Health, Housing & Human Services
CLACKAMAS COUNTY

MULTNOMAH COUNTY HEALTH DEPARTMENT

WASHINGTON COUNTY OREGON

Public Health
Prevent. Promote. Protect.

2010-2020

Regional Climate and Health Monitoring Report

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Fall 2021

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Introduction

Climate Change and Health

Climate change is a major public health concern that affects the health and well-being of people living in the region. The 2018 National Climate Assessment found that the Pacific Northwest has warmed about 2 degrees Fahrenheit since 1900, resulting in warmer winters, declining snow pack, and more instances of high heat, drought, and wildfires.[1] The 2021 Oregon Climate Assessment projects an average increase by 5 degrees Fahrenheit by 2050, and 8 degrees by 2080.[2] These reports found health impacts related to heat illness, infectious diseases, drinking water quality issues, extreme weather, and mental health.

The 2021 Intergovernmental Panel on Climate Change reported human influence has unequivocally warmed the atmosphere, and this is creating weather and climate extremes around the world.[3] Addressing the cause of these environmental conditions and slowing future warming rates will depend on finding ways to reduce greenhouse gas emissions.[4]

Addressing the health impacts caused by climate change will require a collaborative and comprehensive approach involving health care, public health, community-based organizations, civic groups, private industry, and local and state elected officials. **The first step is identifying and monitoring the ways health is impacted by climate change in the region.**

What is this Report?

The Regional Climate and Health Monitoring Report provides data on 12 health conditions. The health conditions span six areas that climate change is known to affect. This data will help guide current mitigation efforts and provide a benchmark for future measurement.

What is in the 2021 Update?

This document is the first update to the Regional Climate and Health Monitoring Report released in 2019. This update:

- Adds three years of the most recent data from 2018-2020 for most indicators
- Discusses connections between mental health and climate change and provides a snapshot of data available on that intersection
- Highlights impacts from the September 2020 wildfire season on asthma-like symptom emergency department and urgent care (ED) visits

It is unclear how the COVID-19 pandemic has affected the climate change-related health outcomes tracked in this report for the year 2020. Many ways people are typically exposed to high heat and pollen were less likely to be a risk during the summer of 2020. For example, large outdoor events such as festivals were cancelled, as were most organized athletic events. Many dining options were closed for extended periods throughout the year, which may have affected the incidence of food borne illness. Health care resources were also strained due to pandemic response and people were more likely to forego medical treatment for fear of contracting the virus at a health care facility.[5] The full extent of these factors on the outcomes in this report is unknown.

Key Takeaways

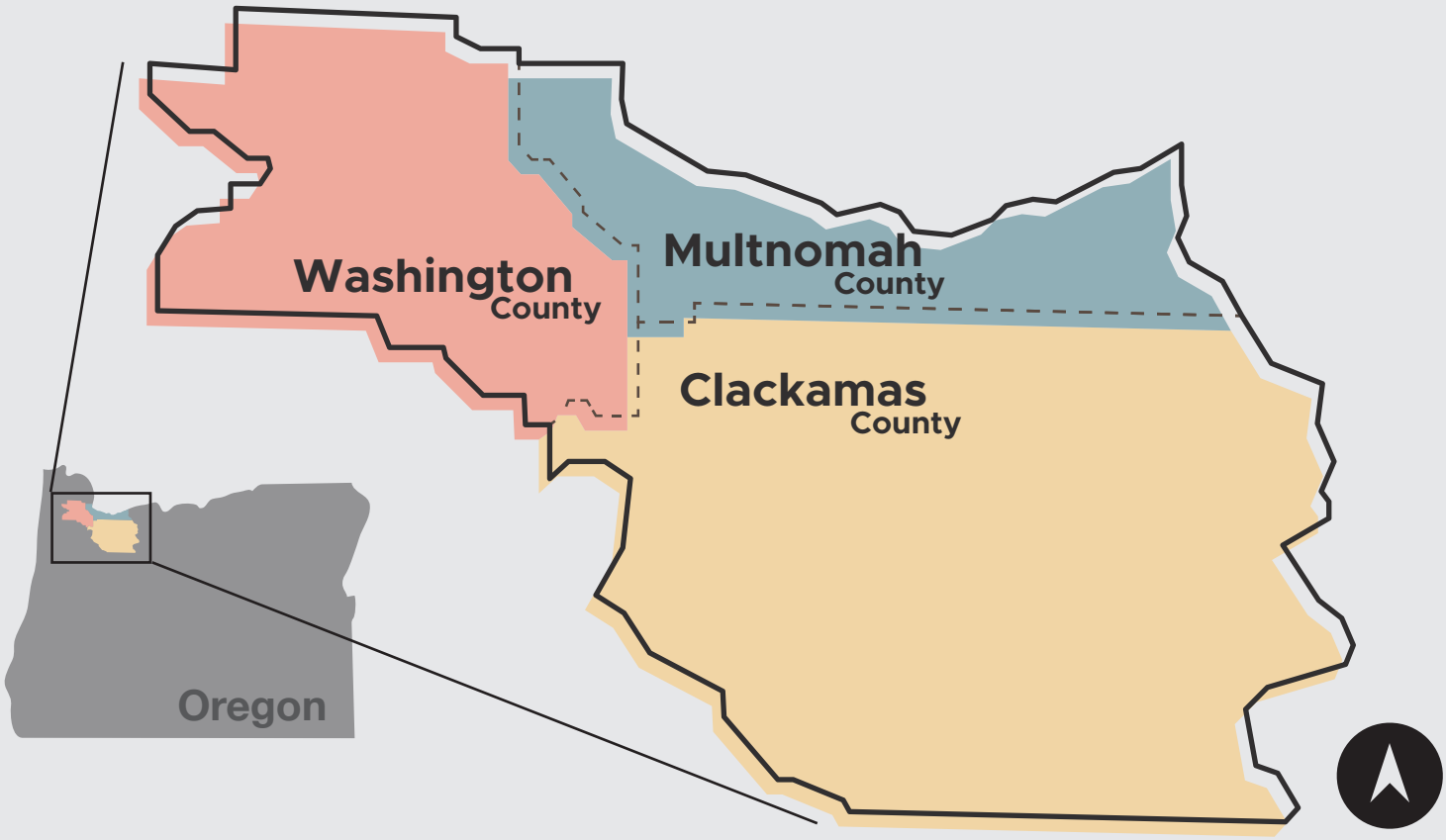
This report updates baseline measurements of health conditions that are influenced by climate change with new data available between 2018 through 2020. It compiles data from multiple sources to capture a broader view of climate change and health. Key takeaways include:

- Climate change events likely to impact health in the tri-county region include heat waves, extreme weather events, conditions that promote the spread of vector-borne and communicable diseases, poor air quality, and negative mental health impacts from ongoing climate events and threats.
- In 2020, coinciding with the COVID-19 pandemic, several heat, air quality, and foodborne communicable disease health outcomes decreased in number in comparison to previous years.
- Among the health conditions in this report, those related to poor air quality, asthma-like symptoms, and allergic disease affect the greatest number of people in the region. Despite the COVID-19 pandemic, ED visits for asthma-like symptoms increased by 29% across the tri-county region in the four weeks during and after the 2020 September wildfires in comparison to the four weeks before.
- There is a need for more robust and consistent tracking systems for mental health-related impacts that collect counts, rates, and stories over time and within the context of different climate events. Estimates from the Yale Climate Opinion Survey show increasing worry and concern regarding global warming impacts in the region.
- Systemic racism and discrimination unjustly distribute the impacts and burdens of climate change among low-income people and communities of color. The way physical, social, and work environments are designed play important roles in determining community resiliency for all against climate change health impacts.

So far in 2021, the region has experienced record air pollution and heat attributed to climate change. These environmental conditions have had profound health implications not fully captured in this report update.

The health impacts of these events add urgency to the need for investment in resilience and public health capacity.

The Tri-County Region



The tri-county metro area is diverse, encompassing wild forestland, rich farmland, numerous rivers and lakes, and rural, suburban, and urban communities. Clackamas, Multnomah, and Washington Counties operate as a contiguous region where community members cross county borders to work, live, attend school, and recreate. They are the three most populous counties in Oregon (~1.8 million residents total), and 43% of the state's population lives within this area.

