot of our neighbors have lived there 20 plus years and they're still grieving over the loss. They can't even imagine moving on to the rebuild process.”

“There's a lot of guilt associated with shutting down also. You just feel like the lowest – can't get anything done. And it makes you feel guilty, and that's a huge part of it.”

Although grief or mourning for the natural environment was not a frequent theme in the focus groups, the idea did come up in key informant interviews. Some individuals expressed concerns over the stress related to a constantly changing landscape during clean-up; another key informant shared how community members and visitors frequently grieved over the loss of the natural beauty of the canyon. Over 80% of survey respondents agreed with the statement “I feel like I have been grieving for the loss of the forest” (Appendix B, question 14)

Social Connections and Social Support

Addressing the current state of social support in Santiam Canyon is like describing two sides of a coin – there are different perspectives and describing either side is an accurate depiction. Through key informant interviews, and from the survey results, there is evidence of community members coming together to help, to support each other, to grieve and heal together, and even some instances of expanding social circles. There has been significant mobilization of local effort to restore the homes and livelihoods of residents and neighbors. And this may reflect the nature of social cohesion that existed within the canyon before the wildfires.

Question	Strongly disagree		Somewhat disagree		Neutral		Somewhat agree		Strongly agree		Total
	%	n	%	n	%	n	%	n	%	n	
People around here are willing to help their neighbors.	4.62%	3	6.15%	4	18.46%	12	32.31%	21	38.46%	25	65
People are more willing to help their neighbors since the wildfires occurred last year.	4.62%	3	7.69%	5	24.62%	16	36.92%	24	26.15%	17	65

On the other hand, focus group participants spoke of changes in their social networks that suggest the stress-reducing buffering of social support is no longer present for many survivors, and may even function to deepen stress and grief.

"[description of neighbors] we'd see him all the time, we'd stand there and talk. How's your kid doing, or grandkids? And all this other stuff. And we don't do that anymore. We can't do that."

"Has anybody really talked about the loss of community? The loss of community. That actually was the hardest. . . Well, they're still our neighbors and they're still our friends, but they're not there. And it's like you're living in a different location right now and you're not next door to them anymore."

Some focus group comments also reflected frustration with the slow, bureaucratic process that is required for receiving support from some agencies, as well as the political aspects of the rebuilding process. The procedural aspects required to obtain different forms of aid was seen as contributing significantly to survivors' stress levels. To some degree this could be seen as reflecting a loss of trust in institutions.

"I think part of the stress too is that some of these agencies make you feel like you're whining. Like we want stuff for nothing....They make you feel like you've got your hand out."

Recommendations

1. **Normalize that trauma, mental health challenges, and chronic stress are expected for many years after wildfires.** Community leaders and health agencies can encourage public discourse about mental health symptoms, educate others to recognize signs of concern, and work to de-stigmatize help seeking. In this way, leaders and service providers will help community members to process their grief individually and collectively. Public communications would do well to embrace different ways that people experience or process grief; Harms et al. (2015) suggest maintaining flexibility in validating all types of experiences and losses.
2. **Address the shortage of mental health care providers in the Santiam Canyon area immediately.** Future disaster planning should include protocols for relocating or re-assigning mental health care providers who specialize in trauma recovery for at least two years post-disaster. All age groups as well as the use of existing structures should have the option to access mental health care. Overstreet et al. (2011) recommend school-based mental health services nested within a public health framework for children impacted by natural disasters; a comprehensive approach would mean employing a number of evidence-based actions including trauma-informed approaches, screening for mental health conditions, tracking those with diagnosed conditions, teaching coping and regulation skills, and enlisting the help of parents, teachers, and other leaders.

3. **Provide training on trauma informed practices for all responders and relief agencies to lessen emotional distress, including insurers.** Focus group participants consistently reported experiencing extreme stress and re-traumatization through interactions with agencies and organizations who were supposed to provide relief and support. There appears to be a significant opportunity to make recovery a more humane and dignified process by espousing a shared understanding of traumatic experiences.
4. **Advocate for more efficient and less bureaucratic processes to relieve stress.**
5. **Hold community dialogue about how wildfire impacts the natural environment.** By discussing and normalizing what residents can expect to see, they may experience less disorientation or solastalgia. Dialogue sessions could also emphasize the natural process of healing with a future orientation. Marking instances of growth, or the recognition of an expected phase of recovery, could support a more hopeful mindset, especially for those who despair that they may never see the canyon restored.
6. **Continue to support information sharing.** Community support meetings, religious practices, support for families with children, and the development or maintenance of social networks are all vital, affirming experiences that bolster resilience and recovery. Research suggests that communities with strong social cohesion recover faster and more fully (Aldrich, 2017).

Food Security and Adequate Healthy Eating

Background

The displacement and disruption caused by wildfires place a heavy burden on community food systems and generally create difficult challenges for families and individuals with regard to food access and consumption. The impacts on children and seniors can be especially severe.

The U.S. Dept. of Agriculture provides short-term food assistance benefits to people who have experienced a disaster through the Disaster Supplemental Nutrition Assistance Program (D-SNAP), and Santiam Canyon residents were eligible for these benefits following the 2020 wildfires (Oregon Department of Human Services, 2020).

What may be less fully appreciated is that food security problems created by natural disasters can persist over the long term and continue for months or years. Experiences in recent years have shown that wildfires create challenges related to food availability, healthy eating, and adequate nutrition through a variety of interrelated factors (e.g., Bohannon, 2020). The contributing factors may include:

- Lack, or limited availability, of running water
- Wildfire survivors' loss of income
- Reduced food storage space or access to refrigeration
- Closures of nearby retail groceries, necessitating increased travel to obtain food
- Loss of ready access to particular kinds of food, such as fresh produce and meats
- Heavy strain or disruption to the operation of local food pantries
- Loss of access to hunting, fishing, and gardening as regular food sources

In addition, the economic impact of Covid-19 over the past year may have made these effects even more difficult for survivors of wildfires and other disasters.

Therefore, in this study we sought to examine the degree to which long-term negative impacts on food security were still being felt in Santiam Canyon communities, one year following the 2020 wildfires.

Food security and its measurement

According to the U.S. Department of Agriculture (USDA, 2021), food security is defined as:

“...access by all members at all times to enough food for an active, healthy life. Food security includes at a minimum:

- The ready availability of nutritionally adequate and safe foods.
- Assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).”

Conversely, food insecurity is “the limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.” (USDA, 2021).

USDA measures household food security in the United States each December, through an annual supplement to the monthly, nationally representative Current Population Survey conducted by the Bureau of the Census. The standard food security measure includes 10

survey questions, with an additional eight questions included for households with children under age 18. A shorter, 6-question version exists as well, but is considered somewhat less reliable. Based on responses to these scales, USDA (2021) classifies food security into four levels, as follows:

High food security	Households had no problems, or anxiety about, consistently accessing adequate food.
Marginal food security	Households had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced.
Low food security	Households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted.
Very low food security	At times during the year, eating patterns of one or more household members were disrupted and food intake reduced because the household lacked money and other resources for food.
<i>Source: USDA (2021)</i>	

The *binary* classification of households as either “food secure” or “food insecure” refers to the higher two vs. lower two levels of food security, respectively.

Food security in Oregon and the Santiam Canyon counties

A September 2021 USDA report, using data averaged over the 3-year period 2018-2020, found that Oregon was one of 15 states that were significantly *lower* in food insecurity (FI) than the national average during that period, with FI in Oregon being 9.2% compared to 10.7% in the U.S. overall (Coleman-Jensen et al., 2021). (“Significant” in this instance means that the difference between state average and national average was outside the statistical margin of error.) This reflected a dramatic improvement in food insecurity in the state over the past decade. Indeed, Oregon’s five-year drop in FI from 2014-2019 was “the greatest improvement by any one state over that five-year period” (Edwards, 2020). The economic setbacks triggered by the COVID crisis complicated the picture and threatened a sharp escalation of food insecurity across the country (Feeding America, 2020). Fortunately, however, levels of food insecurity in both Oregon and the U.S. remained surprisingly stable in 2020, which may have been due, in large part, to the expansion of SNAP benefits and other components of the expanded social safety net that were implemented in response to the COVID crisis (Edwards, 2021).

The organization *Feeding America* (FA) releases an annual Map the Meal Gap study that estimates county-specific levels of food insecurity across the U.S., based on a predictive model that incorporates county unemployment rates, poverty rates, and other known determinants of food insecurity to arrive at their estimates. FA’s estimates tend to run higher than the results reported by USDA from the Current Population Survey, in part because their predictive model does not take account of SNAP participation and other government safety net programs that reduce food insecurity for participating families. FA’s estimates for 2019 (the most recent year available) report the overall rate of food insecurity in Oregon as 11.5%. In comparison to this statewide rate, FA’s estimated food insecurity rates for Linn and Marion County are 12.7% and 11.2%, respectively (Feeding America, 2021).

No coordinated, reliable data exist for areas in Oregon smaller than counties, so information on food security in the Santiam Canyon communities is not directly known.

Food insufficiency

A more recent concept closely related to food security / insecurity is *food sufficiency / insufficiency*. This is measured on the Census Bureau's Household Pulse Survey, which has been in operation since April 2020. Whereas food security refers to the quality, variety and quantity of food in a household, food sufficiency refers only to the quantity of food. Thus it is a simpler, more straightforward concept. But in addition, "Food insufficiency is a more severe condition than food insecurity and measures whether a household generally has enough to eat. In this way, food insufficiency is closer in severity to very low food security than to overall food insecurity" (USDA, 2021).

Another important difference between the concepts, relevant to our current study, pertains to how they are measured in the Census Bureau surveys. Food sufficiency is measured by a single item rather than the multiple-item scales comprising the measurement of food security.

How we addressed issues of food access and availability in our data collection

As can be seen from the Food Security and Adequate Healthy Eating section of our overall study questions, our interest in issues of food in relation to the Labor Day wildfires involved several dimensions. These included not only overall food security (or food sufficiency) but also the wildfires' impact on non-commercial food sources such as hunting and gardening, as well as the safety of food storage and preparation for fire survivors. However, because of the broad scope of all of the study's topic areas, we needed to be economical in the sections of our measures that focused on food.

In the online survey, we chose to use the Census Bureau's single-item food sufficiency measure rather than either of the longer (6 or 10 items) food security scales. Both concepts are relevant for our overall questions, but given our need to keep the overall survey reasonably short, the shorter measure suited our purposes more effectively. Given our information needs, we used two related questions. The first was the food sufficiency question used in the Pulse survey, which refers to the time period "the last 7 days." However, since we were also interested in understanding Canyon residents' experiences over the past year rather than only the present time (last 7 days), we added a second question, amended to identify the time period "over the past year, since the wildfires." (We are grateful to Professor Mark Edwards at OSU for suggesting this adaptation.) An additional set of interrelated questions asked about the fires' impact on gardening, hunting, travel time to shop for groceries, and food storage.

In the focus group interview, one question out of the 13 focused on "current health problems in the Canyon communities with regard to food security and food safety, in other words, people's ability to get adequate healthy food and to store and prepare it safely." (See Appendix C.)

Our key informant interviews included personnel from Marion Polk Food Share (a nonprofit that delivers food to a network of food pantries, shelters, and other sites), the Mill City / Gates food pantry, OSU SNAP-Ed county Extension faculty, and food security researchers.

Findings***Food security and food sufficiency***

The food security experts whom we interviewed as key informants were in agreement that it would be very challenging to assess the wildfires' effects on food security in the Santiam Canyon. As described above, data from representative samples do not exist specifically for the Canyon region, and, in addition, existing data for larger regions such as counties predate the

2020 fires. Thus, judgments about the impact of the fires must be arrived at through assessing other kinds of information and evidence.

SIT food insecurity figures. The Canyon's Service Integration Team (SIT), which is an agency and community partnership coordinated by Santiam Hospital, provides disaster case management services to survivors of the wildfire. The SIT has recently started assessing food security as part of its intake procedure for their clients. They reported in September that since they had started this screening, 21 out of 181 individuals (11.6%) were classified as food insecure (T. Swisher, personal communication, Sept. 21, 2021). This rate is generally consistent with Feeding America's figures for Linn (12.7%) and Marion (11.2%) Counties, as described above. One must be cautious in interpreting this figure, which is based on a nonrepresentative sample, but it seems to provide some supporting evidence that the food insecurity rate of Santiam Canyon wildfire survivors might not be appreciably different from that of the two-county area as a whole.

Food pantries. The experiences of the food pantries paint a complex picture. A member of the leadership team at Marion Polk Food Share, which delivers food to the pantries in Mill City/Gates, Idanha, Lyons, and Stayton for distribution to local families, observed that the Idanha pantry seems to serve around the same number of families as it did pre-fire, but the numbers of families served by the other Canyon pantries seem to have dropped (M. Rivera, personal communication, Sept. 20, 2021). Fortunately, the pantries were mostly unaffected structurally by the fires and have been able to continue operation. In trying to compare the numbers of clientele pre- and post-fire, the most significant confounding factor is that the populations of the Canyon communities have changed in the past year. Many former residents have moved away from the area, possibly permanently, and many others who are rebuilding their homes are living in temporary quarters away from the Canyon itself. Thus, at present the communities may be smaller than they were before September 2020.

Pantries also report having changed how they operate. The Mill City/Gates pantry has let families know that they can come and restock as often as they need to, and many clients do in fact come in more often than before. Conversely, many clients now take less food per visit, usually because their storage space is limited and they may not have refrigeration in their residences to keep food for long periods of time (S. Heller-Tuers, personal communication, Sept. 24, 2021).

Survey results. As described above, the items on our survey that were drawn from the USDA questions address the concept of food sufficiency rather than food security. Food sufficiency focuses on whether respondents have sufficient quantities of food, whereas food security incorporates attention to dietary quality and variety as well as the quantity of food consumed. For our survey question #9, asking about food sufficiency over the last 7 days, 9% of respondents (6 of 69) responded that *sometimes* or *often* there was "not enough to eat" (see Appendix B for full results). This is not a high percentage, but given the severity of food insufficiency as a household condition, even relatively small percentages will cause concern. The answers to the parallel question asking about food sufficiency over the past year (Question 10) were somewhat less disquieting: only 4% of respondents (3 of 68) answered that there was "*sometimes* not enough to eat" over the past year, and none of the respondents answered that there was "*often* not enough to eat."

Also worth noting is the pattern of responses to Question 1 in which respondents provided their opinions about "the most significant health-related issues that still exist in Santiam Canyon as a result of the wildfires." Respondents answered this question twice, once "for myself and/or my

family” and once for “the Santiam Canyon community.” They were instructed to select up to 5 options in each case. The option “Availability of healthy food” was selected by 13 respondents as a significant *personal* issue, ranking 10th in the list of 16 possible selections. That same option was selected by 20 respondents as a significant *community* issue, ranking 8th out of the 16 options. Thus, the availability of healthy food was rated as a moderate concern by survey respondents, but was not in the top tier of ongoing wildfire-related problems.

Focus group results. Focus group participants were asked for their observations about “current health problems in the Canyon communities with regard to *food security and food safety*, in other words, people’s ability to get adequate healthy food and to store and prepare it safely” (Appendix C). Some participants expressed concerns about residents not having enough to eat, although a much larger proportion of comments focused on the issues of food storage, ready food access, food quality, and food safety.

Food storage, quality, access, and safety

Across our various forms of data collection, the most frequently occurring theme related to food was the sharply increased difficulty in storing, preparing, and obtaining food due to the housing displacements caused by the wildfires. Many of the survey’s open-ended responses about food addressed this theme, as these examples illustrate:

“We have a very small fridge so we can only keep a few days of fresh fruits and vegetables on hand. The oven is extremely small and uses too much propane, so we have to buy meals that are microwavable.”

“RV storage and refrigerator bring limitations to the food and quantity you can buy as well as cook on a propane stove. We have to shop more frequently to have fresh food and an RV freezer doesn’t always maintain consistent freezer temps.”

“We were fortunate to find a rental in Silverton Oregon, so we have access to grocery stores and fresh food. Once we return to Detroit, this will be much more difficult. The amount of road construction makes it difficult to go shopping or go to Stayton/Salem for services.”

“There were 2 grocery stores in Detroit before the fires, but with limited variety and supply. After the fire there was only 1 standing and it was closed for 9 months before reopening and with less population the hours and variety has been limited. We had to recycle our two refrigerators due to spoilage after the fire when power was out, so there was a period of readjustment. We now have that handled and are able to purchase healthy food in Salem/Stayton area and transport to our home.”

In addition to the survey responses, many of the focus group participants commented on this issue as well.

“When we were in the RV, the fridge was very small, and so trying to store fresh fruits and vegetables felt almost impossible to keep enough for five people on hand all the time. And so there was a lot of packaged or other stuff, and we couldn’t eat as healthy as we normally would.”

“It’s not very plausible to make three or four trips to the grocery store on a weekend....The storage was the problem we had. We struggled with fruit flies too, when we had fruit in the

camper. I agree you end up eating much more processed [foods], because there's just no way to store things very well. And there's not really a grocery store super close."

"Root cellars are gone [and so is] your storage of food. If you're transient your diet is done, because you can't stock up, cook, and do whatever you want. I know it's affected my neighbors."

"Living in the hotel, pretty much our food source is that the state sends in some kind of catering, so we have absolutely no choice. I'm diabetic and I have a bunch of other health issues, so if they send something that doesn't fit into the diet that I can eat, I'm pretty much out of luck for the day. And it's the same with my partner, we have very specific foods that we can and can't eat. But at the same time they're like, 'Well, we've got to feed everyone, so you kind of just have to go with what we give you.' "

In Question 11 of the survey, 43% of survey respondents (27 of 63) indicated that their ability "to store food in adequate quantities" was *moderately impacted* or *very much impacted* by the fires. Similarly, 37% (23 of 63) indicated a moderate or greater impact on their ability "to store food safely and prevent spoilage" (see Appendix B).

Non-commercial sources of food: Gardening and hunting

The wildfires also had an impact on food access based on gardening and hunting. Some residents commented either that their gardens were gone or, if they remained, that the produce from the garden was suspect because of potential toxins in the soil. Sample comments are the following (quoted from the focus groups unless otherwise indicated):

"We had a big garden, and now when you go to plant you're going to be concerned about soil and what burned and what's in your soil."

"All the toxins are still in the soil. So you eat what's going through it. Good in, good out. Bad in, bad out, you know?"