Since 2010, the regional population has increased by 12%. Regional population is not an indicator in this report, but is an important consideration when evaluating climate change health impacts. Increases in the number of residents create a greater burden on our transportation, health care, utility, and social service systems. Growth also creates opportunities to build more resilient communities.

Projected impacts for Clackamas, Multnomah, and Washington counties include more extreme heat days, poorer air quality days, larger wildfires, and heavier rainfall increasing the risk of floods and landslides. Changes in our regional climate from deteriorated water and air quality, heat waves, and increased allergens are already affecting health.

Climate Change and Health Equity

The conditions in which we live, learn, work, and play are some of the strongest predictors of our overall health and well-being. This includes access to and availability of safe and affordable housing, jobs with fair pay, quality education, health care, and safe neighborhoods. These conditions are shaped by past and present systemic racism, resulting in state and local policies designed to favor white communities. These decisions have left many racial and ethnic groups without social or political power to build intergenerational wealth and health, creating and reinforcing persistent health inequities.[6-,7]

The impacts of climate change on health vary significantly by individual characteristics and community conditions. Black people, Indigenous people, Latinx people, and other people of color disproportionately experience the impacts of climate change. This is because climate change interacts with and worsens existing inequalities in our communities that are often shaped by racism.

Policy changes and public health interventions cannot alter some traits, like life stage or physical and cognitive ability status. However, policy and system changes can address social conditions which are root causes of inequities in health outcomes, such as housing affordability or working environments.[8] For low-income communities and communities of color, power and resource imbalances have created unhealthy living, working, and learning conditions that put people at greater risk for exposure and limits the ability of a community to recover from climate change events.[9]

The intersection of individual characteristics and community conditions is where we see the most profound health impacts of climate change. It is essential that low-income communities, communities of color and other historically disenfranchised communities participate in climate adaptation planning as they best understand their needs and full range of health impacts.

Unequal Impacts

Throughout this report, the groups most impacted, either due to individual or community vulnerability, are outlined for each health impact area.

Key Definitions

Health Equity
Everyone has a fair opportunity to live a long, healthy life. It implies that health should not be compromised or disadvantaged because of an individual or population group's race, ethnicity, gender, income, sexual orientation, neighborhood or other social condition.

Baltimore Public Health Commission, 2017

Climate Change Resilience
The ability to survive, recover from, and even thrive in changing climatic conditions.

Public Health Institute, 2015

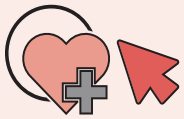
Systemic Racism
Racism is codified into our laws and institutions, which were created on a foundation of the ideology of white supremacy; it upholds systems, structures, and policies that were created to advantage white people while neither serving nor benefiting people of color.

Multnomah County, Declaring Racism a Public Health Crisis

Climate Change Vulnerability
The degree to which people are at risk from the impacts of climate change based on the intersection of individual and community characteristics, and also takes into account how well they can cope with those impacts.

Public Health Institute, 2015

Reporting Methods



Indicator Selection

Indicators for this benchmark were selected by a panel of local public health professionals based on guidance from national organizations, literature review, regional relevance, data availability, and previous climate change work in Oregon. Table 1 below shows each indicator in this report and the database from which it was sourced.

Benchmark Period

The study period for this report is from 2010 through 2020 for all indicators except emergency department visits (heat-related, asthma-like symptoms, and allergic disease), heat hospitalization, and heat-related deaths. The collection range for these indicators is 2016-2020 due to changes in data collection methodology in the Oregon Health Authority (OHA) Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE) system.

Data Presentation

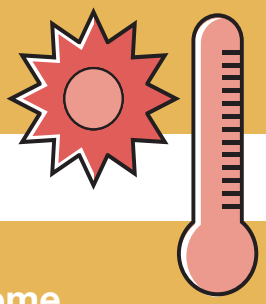
For each environmental area, we provide a description of how climate change creates conditions that affect health and the groups that are most vulnerable to those impacts. These narratives are based on academic literature and local data sources. Regional counts for each indicator are the sum of cases in Clackamas, Multnomah, and Washington counties.

We report a rate per 100,000 population, as well as a count. We do not report rates based on five or fewer events for individual counties or for the region as a whole due to possible reliability issues related to small numbers. Rates are calculated with data from the 5-year U.S. Census American Community Survey, which is why rates are not available for 2020 data.

Table 1. Climate Change Health Impact Indicators

	Indicator	Data Source	Time Period
Extreme Heat	Heat-related Emergency Department and Urgent Care (ED) Visits	Oregon Health Authority (OHA), Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE)	May-Sept of 2016-2020
	Heat-related Hospitalizations	Oregon Inpatient Hospital Discharge Data	2010-2019
	Heat-related Deaths	OHA, Center for Public Health Practice, Oregon Death Certificates	2010-2018
Extreme Weather	Extreme Weather-related Injury	National Oceanic and Atmospheric Administration (NOAA) Storm Event Database	2010-2020
	Extreme Weather-related Deaths	NOAA Storm Event Database	2010-2020
Vector-Borne Disease	West Nile Virus	OHA, Public Health Division	2010-2020
	Lyme Disease	OHA, Public Health Division	2010-2020
Communicable Disease	Salmonellosis	OHA, Public Health Division, Oregon Public Health Epidemiologist User System (ORPHEUS)	2010-2020
	Campylobacterosis	OHA, Public Health Division, ORPHEUS	2010-2020
	Tuberculosis	OHA, Public Health Division, ORPHEUS	2010-2020
Air Quality	Asthma-Like ED Visits	OHA, ESSENCE	May-Sept of 2016-2020
	Allergic Disease ED Visits	OHA, ESSENCE	May-Sept of 2016-2020

Extreme Heat



Climate Change Connection

Exposure to higher temperatures is one of the more direct impacts related to extreme weather driven by climate change. Extreme heat events can cause loss of internal temperature regulation and conditions including heat cramps, heat exhaustion, heat stress, heat stroke, and death.[10] Researchers estimate that extreme heat causes more deaths annually than all other weather events combined[11], and that investments to mitigate temperature increases can reduce heat-related mortalities.[12] Climate scientists project that most communities in Oregon will experience an increase of more than 30 days over 86°F by mid-century.

The Pacific Northwest has seen an increase in average annual temperatures of 1.5°F compared to the first half of the 20th century, and a further increase of 4-9°F is expected by the end of this century.[13] In 2016, the Portland region saw 13 days over 90°F, increasing to 22 days in 2017 and 29 days in 2018. Temperatures during the summer of 2019 were more moderate compared to other recent years, with just 9 days over 90°F recorded at Portland International Airport, less than half of the average the number of hot days in 2016-2019.

2021 Heat Dome

Although 2021 data are not reflected in this report, the June heat dome that affected the Pacific Northwest caused record-breaking temperatures of 116°F in the Portland Metro area. The event led to many emergency department visits and dozens of deaths, outcomes that will be detailed in future reporting efforts.

As of July 2021, there were at least 81 heat-related deaths in the tri-county region. This contrasts with a typical summer where we would typically see only one heat-related death. Climate scientists have concluded that such an event would be virtually impossible in the absence of climate change.[15]

Unequal Impact

Exposure to heat varies with social and environmental conditions. Both also determine what resources are available to adapt. In a comprehensive study of health impacts from heat, the U.S. Global Change Research Program synthesized evidence on populations especially at risk.[14] The study found evidence that the following groups face higher risk from extreme heat:

- Older adults, especially those over age 65, because of reduced thermoregulation or underlying chronic illness
- People experiencing houselessness
- People with chronic medical conditions that reduce thermoregulation (like cardiovascular disease or poor blood circulation)
- People with few social connections and limited social networks
- Children, who are vulnerable because they depend on others to reduce risk
- Pregnant people
- People living, working, or going to school in an urban heat island
- People from some racial and ethnic groups affected by structural environmental racism and decreased access to protective factors
- Outdoor workers (construction, road crews, farm workers)
- People with mental, behavioral, or cognitive disorders that are exacerbated by heat, or who rely on medications that interfere with thermoregulation
- People with no access to cooling systems at home

Air conditioning is protective from heat exposure, but access is uneven and many households in the region do not have any form of air conditioning.[17] About 20% of housing units in the region do not have air conditioning.[18]

Indicator 1

Heat-Related Emergency Department Visits

This indicator measures the number of visits by people seeking care at an emergency department or urgent care clinic (ED) for symptoms of heat-related illness resulting from prolonged exposure to hot weather, dehydration, and lack of acclimation.

What is happening in the region

Region-wide visit counts were lower in 2019 and 2020 compared to recent years. The regional rate per 100,000 population changed from 13.5 in 2016 to 18.4 in 2017, and then decreased in 2018 and 2019, reflecting no long-term increase or decrease. On average, there were about two visits each day during the warm season across the region in the five-year period of 2016-2020. The full impact of COVID-19 on 2020 counts is unknown.

Figure 2. Heat-Related ED Visit Counts, May-Sept, 2016-2020

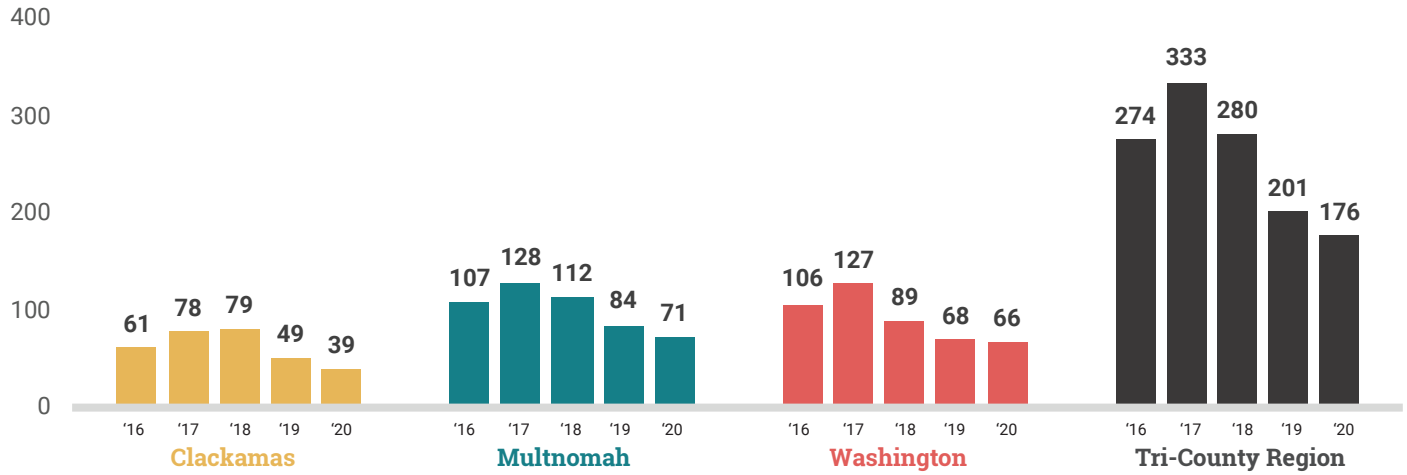
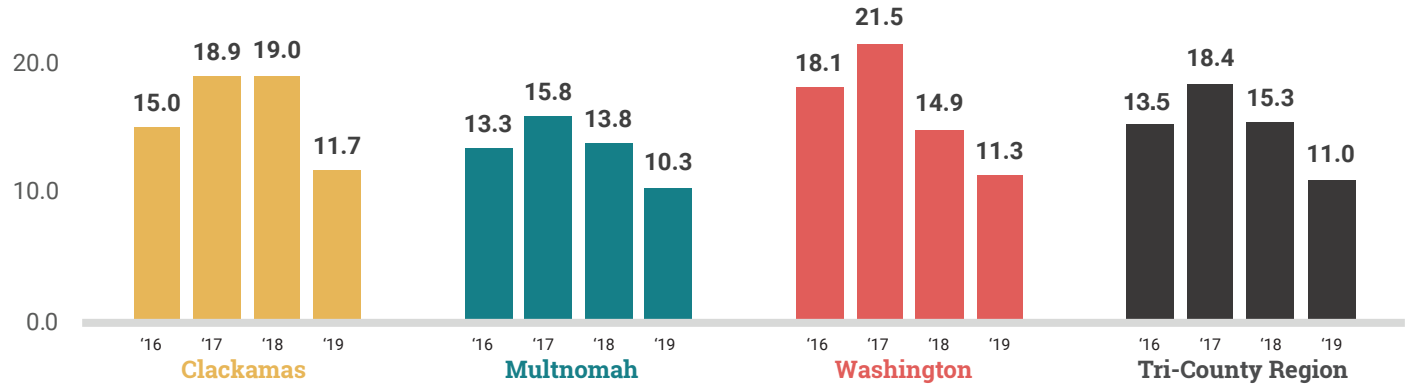


Figure 3. Heat-Related ED Visit Rates per 100,000 Persons, May-Sept, 2016-2019



Data Details

This indicator was collected from a statewide data system (ESSENCE)[16] for analyzing visits to emergency departments and urgent care clinics (ED). This indicator documents visits for heat stress during the warm season — May through September — for the years 2016 through 2020. Complete data became available beginning in the 2016 season, meaning that comparisons to earlier years are not reliable. Records are for visits, not patients, meaning that one person could be counted multiple times if they visited the emergency department more than once for the same complaint or for different complaints. Missing or incomplete records could result in undercounting. The number of urgent care clinics that report visits fluctuates over time.

Indicator 2
Heat-Related Hospitalizations

This indicator measures the number of hospitalizations with patients diagnosed of heat stress or a related condition. These cases are in-patient hospitalizations, reflecting health impacts from heat that are more severe or more complicated than the emergency department visits described above, and require a longer term of care.

What is happening in the region

Between 2010 and 2019, there were on average 14 heat-related hospitalizations every year. No clear upward or downward trend is apparent. Regionally, about one person per 100,000 was admitted for heat-related health conditions every year. A little less than half (45%) of all heat-related hospitalizations in the state came from the tri-county region.

Figure 4. Heat-Related Hospitalization Counts, May-Sept, 2010-2019

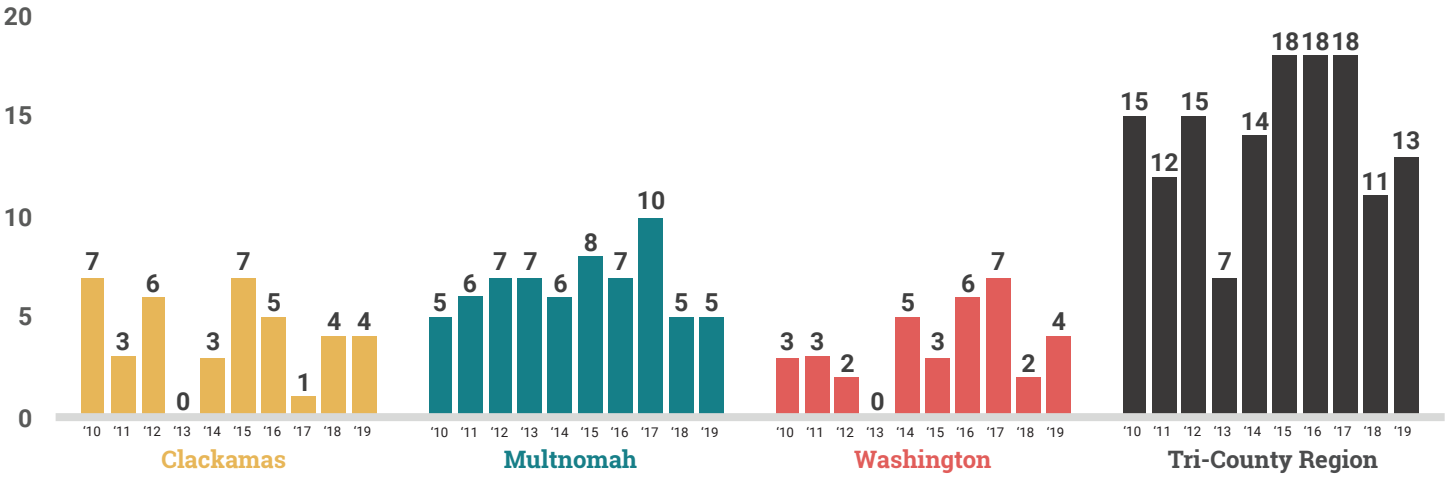
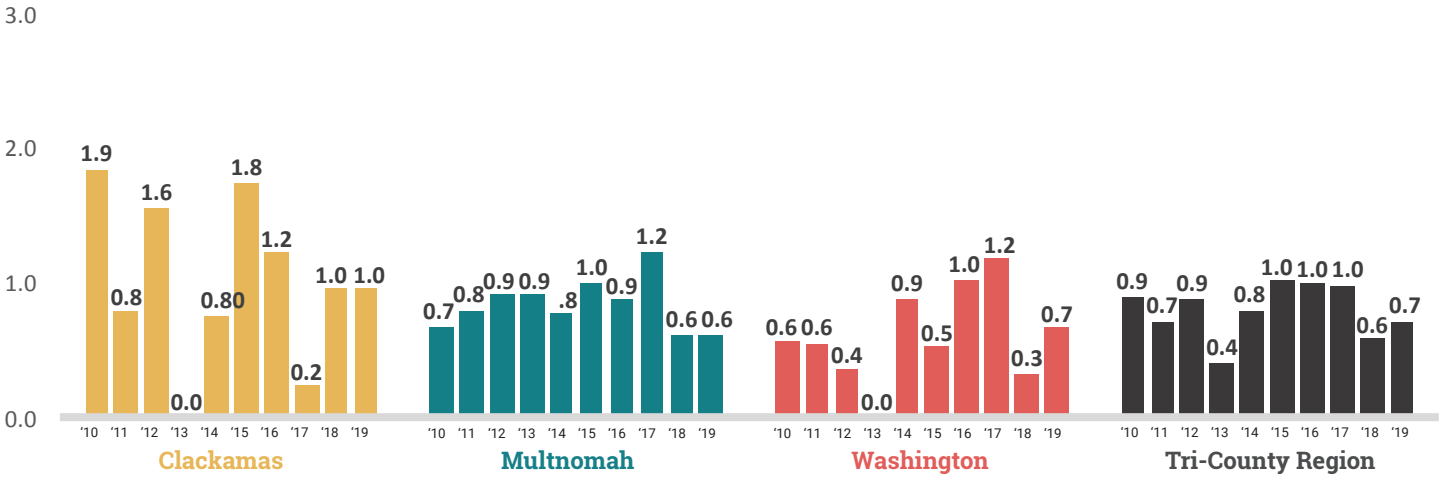