"We had a garden that helped feed our family. Our car was ruined and I had to sell the truck to get a car, so hunting is impossible, which supplied our meat." [from the survey]

"I think that due to the fires, the natural habitat's gone. Some people relied on game, and that's all they ate. Well, guess what's not around anymore? The game....So now people who live way up in the canyon, who maybe went to town once a year for supplies, are now forced to come in for food and get food that their budget wasn't set up for."

One of our key informants, a longtime resident who manages one of the Canyon's food pantries, confirmed the drastic effects on hunting, remarking that "the deer have been wiped out by the fire and the habitat has been wiped out. It may be 5-10 years before the herds develop again. The elk may have been diminished also." This individual also commented that the fishing in the region, especially for salmon and steelhead, has been diminished as well.

In Question 11 of the survey, 39% of respondents (26 of 66) indicated that their ability to "[add] to our food supply through gardening" was *moderately* or *very much impacted* by the fires. Similarly, 27% of respondents (17 of 64) indicated that their ability to "[add] to our food supply through hunting" was *moderately* or *very much impacted* (Appendix B).

Summary

Overall, the input from both our survey and focus groups suggest that the most significant and extensive food-related problem caused by the wildfires is Canyon residents' sharply reduced ability to store food safely and in adequate quantities, due to their housing disruptions. Managing diet and food storage has become a much larger burden for households in the Canyon, especially households with children, because families are in temporary living quarters that do not offer the standard conveniences involving storage, refrigeration, cooking, and other forms of food preparation. This reduces the quality of their diets, due to a greater reliance on processed foods that are more easily accessible from stores and may not require refrigeration or extensive preparation. It also means that they must spend a larger proportion of their daily routine on frequent shopping trips and other food-related activities.

Another finding is that a moderate proportion of Canyon residents were reliant on gardening and/or hunting for parts of their diet, and those sources have been largely disrupted.

A small but concerning percentage of our survey respondents (9%) reported food insufficiency within the past 7 days, i.e., indicating that there was *sometimes* or *often* not enough to eat in the household. Balancing that figure, however, a parallel question about food insufficiency over the past year, rather than the past week, showed lower levels of this condition.

Recommendations

- 1. Maintain and/or increase attention to the monitoring of food insecurity through multiple channels by local agencies and organizations.** Given the need to obtain information quickly and to effectively provide services to survivors experiencing food insecurity, relying on government sources of food insecurity data will not be sufficient, because those data are not contemporary (being 1-2 years old) and are not geographically targeted specifically to the Santiam Canyon. Local monitoring can occur in clinic settings, as is currently done by the Service Integration Team, which has incorporated food security monitoring into its intake procedure for case management. Ensure that individuals and families who are experiencing difficulties in obtaining food can be quickly identified and supported.
- 2. Support the operation of food pantries and other sources of food assistance.** Food pantries can be supported in numerous ways to ensure their effective operation, including helping to publicize their services to potential clients, assisting with the recruitment of volunteers, and so on. Local agencies and government officials can also help to create and operate congregate meal sites, as opportunities arise, and other strategies for providing food assistance to individuals and families experiencing food insecurity or food insufficiency.
- 3. Support wildfire survivors in their efforts to rebuild or to find permanent housing in the Canyon.** As we have described, the most common food-related problems experienced by survivors may be the difficulties inherent in finding and maintaining temporary housing, which often creates significant challenges for food storage and food preparation. Thus this food security problem within the Canyon is closely linked to the housing crisis. This is a long-term solution to an immediate problem, but it is relevant because it addresses a root cause of that problem. Assisting residents in their efforts to rebuild or relocate to a stable housing environment will contribute to ameliorating the current challenges associated with food access and healthy eating.

Personal Health

Our final area of investigation was the wildfires' continuing effects on survivors' personal health, including issues such as physical safety and injuries, access to medical care, and sleep quality, among others. We report here on data gathered from our survey and focus group interviews, as well as the report on patterns of health care utilization from Samaritan Health Services (Appendix D).

Physical safety and injuries

Survey question 5 asked whether the respondents or their family members had experienced an injury resulting from either the fire itself, the clean-up, or the rebuilding process. Thirty-five percent of respondents (26 of 74) reported that they had. Their follow-up comments indicated that many of the injuries were not long-term, although several of them did involve emergency room visits. Several comments cited back injuries that have become ongoing ailments. One respondent reported that her grandfather had been killed in the fire itself because he didn't have time to get out. Written survey comments included the following:

"I injured my back hauling debris and fractured my leg in a fall and punctured my foot during cleanup. The leg and puncture have healed but I am still dealing with 2 bulging disks in my back. I have had spinal injections and am still in physical therapy. I may have to have spinal surgery."

"My husband of 50 years, who always had low blood pressure and took no prescriptions, developed high blood pressure which resulted in an aortic aneurysm and killed him just four months after the fire."

Question 1 asked respondents to identify the most significant remaining health-related issues resulting from the fires, both for "myself and/or my family" and for "the Santiam Canyon community." The option "Physical safety hazards created by the fires" was selected as a personal family issue by 37% of respondents (27 of 74), ranking it tied for fifth among the 16 available options. In addition, this option was selected by 50% of respondents (37 of 74) as a significant ongoing issue for the entire Santiam Canyon community, ranking it second behind only "Emotional stress." (See Appendix B.) We can conclude survey respondents regarded safety as an important area for concern.

Focus group participants cited hazardous road conditions following the fires, especially on Highway 22, as a threat to physical safety.

"There's been like a 1,000 percent increase in traffic. Which means it's a 1,000 increase in the chance somebody's gonna get hurt. All day, every day, log trucks screaming down. Like they take a 30 mile an hour corner, where I'm at, at 45. I hear the tires."

"Through the Canyon there's guard rails that are missing. When you drive Highway 22, no one should be driving that at night. You cannot see when a car is coming, especially when you're heading east on Highway 22 and a vehicle comes at you, you lose sight for about 3 seconds of those yellow and white lines....There's seconds where you cannot see. And so when people go driving fast on Highway 22, or tail you when you're doing 55 or maybe 50 because you can't see, they don't understand that you're going blind and there's no guard

rail. That's the biggest safety factor. I wish they'd get a guard rail, at least you'd have a little bit of a chance in the rain and the dark."

Accessing medical care

In identifying the most significant health-related issues from the fires, the option "Access to medical care" was not among the top choices of survey respondents. It was selected as a significant issue "for myself and/or my family" by only 14% of respondents (10 of 74), ranking it 13th of the 16 options, and by 16% (12 of 74) as an issue "for the Santiam Canyon community," ranking it tied for 11th out of 16.

However, 23% of survey respondents (17 of 74) reported that there had been a time in the past year when they needed medical care, either because of the fires or the resulting clean-up, but did not get that care (question 6). In describing their experiences, respondents identified two primary reasons. One was the increased difficulty of road travel, primarily due to blockages from fallen trees. The second reason, however, was self-determined: respondents noted that their stress levels were too high and they felt overwhelmed. In addition, one respondent explained that he lost his health insurance after needing to retire early due to his experience with the fire. Sample comments:

"Getting around was difficult due to all the trees that had fallen on the roads. Also, the bridge in Mill City was out during and after the fire so that made it difficult for people living on the Marion side of the bridge."

"Unable to get out, road blocked."

"Me! I am my own barrier. I know I need to get into a doctor. My stress levels are off the chart."

"No time, costs too much, overwhelmed with other responsibilities."

Data on healthcare utilization from Samaritan Health Services

As another source of input relating to access of medical care, we contracted with Samaritan Health Services (SHS) for a deidentified summary of healthcare utilization of SHS facilities by Santiam Canyon residents (see Appendix D), comparing healthcare visits in the year prior to the fires (Sept. 7, 2019 – Sept. 6, 2020) with the year following the fires (Sept. 7, 2020 – Sept. 6, 2021). SHS included the records of 330 patients whose residences were in the Santiam Canyon as defined by zip code and who visited SHS at least once in the identified two-year period.

As can be seen in Tables 1 and 2 of Appendix D, the utilization of SHS services was notably similar in the two time periods. For example, as shown in Table 2, the review of visits to urgent care facilities, emergency departments, hospitals, primary care departments, and other locations shows that the great majority of the 330 patients had the same number of visits to each of those location categories pre- and post-fire. In addition, in all of those location categories the numbers of patients who had *more* vs. *fewer* visits in the post-fire year compared to the pre-fire year were not appreciably different from each other. Similarly, there was no noticeable change in healthcare visits with mental health, substance use, respiratory, or trauma diagnoses.

Although this summary is of interest, we must caution that the evidence it provides regarding potential shifts in the overall level of healthcare utilization by Santiam Canyon residents following the wildfires is very limited, for several reasons. First, the geographical overlap between the Santiam Canyon and SHS locations is not extensive. SHS has facilities in Linn, Benton and Lincoln Counties but does not operate in Marion County, and a large proportion of the healthcare delivery for Canyon residents is excluded from these figures. Comparable data from Marion County facilities, which would have bolstered these results, were not available.

Second, the COVID crisis has resulted in significantly reduced individual use of healthcare services offered over the past year (Moynihan et al., 2021). Thus, whatever changes may be due to the wildfires are confounded with patterns resulting from COVID, complicating any attempts at interpreting trends over time. Nevertheless, keeping these cautions in mind, the SHS report does provide some very limited evidence that Santiam Canyon residents' healthcare utilization did not increase in the year after the wildfires.