Figure 5. Heat-Related Hospitalization Rates per 100,000 Persons, May-Sept, 2010-2019



Data Details

Compiled by the Oregon Environmental Public Health Tracking Program, this indicator documents hospitalizations for heat stress during the warm season, May through September, for the years 2010 through 2019. These records exclude out-of-state residents, admissions to federal facilities, and transfers from other hospitals.

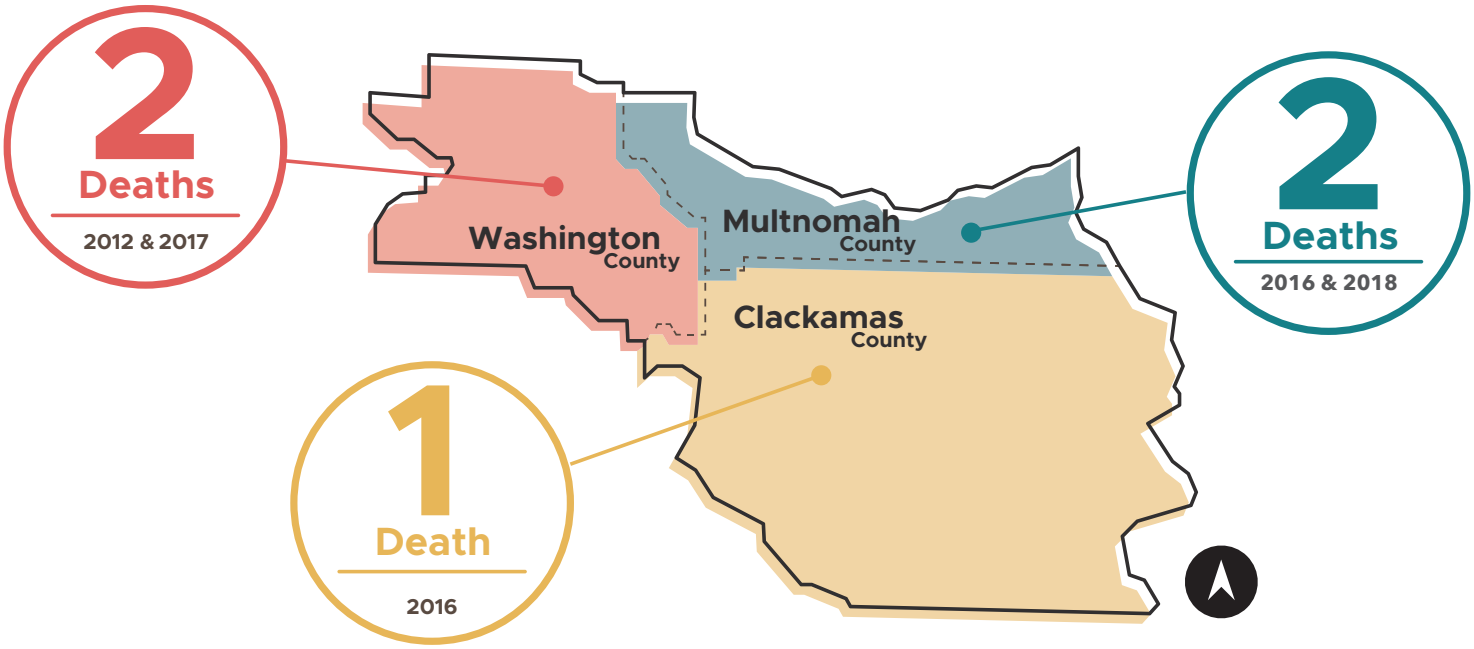
Indicator 3
Heat-Related Deaths

This indicator measures the count of deaths with heat exposure identified as a cause. Exposure to extreme heat can cause serious, life-threatening health effects. Examples of heat-related deaths include those from heat stroke, heat exhaustion, or dehydration.

What is happening in the region

Between 2010 and 2018 there have been very few documented heat deaths in the region. During this time, no county in the region recorded more than two heat deaths. There was at least one heat death in the region every year from 2016 to 2018.

Figure 6. Heat-Related Deaths, May-Sept, 2010-2018



Rates not calculated for this indicator due to sample size

Data Details

Heat deaths are defined in death records by ICD-10 Code X30: "Exposure to excessive heat-hyperthermia," identifying heat as the main underlying cause. The data presented here are from Oregon death records for the years 2010 through 2018 by county of residence. Annual data from 2019 and 2020 was not available through the Oregon Public Health Assessment Tool because of delay in vital statistics confirmation. The data presented here are unlikely to capture all deaths associated with extreme heat, only those with heat as a primary underlying cause. Heat can be associated with deaths from other heat-related mechanisms, such as drowning or violence.

Extreme Weather Events

Climate Change Connection

Extreme weather is one of the most visible consequences of climate change. Extreme weather is a broad term that encompasses severe storms and weather-related events that cause damage and destruction.

Extreme weather events include thunderstorms, tornadoes, heat waves, hurricanes, hailstorms, blizzards, floods, landslides, and lightning strikes.[19] Changing climate conditions in Oregon are expected to create more extreme weather events in the future, likely in the form of floods, heatwaves, wildfires, and storms.[20]

Damage from extreme weather events can restrict access to essential services, including clean water, food, basic sanitation, and health care.[21-22] Trauma from the loss of friends, family, and community also creates stress and affects mental health. This stress can grow over time if limited resources are available for mental and physical care, recovery, and reconstruction efforts.[23]

2020 Wildfires

In September of 2020, abnormally warm weather for the month, dry conditions, and high winds led to explosive growth of ongoing wildfires. The Riverside fire and several smaller fires in North Clackamas burned over 100,000 acres in Clackamas County.

These fires collectively led to the evacuation of around 1/10 of the County population, and put the rest of the county on alert for evacuation. Over 50 homes were destroyed.

Smoke from the wildfires affected the whole region, and is discussed more in the Air Quality section of this report.

Unequal Impact

Climate change-driven extreme weather can have greater impacts on some people and communities based on their ability to prepare for, withstand, and recover from events. Learning from previous extreme weather events,[24-25] the following groups face higher risks in extreme weather events:

- Older adults, children, people who use mobility devices, and people with disabilities who are unable to find protection from a storm or have limited access to transportation
- People who have less capacity or fewer resources to gather supplies for extreme weather events, as well as to cover costs related to post-storm recovery
- Communities who are isolated culturally, linguistically, or by technology barriers like limited internet and may not have access to emergency communications
- People experiencing houselessness and do not have means to shelter from extreme weather events
- Communities of color that have experienced historic redlining, structural exclusion, or lived in areas that have not been prioritized for public works enhancements
- Communities that are geographically isolated or do not have backup systems for essential services like water, power, or travel routes damaged by extreme weather

Indicator 4

Extreme Weather-Related Injuries

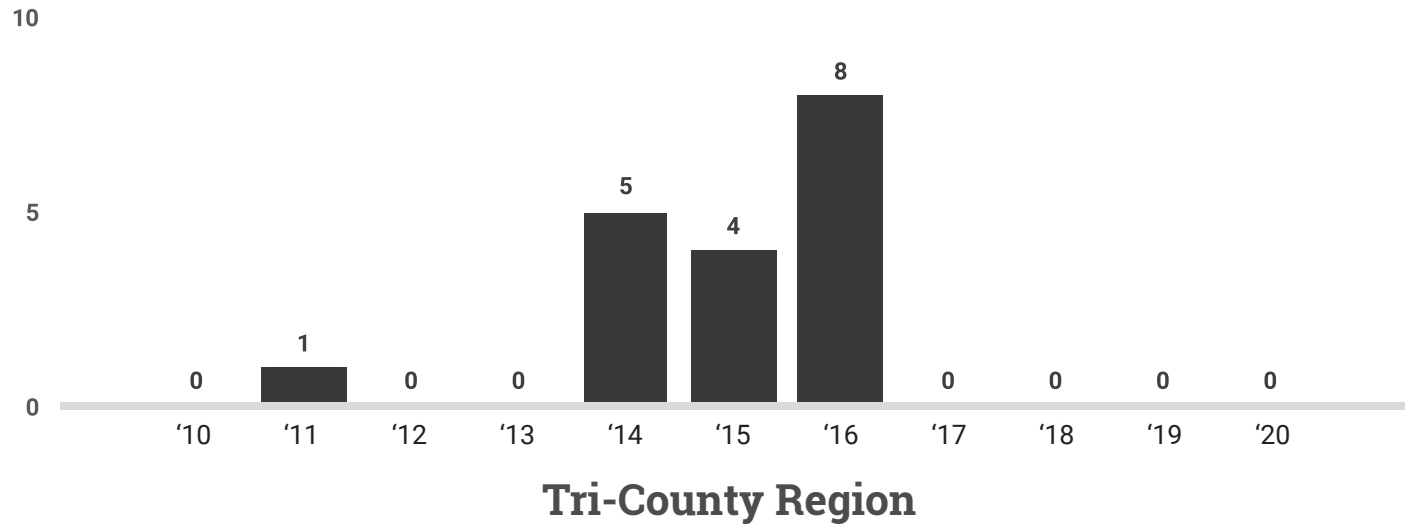
This indicator measures the number of injuries directly or indirectly attributed to extreme weather events. Increases in flooding, storms, and wildfires lead to more instances where people may become trapped and unable to escape. Damage to homes, workplaces, and roads increases the risk of injuries during travel or disaster recovery.

What is happening in the region

Most extreme weather injuries in the region are related to high winds or extreme heat. Injuries related to extreme weather are expected to occur in spikes rather than trends. Five of the cases within the study period were related to high, strong winds in the area. In 2016, eight injuries were attributed to heat in the region.

No new injuries attributed to extreme weather events were recorded through the National Weather Service (NWS) in the region between 2018 and 2020. The NWS did not record any injuries for the Riverside or North Clackamas fires in 2020.

Figure 7. Regional Extreme Weather-Related Injuries Counts, 2010-2020



Rates not calculated for this indicator due to sample size

Data Details

Data on injuries related to extreme weather is collected by the National Weather Service. The data is only collected for events that cause a significant level of disruption to commerce, destruction of property, or draw media attention, and therefore may not represent the full impacts from all extreme events. Some weather injuries may also be counted as heat-related illness in this report, but data sources do not contain sufficient information to identify duplicates.

Indicator 5
Extreme Weather-Related Deaths

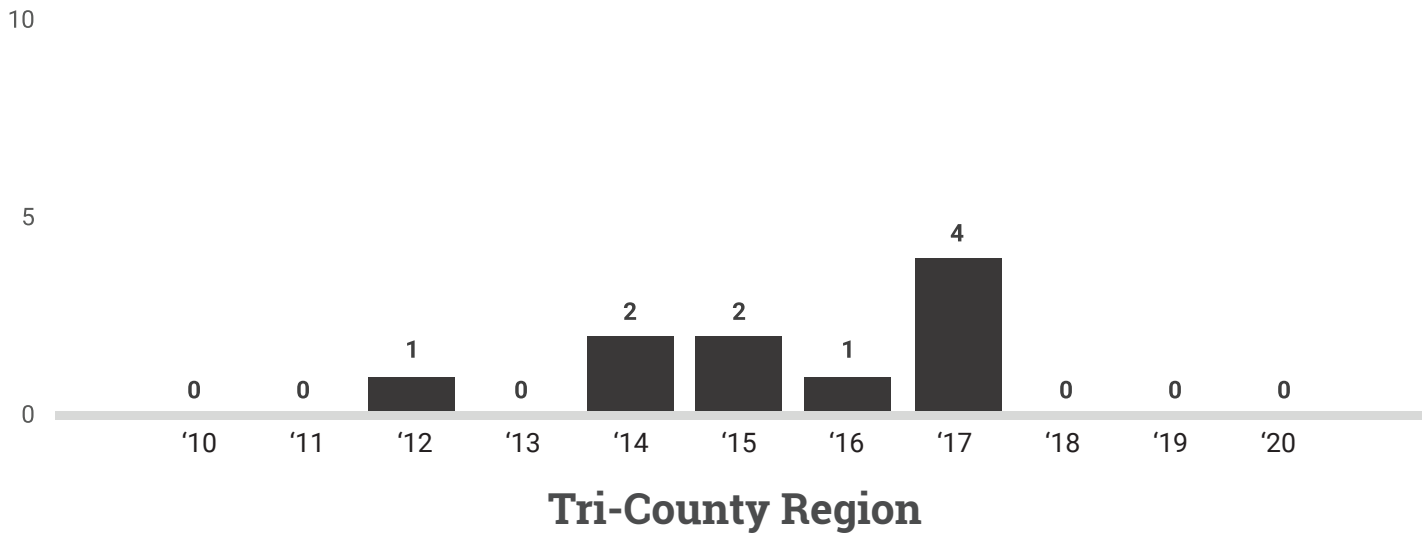
This indicator measures the number of deaths directly or indirectly attributed to extreme weather events. Extreme weather can cause death when hazards occur suddenly or when safe shelter is unavailable. Examples of hazards that can lead to weather-related deaths include extreme temperatures, flooding, landslides, and flying or falling debris.

What is happening in the region

Deaths related to extreme weather are expected to occur in spikes rather than trends. Strong winds were a factor in deaths that occurred in 2012, 2014, 2015, and 2016 in the greater Portland Metro area. One death occurred in Clackamas County in 2014 when a flash flood washed out a bridge near Ramona Falls by the Sandy River.[26]

Both extreme heat and extreme cold have caused deaths in the region. The NWS attributed one death to extreme heat in the Portland Metro area in 2016. In January 2017, four people died in Multnomah County during a period of freezing temperatures. No new deaths attributed to extreme weather events were recorded through the NWS in the region between 2018 and 2020. The NWS did not record any deaths for the Riverside or North Clackamas fires in 2020.

Figure 8. Regional Extreme Weather-Related Deaths Counts, 2010-2020



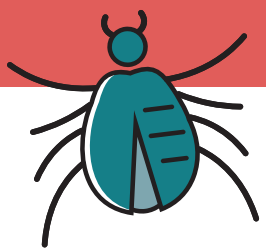
Rates not calculated for this indicator due to sample size

Data Details

Data on deaths related to extreme weather is collected by the National Weather Service. The data is only collected for events that cause a significant level of disruption to commerce, destruction of property, or draw media attention, and therefore may not represent and impacts from all storms.