Respiratory problems

As noted in earlier sections, ongoing respiratory issues were frequently cited as a serious and continuing personal health problem by many Canyon residents. On survey question 12, 28% of respondents (18 of 65) indicated that breathing problems had presented "some difficulty" or "a lot of difficulty" for them *before* the fires, but that percentage jumped to 55% (34 of 62) *after* the fires.

Some focus group comments were the following:

"My breathing has become terrible."

"I gasp for air coming out my small hill from the back property. I never use it anymore."

Sleep quality

Many Canyon residents reported that their sleep quality had deteriorated significantly over the past year, due to their increased levels of stress. On survey question 12, the percent of respondents reporting that sleeping problems presented "some difficulty" or "a lot of difficulty" increased sharply from 44% (28 of 64) to 82% (50 of 61). In addition, on question 1, the option "Sleep quality" was ranked second by respondents as a significant health issue "for me and/or my family," being selected by 43% (32 of 74). Sleep quality was ranked lower as an issue for the Canyon community as a whole, selected by 16% of respondents (12 of 74), which ranked it tied for 11th.

"Everybody that I talk to has sleep issues. Everyone, me included. I don't sleep."

"If I smell smoke at night I'm up for the rest of the night, if I think I smell smoke."

Other personal health issues

Reproductive health

In one of the focus groups, one participant described that she knew of several cases of pregnancy complications and loss. She spoke of three young women who lived in the Canyon and were pregnant at the time of the fire. They all developed preeclampsia and needed high-risk deliveries. Tragically, one of the young women died from complications with the birth. Our focus

group participant noted, “You can’t have all of that happening and it’s not related to the fire....I believe it’s all stress due to the fire.”

Chronic health conditions

Question 1 included “Ability to manage chronic health conditions such as diabetes, heart disease, etc.” as a potential option for the most significant health-related problems. It was selected by 15% of respondents (11 of 74) as an issue for themselves or their family, and by only 10% (7 of 74) as an issue for the Canyon community, making it one of the lower-ranked options from the list. Conversely, however, on question 12, the percent of respondents reporting that their management of chronic health conditions presented them with “some difficulty” or “a lot of difficulty” increased from 27% (17 of 64) before the fires to 50% (30 of 60) after the fires, indicating that this issue has been exacerbated in the year since the fires.

Recommendations

- 1. Monitor and correct potential safety hazards on Highway 22 and other roads.** This is especially important in light of the general increases in traffic over the past year and the heavy use of the road by logging trucks. Multiple respondents indicated that those trucks do not always maintain high levels of road safety.
- 2. Consider establishing a health registry to track the ongoing conditions of wildfire survivors.** Our assessment shows that many Canyon residents are suffering from a range of health complaints one year after the 2020 wildfires, especially respiratory problems and manifestations of stress such as sleep disruption. Reports from our survey, focus groups and other sources also suggest that many Canyon residents may be living with these conditions without seeking medical care for them. Therefore it may be valuable to set up a registry to track the existence and severity of these conditions over a period of months or years.

References

- Abraham, J. Dowling, K., and Florentine, S. Controlled burn and immediate mobilization of potentially toxic elements in soil, from a legacy mine site in Central Victoria, Australia, *Science of The Total Environment*, Volumes 616–617, (2018), Pages 1022-1034, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2017.10.216>.
- Agyapong, V. I. O., Juhas, M., Omege, J., Denga, E., Nwaka, B., Akinjise, I., Corbett, S. E., Brown, M., Chue, P., Li, X.-M., & Greenshaw, A. (2021). Prevalence Rates and Correlates of Likely Post-Traumatic Stress Disorder in Residents of Fort McMurray 6 Months After a Wildfire. *International Journal of Mental Health and Addiction*, 19(3), 632–650. <https://doi.org/10.1007/s11469-019-00096-z>
- Aldrich, D. P. (2017). The importance of social capital in building community resilience. In *Rethinking resilience, adaptation and transformation in a time of change* (pp. 357-364). Springer, Cham.
- Alexakis, D.E., Suburban areas in flames: Dispersion of potentially toxic elements from burned vegetation and buildings. Estimation of the associated ecological and human health risk, *Environmental Research*, Volume 183, (2020), 109153, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2020.109153>
- Bauer, D. K. (2015). *Immediate and long-term emotional needs and responses: Experiences of survivors of the 2012 High Park Fire* (Doctoral dissertation, Colorado State University).
- Bernstein, S. A growing problem after wildfires: Toxic chemicals, UC Davis Environmental Health Sciences Center Director Irva Hertz-Picciotto on the effects of the 2017 Tubbs Fire. *The Washington Post*. April 8, 2019. Accessed 11/24/2021 <https://environmentalhealth.ucdavis.edu/wildfires-and-toxic-chemicals>
- Bohannon, S. (2020, Feb. 26). A year after California's most destructive wildfire, many survivors struggle with food insecurity. *Center for Health Journalism*, University of Southern California. Retrieved from: <https://centerforhealthjournalism.org/2020/02/25/investigating-food-insecurity-more-year-after-californias-most-destructive-wildfire>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3, 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
- Carroll, M. S., Cohn, P. J., Seesholtz, D. N., & Higgins, L. L. (2005). Fire as a Galvanizing and Fragmenting Influence on Communities: The Case of the Rodeo–Chediski Fire. *Society & Natural Resources*, 18(4), 301–320. <https://doi.org/10.1080/08941920590915224>
- Chase, J., & Hansen, P. (2021). Displacement after the Camp Fire: Where are the Most Vulnerable? *Society & Natural Resources*, 34(12), 1566–1583. <https://doi.org/10.1080/08941920.2021.1977879>
- Coleman-Jensen, A., Rabbitt, M.P., Gregory C.A., & Singh, A. (2021). *Household Food Security in the United States in 2020*, ERR-298, U.S. Department of Agriculture, Economic Research Service. Retrieved from <https://www.ers.usda.gov/publications/pub-details/?pubid=102075>

- Day, M.A., C. Ringo, & A.A. Ager. Chapter 8: Assessment of Wildfire Exposure to Public Water Supply Areas in Oregon. in *Trees to Tap Science Review Working Papers*. Oregon Forest Resources Institute and Oregon State University. (2020)
https://oregonforests.org/sites/default/files/2020-06/Trees-To-Tap-Science-Review-Working-Papers_1.pdf
- De Graff, J.V. A rationale for effective post-fire debris flow mitigation within forested terrain. *Geoenviron Disasters* 5, 7 (2018). <https://doi.org/10.1186/s40677-018-0099-z>
- Dowling C.A., Santi P.M. (2014) Debris flows and their toll on human life: a global analysis of debris-flow fatalities from 1950 to 2011. *Nat Hazards* 71:203–227
- Edwards, M. (2020). *Oregon's food insecurity in the time of COVID*. Oregon Policy Analysis Lab (OPAL), Oregon State University. Retrieved from <https://liberalarts.oregonstate.edu/spp/opal/projects>
- Edwards, M. (2021, Sept. 9). *Surprising stability in Oregon and U.S. food insecurity during the COVID pandemic*. Oregon Policy Analysis Lab (OPAL), Oregon State University. Retrieved from <https://liberalarts.oregonstate.edu/spp/opal/projects>
- Eisenman, D., McCaffrey, S., Donatello, I., & Marshal, G. (2015). An ecosystems and vulnerable populations perspective on solastalgia and psychological distress after a wildfire. *EcoHealth*, 12(4), 602-610.
- Finlay, S. E., Moffat, A., Gazzard, R., Baker, D., & Murray, V. (2012). Health impacts of wildfires. *PLoS currents*, 4.
- Eriksen, C., & Vet, E. (2021). Untangling insurance, rebuilding, and wellbeing in bushfire recovery. *Geographical Research*, 59(2), 228–241. <https://doi.org/10.1111/1745-5871.12451>
- Feeding America. (2020). *The impact of Coronavirus on food insecurity in 2020*. Retrieved from <https://feedingamericaaction.org/resources/state-by-state-resource-the-impact-of-coronavirus-on-food-insecurity/>
- Feeding America. (2021). *Food insecurity in Oregon, before COVID-19*. Retrieved from <https://map.feedingamerica.org/county/2019/overall/Oregon>
- Felix, E. D., & Afifi, W. (2015). The Role of Social Support on Mental Health After Multiple Wildfire Disasters. *Journal of Community Psychology*, 43(2), 156–170.
<https://doi.org/10.1002/jcop.21671>
- FEMA, Beachie Creek Fire Erosion Threat Assessment/Reduction Team (ETART) Extended Report, DR-4562-OR (2020). Accessed 11/24/2021
<https://gscdn.govshare.site/1aa8ace4addf06592a8d7dcb775413bf10fd1ec6/ETARTReport-BeachieCreekFire.pdf>
- Gilbertson-Day, J.; Stratton, R.D.; Scott, J.H.; Vogler, K.C.; Brough, A. Pacific Northwest Quantitative Wildfire Risk Assessment: Methods and Results; Pyrologix: Missoula, MT, (2018)