Counts from the National Weather Service may be inconsistent with those reported from other data sources that use different data collection methods. In at least one instance, Multnomah County documented a different number of deaths attributable to extreme weather during this period.[27]

Vector-Borne Disease



Climate Change Connection

Vector-borne diseases can be transmitted by insects. Mosquitoes and ticks are the main concern in the tri-county region. Climate change influences the habitat, survival, and seasonality of these insects. Expanding the habitat and seasons when mosquitos and ticks thrive can lead to new cases of disease where they have not been observed previously.

Mosquitoes reproduce more in hotter and more humid conditions. Warmer weather expands mosquito habitat ranges and extends their season of activity earlier in the summer and later into the fall.[28] Mosquitoes bite more in warmer temperatures, increasing the risk of vector-borne disease transmission. [29]

The life cycle of the tick is guided by changes in seasons. Ticks begin looking for a host during the spring and throughout the summer. As spring and winter temperatures increase, ticks begin to look for a host earlier, increasing the length of the Lyme disease season and number of potential cases.[30]

Unequal Impact

Exposure and vulnerability to the risk of insect bites is largely the outcome of social and environmental factors. The conditions that someone lives or works in shape exposure patterns.[31] Groups that are at a higher risk of vector-borne disease include:

- Outdoor workers near habitats supporting insect breeding (e.g., construction, landscape design, landscaping, agriculture)
- People experiencing houselessness with no shelter from insect exposure
- People without means to purchase personal protective repellants or access to education resources around insect bite prevention
- People living in housing without window or door screens and other sufficient barriers to exclude insects, including renters without tenant protections or under landlords who allow unsafe conditions
- Youth, older adults, and people with immune conditions are more susceptible to severe illness from vector-borne diseases

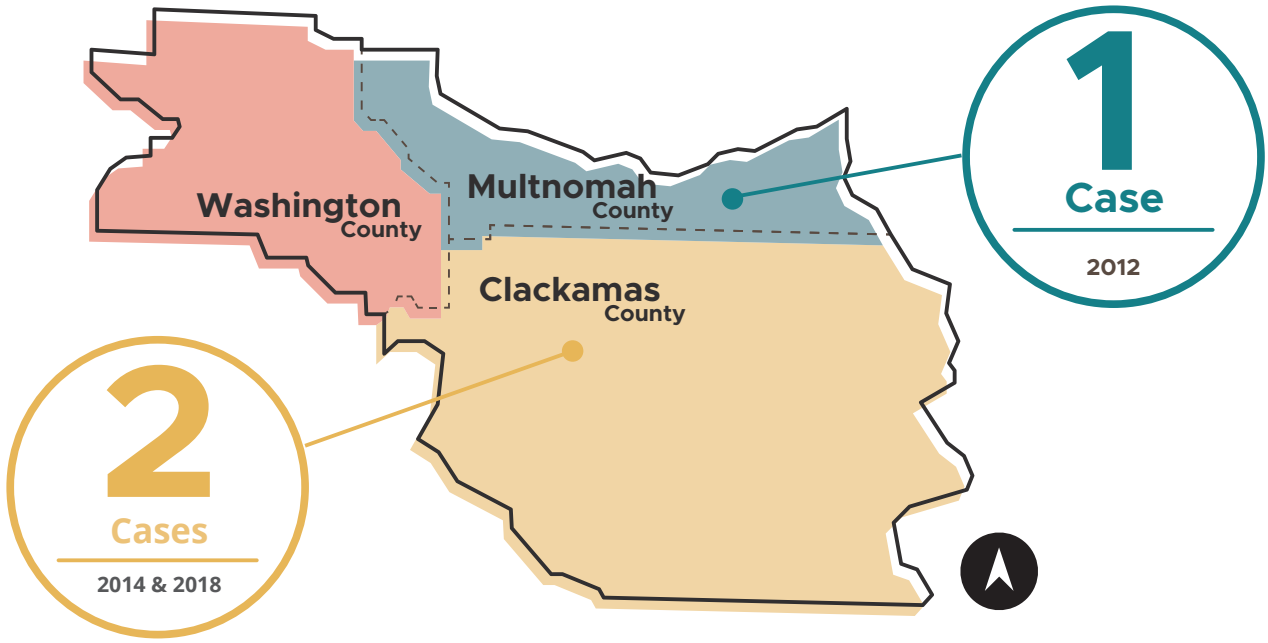
Indicator 6
West Nile Virus

This indicator measures the number of human cases of West Nile virus diagnosed in each county, even if the disease was acquired outside the county. West Nile virus is a mosquito-transmitted infection. Most people infected with the virus do not show any signs or symptoms; roughly one in five people develop a fever, headache, and body aches. Less than 1% of all West Nile virus cases develop severe symptoms affecting the nervous system through inflammation of the brain, spinal cord, and surrounding tissues.[32-33]

What is happening in the region

Three cases of West Nile virus have been documented in the region since 2010, one in Multnomah County and two in Clackamas County. All three cases were acquired outside of the tri-county region, but local transmission is possible.

Figure 9. West Nile Virus Case Count, 2010-2020



Rates not calculated for this indicator due to sample size

Data Details

Cases of West Nile virus in the region, regardless of where they were acquired, are a burden on local health care systems. Tracking cases acquired nearby is necessary to monitor the region. With zero cases originating in the region, even one case originating in the tri-county area is reason for concern. Including this indicator provides a baseline for future evaluation. Data are for 2010 through 2020, the most recent year available.

Indicator 7
Lyme Disease

This indicator measures the number of cases diagnosed with Lyme disease in each county, even if the disease was acquired outside the county. Lyme disease is caused by a bacterium called Borrelia burgdorferi, most commonly carried by blacklegged ticks. When someone is bitten by an infected tick, disease symptoms may include fever, headache, fatigue, and a bullseye-like rash called an erythema migrans. Severe cases may affect cardiovascular and cognitive function.[34]

What is happening in the region

Regional counts of Lyme disease peaked in 2017 with 34 cases. Over the ten-year period from 2010 through 2019, the average rate of Lyme disease cases was roughly one person per 100,000 people every year. In 2020, there were less than half the number of regional cases compared to the previous year. It is not clear if these data represent a true reduction in incidence or confounding in reporting due to the COVID-19 pandemic.