- Greer, A., & Trainor, J. E. (2021). A system disconnected: Perspectives on post-disaster housing recovery policy and programs. *Natural Hazards*, 106(1), 303–326. <https://doi.org/10.1007/s11069-020-04463-1>
- Harms, L., Block, K., Gallagher, H. C., Gibbs, L., Bryant, R. A., Lusher, D., ... & Waters, E. (2015). Conceptualising post-disaster recovery: Incorporating grief experiences. *British Journal of Social Work*, 45(suppl_1), i170-i187.
- Housing and Health: An Overview of the Literature*. (2018, June 7). RWJF. <https://www.rwjf.org/en/library/research/2018/06/housing-and-health--an-overview-of-the-literature.html>
- Johannesson, K. B., Lundin, T., Hultman, C. M., Frojd, T., & Michel, P. (2011). Prolonged grief among traumatically bereaved relatives exposed and not exposed to a tsunami. *Journal of Traumatic Stress*, 24(4), 456-464. doi: 10.1002/jts.20668
- Kramer, H. A., Butsic, V., Mockrin, M. H., Ramirez-Reyes, C., Alexandre, P. M., & Radeloff, V. C. (2021). Post-wildfire rebuilding and new development in California indicates minimal adaptation to fire risk. *Land Use Policy*, 107. <https://doi.org/10.1016/j.landusepol.2021.105502>
- Lalani, N., Drolet, J. L., McDonald-Harker, C., Brown, M. R. G., Brett-MacLean, P., Agyapong, V. I. O., Greenshaw, A. J., & Silverstone, P. H. (2021). Nurturing Spiritual Resilience to Promote Post-disaster Community Recovery: The 2016 Alberta Wildfire in Canada. *Frontiers in Public Health*, 9, 682558. <https://doi.org/10.3389/fpubh.2021.682558>
- Liu, Z., Ballantyne, A.P. & Cooper, L.A. Biophysical feedback of global forest fires on surface temperature. *Nat Commun* 10, 214 (2019). <https://doi.org/10.1038/s41467-018->
- Marshall, G. N., Schell, T. L., Elliott, M. N., Rayburn, N. R., & Jaycox, L. H. (2007). Psychiatric Disorders Among Adults Seeking Emergency Disaster Assistance After a Wildland-Urban Interface Fire. *Psychiatric Services (Washington, D.C.)*, 58(4), 509–514. <https://doi.org/10.1176/ps.2007.58.4.509>
- McKinnon, S., & Eriksen, C. (n.d.). Engaging with the home-in-ruins: Memory, temporality and the unmaking of home after fire. *Social & Cultural Geography, ahead-of-print(ahead-of-print)*, 1–16. <https://doi.org/10.1080/14649365.2021.1939127>
- Mockrin, M. H., Fishler, H. K., & Stewart, S. I. (2018). Does Wildfire Open a Policy Window? Local Government and Community Adaptation After Fire in the United States. *Environmental Management (New York)*, 62(2), 210–228. <https://doi.org/10.1007/s00267-018-1030-9>
- Mockrin, M. H., Stewart, S. I., Radeloff, V. C., Hammer, R. B., & Alexandre, P. M. (2015). Adapting to Wildfire: Rebuilding After Home Loss. *Society & Natural Resources*, 28(8), 839–856. <https://doi.org/10.1080/08941920.2015.1014596>
- Mockrin, M. H., Stewart, S. I., Radeloff, V. C., Hammer, R. B., Mockrin, M. H., Stewart, S. I., Radeloff, V. C., & Hammer, R. B. (2016). Recovery and adaptation after wildfire on the Colorado Front Range (2010–12). *International Journal of Wildland Fire*, 25(11), 1144–1155. <https://doi.org/10.1071/WF16020>

- Moritz, M. A., Batllori, E., Bradstock, R. A., Gill, A. M., Handmer, J., Hessburg, P. F., Leonard, J., McCaffrey, S., Odion, D. C., Schoennagel, T., & Syphard, A. D. (2014). Learning to coexist with wildfire. *Nature*, *515*(7525), 58–66. <https://doi.org/10.1038/nature13946>
- Moynihan, R., Sanders, S., Michaleff, Z. A., Scott, A. M., Clark, J., To, E. J., ... & Albarqouni, L. (2021). Impact of COVID-19 pandemic on utilisation of healthcare services: a systematic review. *BMJ Open*, *11*(3), e045343.
- Norris, F. H., Friedman, P. J., Watson, P. J., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). 60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981–2001. *Psychiatry: Interpersonal and Biological Processes*, *65*(3), 207–239. <https://doi.org/10.1521/psyc.65.3.207.20173>.
- Norris, F. H., Perilla, J. L., Riad, J. K., Kaniasty, K., & Lavizzo, E. A. (1999). Stability and change in stress, resources, and psychological distress following natural disaster: Findings from Hurricane Andrew. *Anxiety, Stress, and Coping*, *12*, 363–396.
- Oregon Dept. of Human Services. (2020). *ODHS announces disaster food benefits (DSNAP) for 8 counties*. News release, October 17, 2020. Retrieved from <https://www.oregon.gov/dhs/DHSNEWS/Pages/News-Releases-2020.aspx>
- Oregon Office of Rural Health. (2021). Oregon areas of unmet health care need report. Retrieved from <https://www.ohsu.edu/sites/default/files/2021-09/2021%20Areas%20of%20Unmet%20Health%20Care%20Needs%20Report%202.pdf>
- Oregon Wildfire Response & Recovery. (2021). Sheltering and Housing. Retrieved from <https://wildfire.oregon.gov/recovery>
- Overstreet, S., Salloum, A., Burch, B., & West, J. (2011). Challenges associated with childhood exposure to severe natural disasters: Research review and clinical implications. *Journal of Child & Adolescent Trauma*, *4*(1), 52–68.
- Papanikolaou, V., Adamis, D., Mellon, R. C., Prodromitis, G., & Kyriopoulos, J. (2012). Trust, social and personal attitudes after wildfires in a rural region of Greece. *Sociology Mind*, *2*(1), 87–94. doi: 10.4236/sm.2012.21012
- Papanikolaou, V., Mellon, R. C., Adamis, D., & Prodromitis, G. (2011). Psychological distress following wildfires disaster in a rural part of Greece: A case-control population-based study. *International Journal of Emergency Mental Health*, *13*(1), 11–26.
- Patel, S., & Hastak, M. (2013). A framework to construct post-disaster housing. *International Journal of Disaster Resilience in the Built Environment*, *4*(1), 95–114. <https://doi.org/10.1108/17595901311299026>
- Paveglio, T. B., Brenkert-Smith, H., Hall, T., & Smith, A. M. S. (2015). Understanding social impact from wildfires: Advancing means for assessment. *International Journal of Wildland Fire*, *24*(2), 212–224. <https://doi.org/10.1071/WF14091>
- Pazderka, H., Brown, M. R. G., Agyapong, V. I. O., Greenshaw, A. J., McDonald-Harker, C. B., Noble, S., Mankowski, M., Lee, B., Drolet, J. L., Omeje, J., Brett-MacLean, P., Kitching, D. T., & Silverstone, P. H. (2021). Collective Trauma and Mental Health in Adolescents: A

- Retrospective Cohort Study of the Effects of Retraumatization. *Frontiers in Psychiatry*, 12, 682041. <https://doi.org/10.3389/fpsy.2021.682041>
- Pietrzak, R. H., Tracy, M., Galea, S., Kilpatrick, D. G., Ruggiero, K. J., Hamblen, J. L., ... & Norris, F. H. (2012). Resilience in the face of disaster: prevalence and longitudinal course of mental disorders following hurricane Ike. *PLoS One*, 7(6), e38964.
- Profita, C. (2020, October 28). Hazardous waste brings hazmat workers to wildfire-destroyed Oregon homes, businesses. Oregon Public Broadcasting. Retrieved from <https://www.opb.org/article/2020/10/28/hazardous-waste-brings-hazmat-workers-to-wildfire-destroyed-oregon-homes-businesses/>
- Profita, C. (2021, July 12). Residents of Gates, Oregon, aim their ire at Pacific Power nearly a year after their town burned. Oregon Public Broadcasting. Retrieved from <https://www.opb.org/article/2021/07/12/residents-of-gates-oregon-aim-their-ire-at-pacific-power-nearly-a-year-after-their-town-burned/>
- Reid C.E., Brauer M., Johnston F.H., Jerrett M., Balmes J.R., Elliott C.T. 2016. Critical review of health impacts of wildfire smoke exposure. *Environ Health Perspect* (2016) 124(9):1334–1343
- Rosenthal, A., Stover, E., & Haar, R. J. (2021). Health and social impacts of California wildfires and the deficiencies in current recovery resources: An exploratory qualitative study of systems-level issues. *PLoS ONE*, 16(3), e0248617–e0248617. <https://doi.org/10.1371/journal.pone.0248617>
- Sattler, D. N., Preston, A. J., Kaiser, C. F., Olivera, V. E., & Schlueter, S. (2002). Hurricane Georges: A cross-national study examining the preparedness, resource loss, and psychological distress in the U.S. Virgin Islands, Puerto Rico, Dominican Republic, and the United States. *Journal of Traumatic Stress*, 15, 339–350.
- Sayre, S. (1994). Possessions and Identity in Crisis: Meaning and Change for Victims of the Oakland Firestorm. *Advances in Consumer Research*, 21(1), 109–114. <http://proxy.library.oregonstate.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=83373794&site=ehost-live>
- Schumann, R. L., Mockrin, M., Syphard, A. D., Whittaker, J., Price, O., Gaither, C. J., Emrich, C. T., & Butsic, V. (2020). Wildfire recovery as a “hot moment” for creating fire-adapted communities. *International Journal of Disaster Risk Reduction*, 42, 101354. <https://doi.org/10.1016/j.ijdr.2019.101354>
- Stahre, M. (2015). Housing Insecurity and the Association With Health Outcomes and Unhealthy Behaviors, Washington State, 2011. *Preventing Chronic Disease*, 12. <https://doi.org/10.5888/pcd12.140511>
- Stamm, B. H. (2017). A Personal-Professional Experience of Losing My Home to Wildfire: Linking Personal Experience with the Professional Literature. *Clinical Social Work Journal*, 45(2), 136–145. <https://doi.org/10.1007/s10615-015-0520-y>
- Sveen, J., Bergh Johannesson, K., Cernvall, M., & Arnberg, F. K. (2018). Trajectories of prolonged grief one to six years after a natural disaster. *PLoS one*, 13(12), e0209757.

- Swope, C. B., & Hernández, D. (2019). Housing as a determinant of health equity: A conceptual model. *Social Science & Medicine*, 243, 112571. <https://doi.org/10.1016/j.socscimed.2019.112571>
- Tak, S., Vellanki, B.P.; Natural organic matter as precursor to disinfection byproducts and its removal using conventional and advanced processes: state of the art review. *Water Health* (2018); 16 (5): 681–703. doi: <https://doi.org/10.2166/wh.2018.032>
- Thomas, J., Harrell, S., Alexander, R. (2020, September 18). Residents recount terrifying descent of wildfire into Santiam Canyon: 'It was like hot lava'. Oregonlive. Retrieved from <https://www.oregonlive.com/wildfires/2020/09/residents-recount-terrifying-descent-of-wildfire-into-santiam-canyon-it-was-like-hot-lava.html>
- U.S. Dept. of Agriculture. (2021). *Food security in the U.S.* Retrieved from <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement>
- Urness, Z. (2020, September 12). Oregon Wildfires: How the tiny Beachie Creek Fire blew up and ravaged the Santiam Canyon. *Statesman Journal*. Retrieved from <https://www.statesmanjournal.com/story/news/2020/09/12/beachie-creek-fire-growth-oregon-santiam-canyon/3474149001/>
- Uzun, H., Dahlgren, R. Olivares, C., Erdem, C.U., Karanfil, T., Chow, A., Two years of post-wildfire impacts on dissolved organic matter, nitrogen, and precursors of disinfection by-products in California stream waters. *Water Research*, Volume 181, (2020)
- Warsini, S., Mills, J., & Usher, K. (2014). Solastalgia: living with the environmental damage caused by natural disasters. *Prehospital and disaster medicine*, 29(1), 87-90.

Appendices

- A. Survey questions (as viewed in Qualtrics format)
- B. Quantitative survey results
- C. Focus group interview questions
- D. Clinic utilization review, pre- and post-fire (Samaritan Health Services)

Introduction

Dear Santiam Canyon resident,

This survey about the 2020 Labor Day wildfires is part of a community health assessment that is funded by Marion County and conducted by a team from Oregon State University's College of Public Health and Human Sciences and College of Forestry. Our goals are to better understand the needs of the communities affected by the wildfires, to provide recommendations for addressing the health needs of wildfire survivors, and to suggest ways to respond to future wildfires and other emergencies.

The survey is completely anonymous, so no one will know who the individual survey participants are. We believe the survey should take you about 8-12 minutes. There are no right or wrong answers. We just want to know your opinions, experiences, and suggestions. Feel free to skip any questions that you would rather not answer.

If you have any questions about the survey or about our project, please feel free to contact our team at santiamcanyonhealth@oregonstate.edu.

Thank you for participating and sharing your insights! Please press the arrow below to continue.

Environmental health, safety, and housing

In your judgment, what are the **most significant health-related issues that still exist** in Santiam Canyon as a result of the wildfires? Please answer for both **(a) yourself and/or your family**, and **(b) the greater Santiam Canyon community**. In each column, **please select no more than 5** of the following issues:

	For myself and / or my family	For the Santiam Canyon community
Drinking water quality and access	<input type="checkbox"/>	<input type="checkbox"/>
Indoor air quality	<input type="checkbox"/>	<input type="checkbox"/>
Outdoor air quality	<input type="checkbox"/>	<input type="checkbox"/>
Exposure to other toxins	<input type="checkbox"/>	<input type="checkbox"/>
Physical safety hazards created by the fires	<input type="checkbox"/>	<input type="checkbox"/>
Availability of healthy food	<input type="checkbox"/>	<input type="checkbox"/>
Food safety and storage	<input type="checkbox"/>	<input type="checkbox"/>
Emotional stress	<input type="checkbox"/>	<input type="checkbox"/>
Strain or changes in family relationships	<input type="checkbox"/>	<input type="checkbox"/>
Isolation or loss of social connection	<input type="checkbox"/>	<input type="checkbox"/>
Alcohol and/or drug use	<input type="checkbox"/>	<input type="checkbox"/>
Mental health challenges	<input type="checkbox"/>	<input type="checkbox"/>
Sleep quality	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to exercise	<input type="checkbox"/>	<input type="checkbox"/>
Access to medical care	<input type="checkbox"/>	<input type="checkbox"/>
Ability to manage chronic health conditions such as diabetes, heart disease, etc.	<input type="checkbox"/>	<input type="checkbox"/>

At any time in the past year, were you **without** access to safe drinking water as a result of the wildfires?

- Yes, we were without access to safe drinking water for some time period.
- No, our drinking water has been safe for the past year

Please describe the experience you had involving access to safe drinking water:

At any time in the past year, has indoor or outdoor air quality been a problem for you or your family as a result of the wildfires?

- Yes, air quality has been a problem for us in the past year
- No, air quality has not been a problem for us in the past year

Please describe the experience you had involving indoor or outdoor air quality.

To your knowledge, have you or your family been exposed to toxins or contaminants over the past year, as a result of the wildfires?

- Yes, I believe that we have been exposed to toxins or contaminants related to the fires over the past year
- No, to my knowledge we have not been exposed to toxins or contaminants related to the fires over the past year

Please describe the experience you had involving exposure to toxins or contaminants.

In the past year since the wildfires, have you, or someone in your family, had an injury resulting from the fire itself, the clean-up, or the rebuilding process?

- Yes, from the fire itself
- Yes, from the resulting clean-up
- Yes, from the rebuilding
- No, we have not had an injury resulting from the fire, its clean-up, or rebuilding

Please describe the injury that your or someone in your family has experienced.

Was there a time during the past year when you needed medical care but did not get it, either because of the wildfires or the resulting clean-up?

- Yes
- No

What were the barriers you experienced in trying to access needed medical care?

Did the wildfires require you to move to temporary housing for any period of time?

- Yes
- No

Are you still living in temporary housing?

- Yes
- No

What kind of temporary housing are you living in at the present time?

- Hotel
- Temporary rental
- Living with friends or family
- Other arrangement (please describe)

In your current place of residence (whether temporary or permanent)...

	Yes	No	Don't Know
Do you use well water?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you use a generator for electricity?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you have a functioning smoke alarm?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is your building structurally sound?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Access to sufficient and healthy food

Getting enough food can be a problem for some people. **In the last 7 days**, which of these statements best describes the food eaten in your household? (Select only one answer.)

- Enough of the kinds of food that I (or we) wanted to eat
- Enough, but not always the kinds of food that I (or we) wanted to eat
- Sometimes not enough to eat
- Often not enough to eat

Which of these statements best describes the food eaten in your household **over the past year**, since the wildfires? (Select only one answer.)

- Enough of the kinds of food that I (or we) wanted to eat
- Enough, but not always the kinds of food that I (or we) wanted to eat
- Sometimes not enough to eat
- Often not enough to eat

For yourself and your family, has your ability to get adequate healthy food been impacted by the fires in any of the following ways over the past year?

	Not at all impacted	Slightly impacted	Moderately impacted	Very much impacted
Adding to our food supply through gardening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Adding to our food supply through hunting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time needed for travel to a grocery or supermarket	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being able to store food in adequate quantities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being able to store food safely and prevent spoilage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any comments to explain your answers to the above questions about adequate healthy food, or to add other kinds of impacts.

Mental and behavioral health

To what degree have you had difficulty related to the following health issues, both (a) before the wildfires, and (b) since the wildfires over the past year?

	Before the fires (Please select one on each line)			Since the fires, over the past year (Please select one on each line)		
	No difficulty	Some difficulty	A lot of difficulty	No difficulty	Some difficulty	A lot of difficulty
Breathing problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digestive problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sleeping problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunity to exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Management of chronic health conditions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In the past month, how much have you been bothered by...

	Not at all	A little	A moderate amount	A lot
Repeated and unwanted memories of the wildfires?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling very upset when something reminded you of the wildfires?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avoiding memories or thoughts related to the wildfire experience?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling jumpy or easily startled because of memories of the wildfires?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree or disagree with each of the following statements.
(Select one answer on each line.)