Figure 10. Lyme Disease Case Count, 2010-2020

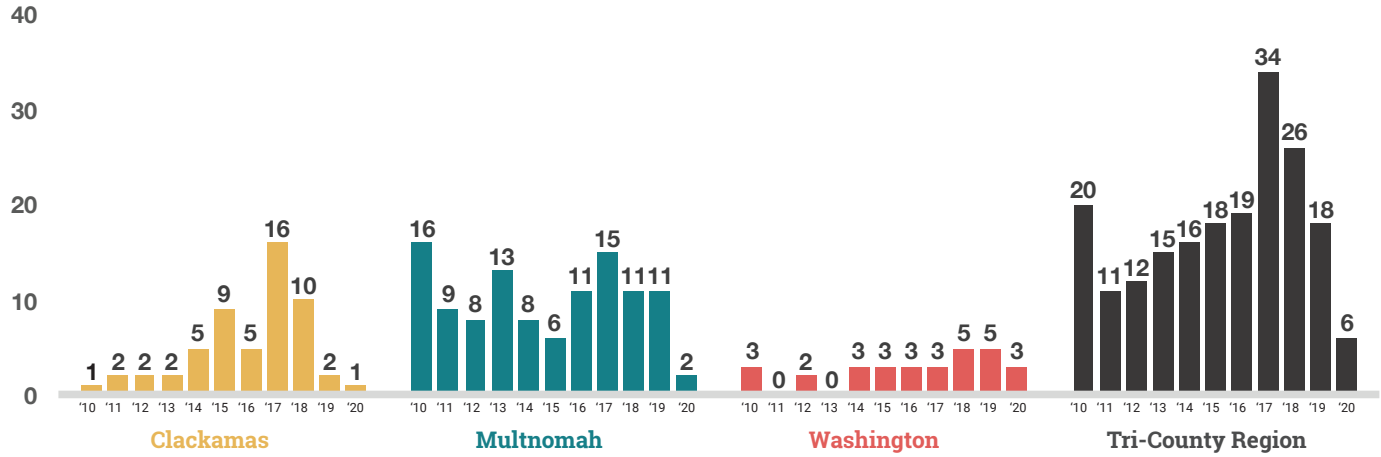
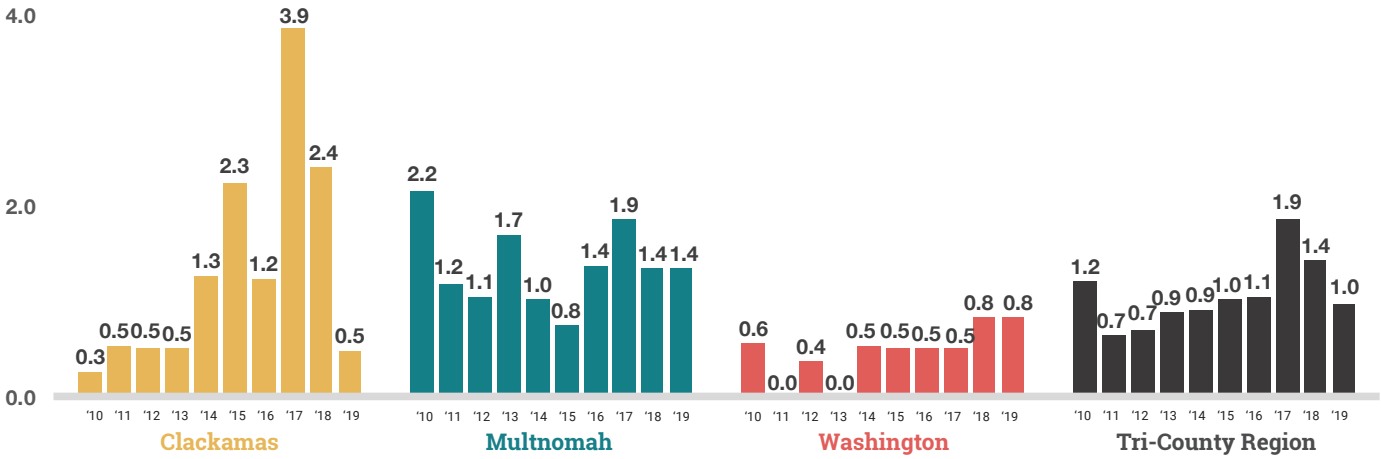


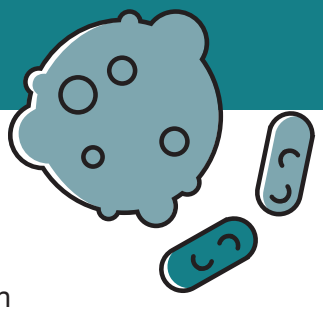
Figure 11. Lyme Disease Case Rate per 100,000 Persons, 2010-2019



Data Details

Data are for 2010 through 2020, the most recent year available. The data does not allow for partitioning by where the disease was contracted. While some cases were not contracted within the region, there are several reasons to include the indicator in this report. Cases of Lyme disease in the region, regardless of where they were contracted, are a burden on local health care systems. Tracking cases is necessary to monitor changes in this burden, and including this indicator provides a baseline for future evaluation.

Communicable Disease



Climate Change Connection

Climate change influences the survival, reproduction and adaptation of the microorganisms that carry disease.[35] Some climate events, such as extreme heat or flooding, increase the growth of disease-causing microbe populations, as well as human exposure and the risk of infection through contaminated food, water, and water-based recreational activities. Changes in temperature and rainfall in the Pacific Northwest are projected to create conditions that promote the growth of disease-causing microbes.[36-37]

- **Salmonellosis:** Increase in temperature is directly associated with increased number of reported salmonellosis cases. Studies have estimated an increase of 1.2% in the relative risk of salmonellosis for every degree increase in weekly temperature.[38] Salmonella species multiply faster in warmer temperatures, which leads to an increased risk of food contamination during processing, storage, and production.[39] The number of cases is typically higher during summer months, with an increased risk among children under 5 years of age and those over 65 years.
- **Campylobacterosis:** The intestinal bacteria infection Campylobacterosis shows a seasonal pattern peaking in the summer months. Warmer conditions promote the growth of bacteria in raw sewage, increasing the risk of exposure. Heavy rains and floods can lead to sewage overflow, also increasing the risk of exposure.
- **Tuberculosis:** Climate change can affect the spread of TB by displacing people through drought, landscape change, rising sea levels and natural disasters. The spread of TB increases when climate refugees from regions where TB is common relocate to places with low rates of the disease. Famine and changes in environmental conditions can also spread TB by lowering a person's immunity and increasing their susceptibility for infections.

Unequal Impact

Low income and rural areas are impacted more by communicable diseases resulting from climate change and environmental factors. People with low incomes have fewer resources and live in areas less equipped to mitigate the fallout from extreme heat, floods from precipitation, and other extreme weather conditions.[40]

Groups that are at higher risk of communicable diseases include:

- Older adults, children, pregnant people and those with compromised immune systems
- Communities of color that have experienced historic redlining, structural exclusion, or lived in areas that have not been prioritized for public works enhancements
- People who spend time in water bodies for recreation or occupation
- People living in communities with aging water and sewage infrastructure that may be more prone to flooding and water contamination
- Communities that are geographically isolated or do not have backup systems for essential services like water when damaged by extreme weather

Indicator 8
Salmonellosis

This indicator measures the number of cases of salmonellosis diagnosed in each county. Salmonellosis is primarily a foodborne illness caused by bacteria with gastrointestinal symptoms that include diarrhea, cramps, nausea, and vomiting.

What is happening in the region

Regional counts were lowest in 2020 with 138 cases, and highest in 2018 with 276 cases. Over the ten-year period of 2010-2019, the average rate of salmonellosis cases for the region was 11 new cases per 100,000 people every year.

In 2020, there were 37 fewer regional cases than in the previous year, a decrease of 21%. Regional counts were also lower than every previous year included in this report. It is unknown if the reduction is due to physical distancing and closure of in person dining or not seeking medical care for symptoms.[41]

Figure 10. Salmonellosis Case Count, 2010-2020

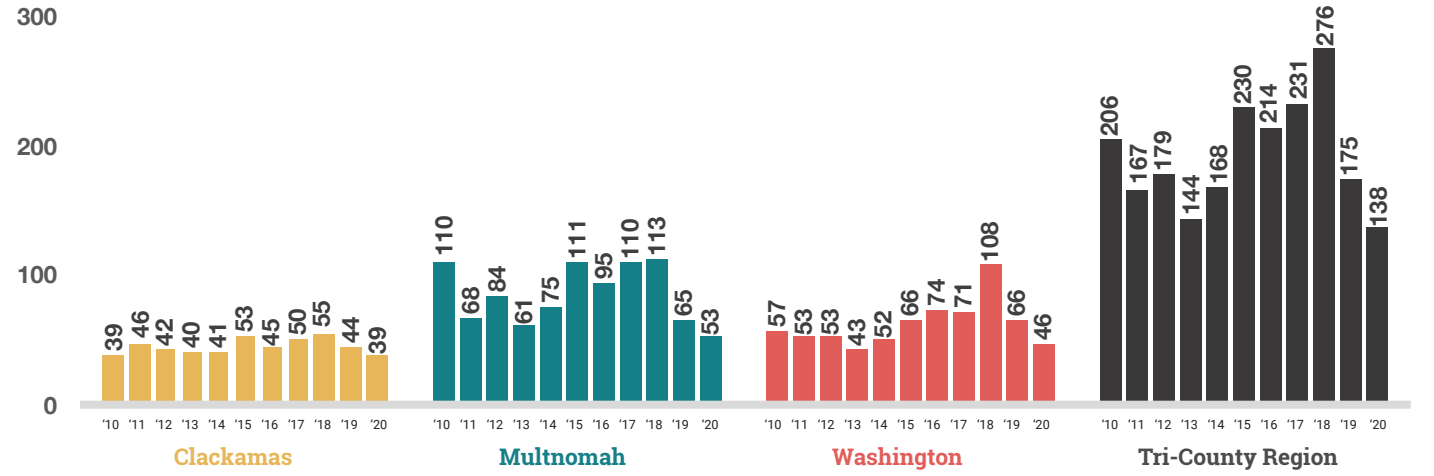
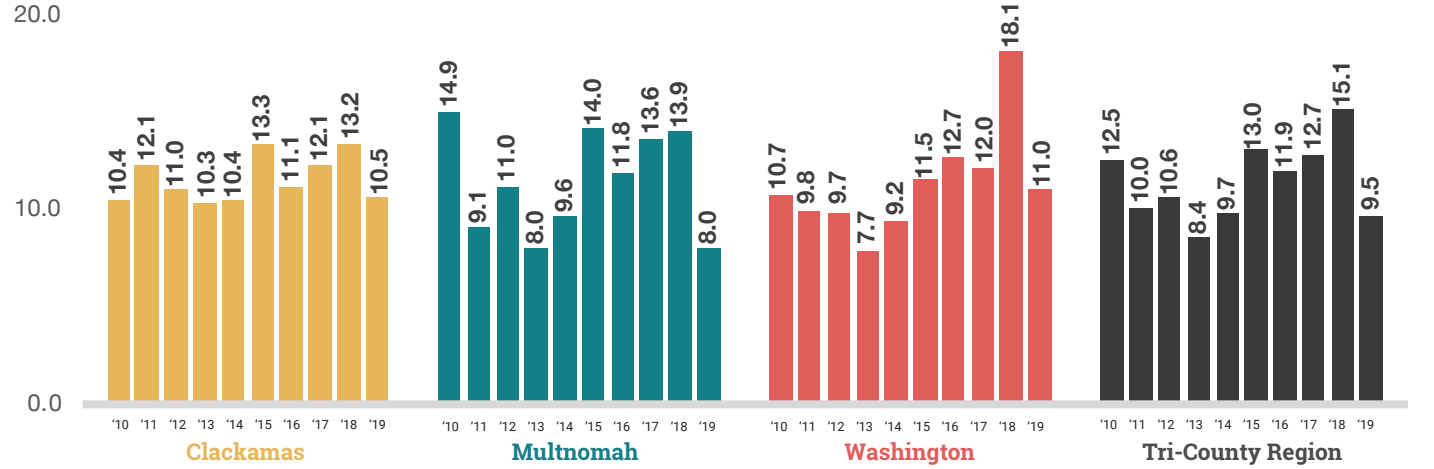