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
People around here are willing to help their neighbors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People are more willing to help their neighbors since the wildfires occurred last year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel like I have been grieving for the loss of the forest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Demographics

In what town do you **currently** live?

- Idanha
- Detroit
- Gates
- Mill City
- Fox Valley
- Lyons / Mehama
- Other, including outside Santiam Canyon. Please indicate:

In what town did you live at the time **immediately prior to the fires**?

- Idanha
- Detroit
- Gates
- Mill City
- Fox Valley
- Lyons / Mehama
- Other, including outside Santiam Canyon. Please indicate:

What is your age group?

- 25 or younger
- 26 – 45
- 46 – 65
- Over 65

Do you describe yourself as female, male, or a different identity?

- Female
- Male
- A different identity

General comments about community responses to the wildfire

Please answer the following questions in your own words, based on your own opinions and observations. There are no right or wrong answers.

Over the past year, what has been **particularly helpful** about the community response to the

wildfires, that is, from government agencies, medical personnel, local organizations, nonprofit agencies, and / or individuals?

Over the past year, what has been **insufficient** about the community response to the wildfires, that is, from government agencies, medical personnel, local organizations, nonprofit agencies, and / or individuals?

What are the most important **actions that should be taken now** in order to maintain or improve the health of Santiam Canyon residents who were affected by the wildfires?

Please feel free to add any comments about the health impacts of the fires that we haven't addressed yet, or that can help explain any of your above answers.

Appendix B Quantitative Survey Results

1. In your judgment, what are the most significant health-related issues that still exist in Santiam Canyon as a result of the wildfires? (up to 5 selections per column)

Question	For myself and/or my family		For the Santiam Canyon community	
	N *	Percent **	N *	Percent **
Drinking water quality and access	23	31.1%	27	36.5%
Indoor air quality	8	10.8%	4	5.4%
Outdoor air quality	12	16.2%	21	28.4%
Exposure to other toxins	16	21.6%	14	18.9%
Physical safety hazards created by the fires	27	36.5%	37	50.0%
Availability of healthy food	13	17.6%	20	27.0%
Food safety and storage	4	5.4%	10	13.5%
Emotional stress	55	74.3%	46	62.2%
Strain or changes in family relationships	30	40.5%	23	31.1%
Isolation or loss of social connection	32	43.2%	27	36.5%
Alcohol and/or drug use	5	6.8%	17	23.0%
Mental health challenges	27	36.5%	32	43.2%
Sleep quality	32	43.2%	12	16.2%
Opportunity to exercise	19	25.7%	9	12.2%
Access to medical care	10	13.5%	12	16.2%
Ability to manage chronic health conditions such as diabetes, heart disease, etc.	11	14.9%	7	09.5%

* Columns marked "N" show the number of respondents, out of 74, who selected the option. Respondents were instructed to select up to 5 options in each column.

** Columns marked "Percent" show the percentage out of 74 who selected the designated option.

2. At any time in the past year, were you without access to safe drinking water as a result of the wildfires?

	%	Count
No, our drinking water has been safe for the past year	45.57%	36
Yes, we were without access to safe drinking water for some time period.	54.43%	43
Total	100%	79

3. At any time in the past year, has indoor or outdoor air quality been a problem for you or your family as a result of the wildfires?

	%	Count
Yes, air quality has been a problem for us in the past year	72.37%	55
No, air quality has not been a problem for us in the past year	27.63%	21
Total	100%	76

4. To your knowledge, have you or your family been exposed to toxins or contaminants over the past year, as a result of the wildfires?

	%	Count
Yes, I believe that we have been exposed to toxins or contaminants related to the fires over the past year	52.78%	38
No, to my knowledge we have not been exposed to toxins or contaminants related to the fires over the past year	47.22%	34
Total	100%	72

5. In the past year since the wildfires, have you, or someone in your family, had an injury resulting from the fire itself, the clean-up, or the rebuilding process?

	%	Count
Yes, from the fire itself	10.81%	8
Yes, from the resulting clean-up	16.22%	12
Yes, from the rebuilding	8.11%	6
No, we have not had an injury resulting from the fire, its clean-up, or rebuilding	64.86%	48
Total	100%	74

6. Was there a time during the past year when you needed medical care but did not get it, either because of the wildfires or the resulting clean-up?

	%	Count
Yes	23%	17
No	77%	57
Total	100%	74

7. Did the wildfires require you to move to temporary housing for any period of time?

	%	Count
Yes	86.30%	63
No	13.70%	10
Total	100%	73

7(a). Are you still living in temporary housing?

	%	Count
Yes	56.45%	35
No	43.55%	27
Total	100%	62

7(b). What kind of temporary housing are you living in at the present time?

	%	Count
Hotel	0.00%	0
Temporary rental	45.71%	16
Living with friends or family	8.57%	3
Other arrangement (<i>please describe</i>)	45.71%	16
Total	100%	35

Written Responses to: "Other arrangement (please describe)"

split between small apt. and rv

Bought a trailer and living on someone else property

still homeless

We purchased a fifth wheel

In our RV

Travel trailer

Fema house

Living in an RV on our property.

Motorhome

RV

Rental home in Scappoose

living in a motorhome on property

FEMA housing

RV on property

22ft rv in a back yard

8. In your current place of residence (whether temporary or permanent)...

	Yes		No		Total
Do you use well water?	31.51%	23	68.49%	50	73
Do you use a generator for electricity?	11.27%	8	88.73%	63	71
Do you have a functioning smoke alarm?	94.12%	64	5.88%	4	68
Is your building structurally sound?	91.94%	57	8.06%	5	62

9. Getting enough food can be a problem for some people. In the last 7 days, which of these statements best describes the food eaten in your household? (Select only one answer.)

	%	Count
Enough of the kinds of food that I (or we) wanted to eat	62.32%	43
Enough, but not always the kinds of food that I (or we) wanted to eat	28.99%	20
Sometimes not enough to eat	5.80%	4
Often not enough to eat	2.90%	2
Total	100%	69

10. Which of these statements best describes the food eaten in your household over the past year, since the wildfires? (Select only one answer.)

	%	Count
Enough of the kinds of food that I (or we) wanted to eat	50.00%	34
Enough, but not always the kinds of food that I (or we) wanted to eat	45.59%	31
Sometimes not enough to eat	4.41%	3
Often not enough to eat	0.00%	0
Total	100%	68

11. For yourself and your family, has your ability to get adequate healthy food been impacted by the fires in any of the following ways over the past year?

	Not at all impacted		Slightly impacted		Moderately impacted		Very much impacted		Total
Adding to our food supply through gardening	39.39%	26	21.21%	14	24.24%	16	15.15%	10	66
Adding to our food supply through hunting	67.19%	43	6.25%	4	9.38%	6	17.19%	11	64
Time needed for travel to a grocery or supermarket	33.87%	21	27.42%	17	20.97%	13	17.74%	11	62
Being able to store food in adequate quantities	36.51%	23	20.63%	13	17.46%	11	25.40%	16	63
Being able to store food safely and prevent spoilage	42.86%	27	20.63%	13	22.22%	14	14.29%	9	63

12 (part 1). To what degree have you had difficulty related to the following health issues,

(a)Before the fires

	No difficulty		Some difficulty		A lot of difficulty		Total
Breathing problems	72.31%	47	26.15%	17	1.54%	1	65
Digestive problems	66.67%	44	27.27%	18	6.06%	4	66
Headaches	68.18%	45	22.73%	15	9.09%	6	66
Sleeping problems	56.25%	36	39.06%	25	4.69%	3	64
Opportunity to exercise	77.42%	48	19.35%	12	3.23%	2	62
Management of chronic health conditions	73.44%	47	20.31%	13	6.25%	4	64

12 (part 2).

(b)Since the fires, over the past year

	No difficulty		Some difficulty		A lot of difficulty		Total
Breathing problems	45.16%	28	35.48%	22	19.35%	12	62
Digestive problems	52.46%	32	32.79%	20	14.75%	9	61
Headaches	39.34%	24	37.70%	23	22.95%	14	61
Sleeping problems	18.03%	11	42.62%	26	39.34%	24	61
Opportunity to exercise	33.90%	20	40.68%	24	25.42%	15	59
Management of chronic health conditions	50.00%	30	30.00%	18	20.00%	12	60

13. In the past month, how much have you been bothered by...

	Not at all		A little		A moderate amount		A lot		Total
	%	Count	%	Count	%	Count	%	Count	
Repeated and unwanted memories of the wildfires?	14.06%	9	28.13%	18	31.25%	20	26.56%	17	64
Feeling very upset when something reminded you of the wildfires?	14.06%	9	25.00%	16	35.94%	23	25.00%	16	64
Avoiding memories or thoughts related to the wildfire experience?	21.88%	14	21.88%	14	32.81%	21	23.44%	15	64
Feeling jumpy or easily startled because of memories of the wildfires?	29.23%	19	32.31%	21	26.15%	17	12.31%	8	65

14. Please indicate how much you agree or disagree with each of the following statements. (Select one answer on each line.)

	Strongly disagree		Somewhat disagree		Neutral		Somewhat agree		Strongly agree		Total
	%	Count	%	Count	%	Count	%	Count	%	Count	
People around here are willing to help their neighbors.	4.62%	3	6.15%	4	18.46%	12	32.31%	21	38.46%	25	65
People are more willing to help their neighbors since the wildfires occurred last year.	4.62%	3	7.69%	5	24.62%	16	36.92%	24	26.15%	17	65
I feel like I have been grieving for the loss of the forest.	3.13%	2	4.69%	3	10.94%	7	26.56%	17	54.69%	35	64

15. In what town do you currently live?

	%	Count
Idanha	1.54%	1
Detroit	10.77%	7
Gates	6.15%	4
Mill City	15.38%	10
Fox Valley	0.00%	0
Lyons / Mehama	23.08%	15
Other, including outside Santiam Canyon (<i>please indicate</i>)	43.08%	28
Total	100%	65

16. In what town did you live at the time immediately prior to the fires?

	%	Count
Idanha	3.08%	2
Detroit	24.62%	16
Gates	12.31%	8
Mill City	4.62%	3
Fox Valley	0.00%	0
Lyons / Mehama	24.62%	16
Other, including outside Santiam Canyon (<i>please indicate</i>)	30.77%	20
Total	100%	65

17. What is your age group?

	%	Count
25 or younger	1.61%	1
26 – 45	19.35%	12
46 – 65	43.55%	27
Over 65	35.48%	22
Total	100%	62

18. Do you describe yourself as female, male, or a different identity?

	%	Count
Female	73.44%	47
Male	26.56%	17
A different identity	0.00%	0
Total	100%	64

Appendix C Focus Group Interview Questions

1. In your opinion, what are the most significant health-related issues that **still exist** in Santiam Canyon as a result of the wildfires?
2. We know that many lives have been overturned because of lost homes, the need for temporary housing, and the continuing lack of stability in where people live. What have been the most important **health** effects that were created by this housing crisis?
3. What have you observed about current health problems in the Canyon communities with regard to **environmental health**, such as the fires' effects on drinking water, air, soil, and so on?
4. What have you observed about current health problems in the Canyon communities with regard to **physical safety and potential injury**, such as physical hazards related to dead trees, or the rebuilding process, and so on?
5. What have you observed about current health problems in the Canyon communities with regard to **food security and food safety**, in other words, people's ability to get adequate healthy food and to store and prepare it safely?
6. What have you observed about current health problems in the Canyon communities with regard to **mental health, behavioral health, or effects on families**?
7. What have you observed about current health problems in the Canyon communities with regard to **personal health**, such as access to medications, access to medical care, reduced ability to exercise, sleep disruptions, and so on?
8. Who are the people who have been hardest hit with regard to health, for example, with regard to age groups, location within the Canyon, job categories, or any other characteristics?
9. Over the past year, what has been **helpful** about the response to the wildfires from county agencies, state agencies, medical organizations, nonprofit organizations, and other groups?
10. Over the past year, what has **not been sufficient** about the response to the wildfires from county agencies, state agencies, medical organizations, nonprofit organizations, and other groups?
11. What are the most important **actions that should be taken now** in order to maintain or improve the health of Santiam Canyon residents who were affected by the wildfires?
12. What actions should local, county and state officials take today to ensure an improved response to future wildfires?
13. As a final question, what kinds of health concerns due to the wildfires have we not covered yet, which you would like to call our attention to?

Santiam Canyon Wildfire, September 2020 Data from Samaritan Health Services

October 2021

Drafted by Olivia Pipitone & reviewed by Paulina Kaiser

Summary of request

Dr. Sandi Phibbs (Program Manager, OSU Oregon Center for Health Innovation) & Dr. Marc Braverman (Professor, OSU College of Public Health & Human Sciences) are working with the Marion County Health Department to do a community health assessment of the 2020 Labor Day wildfires in the Santiam Canyon.

About the data

We identified Samaritan Health Services (SHS) patients who met the following criteria:

- 1) Address stored in Epic as of September 7, 2020 included the cities of Lyons, Mehama, Mill City, Gates, Idanha, Detroit and/or a zip code of 97358, 97360, 97346, 97350, 97342; and
- 2) Had at least one encounter with SHS (any Samaritan clinic or hospital) at some point between 9/7/2019 – 9/7/2021.

These criteria identified 330 people. Table 1 describes the health status and healthcare utilization at SHS of this population in the year before the 2020 wildfire (9/7/2019 – 9/6/2020) and the year after the 2020 wildfire (9/7/2020 – 9/6/2021). Table 2 summarizes patient-level changes from the year before the wildfire to the year after the wildfire – e.g. the proportion of patients that increased, decreased, or had the same utilization over time.

All data was extracted from SHS electronic medical records in September 2021 via a SQL query of the Clarity Database, written by Olivia Pipitone. Cell sizes <11 are suppressed to prevent identifiability, per SHS policy aligned with the CMS Cell Size Suppression Policy.

Definitions

- Urgent Care Visits: Office visits at one of Samaritan's Urgent Care or Express clinics which are located in Albany, Corvallis, Lebanon, and Newport.
- Emergency Department Visits: An Emergency Department visit at one of Samaritan's five hospitals (in Corvallis, Albany, Lebanon, Newport, and Lincoln City).
- Inpatient/Observation Hospital Visits: An inpatient or observation hospital stay at one of Samaritan's five hospitals.

- Any Outpatient Office Visit: Any outpatient office visit at a Samaritan clinic that is not an Urgent Care or Express.
- Outpatient Office Visit in a Primary Care Department: Outpatient office visits at a SHS Family Medicine, Internal Medicine, or Pediatric clinic.
- Any visit with a mental health diagnosis: Any inpatient or outpatient visit that had a visit diagnosis related to a mental disorder and/or to substance abuse.
- Any visit with a respiratory diagnosis: Any inpatient or outpatient visit that had a visit diagnosis related to COPD, asthma, or other respiratory diseases.
- Any visit with a trauma diagnosis: Any inpatient or outpatient visit that had a visit diagnosis related to trauma.

Table 1. Healthcare utilization before & after the 2020 wildfire among 330 SHS patients in Santiam Canyon.

	1 year before wildfire (9/7/2019-9/6/2020) N (%)	1 year after wildfire (9/7/2020-9/6/2021) N (%)
Urgent Care Visits		
% with 0 visits	280 (85%)	294 (89%)
% with 1+ visits	50 (15%)	36 (11%)
Emergency Department Visits		
% with 0 visits	284 (86%)	291 (88%)
% with 1+ visits	46 (14%)	39 (12%)
Inpatient/Observation Hospital Visits		
% with 0 visits	>95%	>95%
% with 1+ visits	<11 (<5%)	<11 (<5%)
Any Outpatient Office Visit		
% with 0 visits	213 (65%)	220 (67%)
% with 1-2 visits	79 (24%)	74 (22%)
% with 3+ visits	38 (12%)	36 (11%)
Outpatient Office Visit in a Primary Care Dept		
% with 0 visits	256 (78%)	256 (78%)
% with 1-2 visits	52 (16%)	51 (15%)
% with 3+ visits	22 (7%)	23 (7%)
Any visit with a mental health or substance use diagnosis¹		
% with 0 visits	302 (92%)	300 (91%)
% with 1+ visits	28 (8%)	30 (9%)
Any visit with a respiratory diagnosis²		
% with 0 visits	299 (91%)	305 (92%)
% with 1+ visits	31 (9%)	25 (8%)
Any visit with a trauma diagnosis³		
% with 0 visits	291 (88%)	297 (90%)
% with 1+ visits	39 (12%)	33 (10%)

¹ Defined by Epic diagnosis groupers for Substance Abuse or Mental Disorder

² Defined by Epic diagnosis groupers for COPD, asthma, or other respiratory diseases

³ Defined by Epic diagnosis groupers for trauma

Table 2. Aggregation of individual-level changes from 1 year before wildfire to 1 year after wildfire.

	1 year before vs 1 year after wildfire
Urgent Care Visits	
% of patients with more visits after	28 (8%)
% of patients with the same number of visits	264 (80%)
% of patients with fewer visits after	38 (12%)
Emergency Department Visits	
% of patients with more visits after	61 (18%)
% of patients with the same number of visits	194 (59%)
% of patients with fewer visits after	75 (23%)
Inpatient/Observation Hospital Visits	
% of patients with more visits after	37 (11%)
% of patients with the same number of visits	252 (76%)
% of patients with fewer visits after	41 (12%)
Any Outpatient Office Visit	
% of patients with more visits after	35 (11%)
% of patients with the same number of visits	254 (77%)
% of patients with fewer visits after	41 (12%)
Outpatient Office Visit in a Primary Care Dept	
% of patients with more visits after	<11 (<5%)
% of patients with the same number of visits	Suppressed
% of patients with fewer visits after	<11 (<5%)
Any visit with a mental health or substance use diagnosis¹	
% of patients with more visits after	24 (7%)
% of patients with the same number of visits	286 (87%)
% of patients with fewer visits after	20 (6%)
Any visit with a respiratory diagnosis²	
% of patients with more visits after	21 (6%)
% of patients with the same number of visits	286 (87%)
% of patients with fewer visits after	23 (7%)
Any visit with a trauma diagnosis³	
% of patients with more visits after	24 (7%)
% of patients with the same number of visits	273 (83%)
% of patients with fewer visits after	33 (10%)

¹ Defined by Epic diagnosis groupers for Substance Abuse or Mental Disorder

² Defined by Epic diagnosis groupers for COPD, asthma, or other respiratory diseases

³ Defined by Epic diagnosis groupers for trauma