Figure 11. Salmonellosis Case Rate per 100,000 Persons, 2010-2019



Data Details

Data is based on hospital visit records from ORPHEUS. Rates may be affected by underreporting or other misclassification errors. Additionally, it is common for people suffering from mild GI illnesses, those with low incomes, and people without insurance to not seek medical care, in which case they would not be captured in hospital visit statistics.

Indicator 9
Campylobacterosis

This indicator measures the number of campylobacterosis cases diagnosed in each county. Campylobacter infection, one of the most common foodborne illnesses in the United States, occurs through consumption of raw or uncooked poultry, or through contaminated water. Symptoms include diarrhea, abdominal pain, vomiting and headache.[42]

What is happening in the region

Prior to 2020, the total number of campylobacterosis cases reported in the region ranged from just below 400 in 2010 to over 500 in 2017. Between 2010 and 2019, the regional average rate of campylobacterosis cases was roughly 25 cases per 100,000 people every year. In 2020, there were 127 fewer regional cases than in the previous year. Regional counts were also lower than every previous year included in this report. It is unknown if the reduction is due to physical distancing and closure of in person dining or not seeking medical care for symptoms.[43]

Figure 12. Campylobacterosis Case Count, 2010-2020

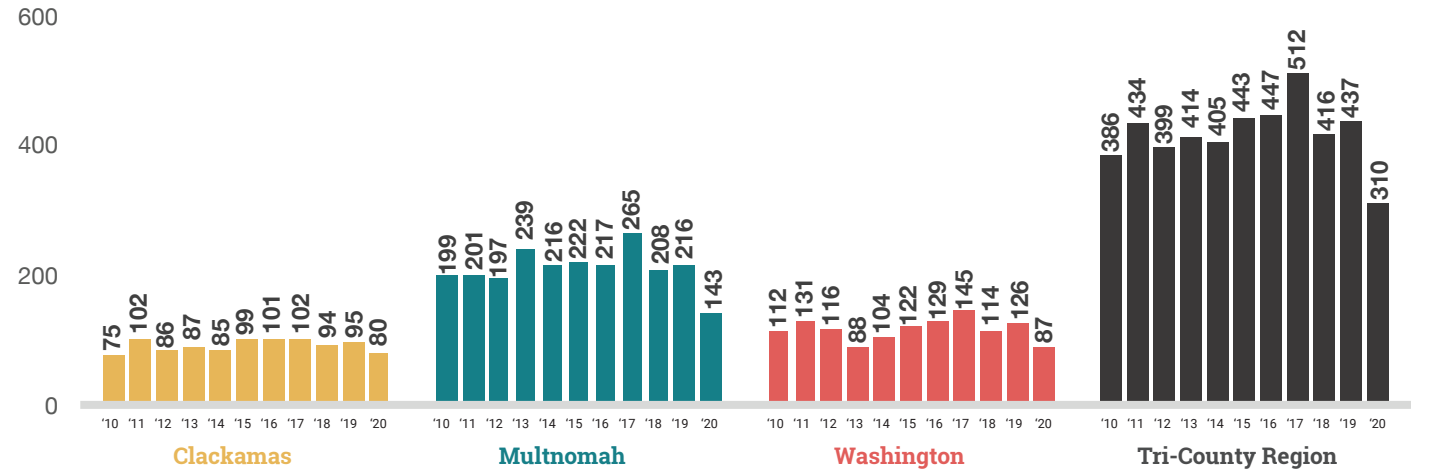
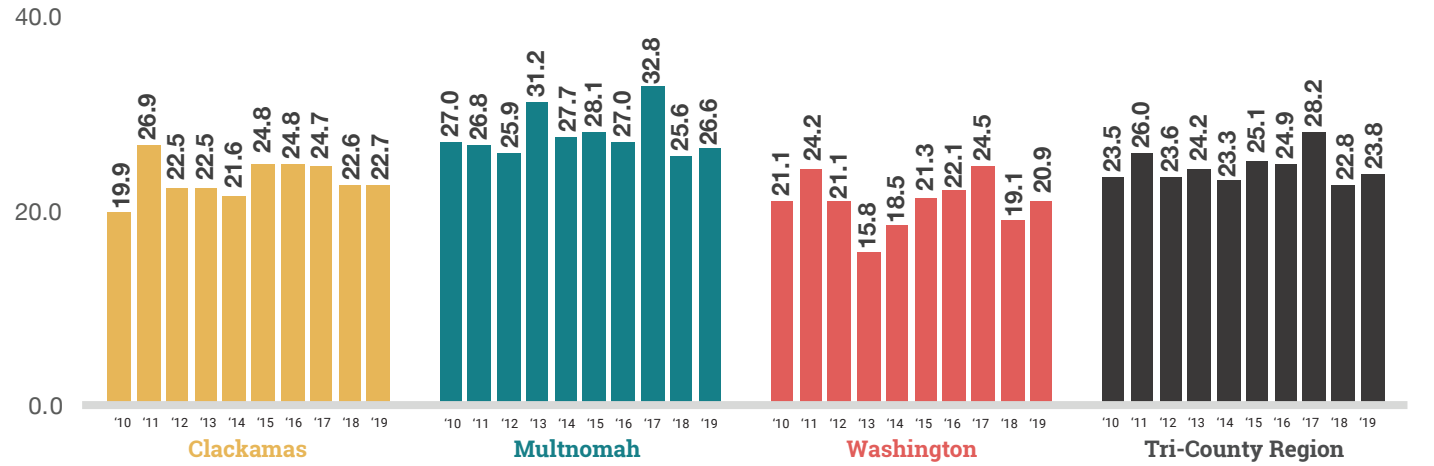


Figure 13. Campylobacterosis Case Rate per 100,000 Persons, 2010-2020



Data Details

Data is based on hospital visit records from ORPHEUS. Rates may be affected by underreporting or other misclassification errors. Additionally, it is common for people suffering from mild GI illnesses, those with low incomes, and people without insurance to not seek medical care, in which case they would not be captured in hospital visit statistics.

Indicator 10
Tuberculosis

This indictor measures the number of active cases of tuberculosis in each county. Tuberculosis (TB) is caused by Mycobacterium tuberculosis, which most frequently attacks the respiratory system but can infect other body systems as well. An infected person does not always develop clinically visible signs of the infection. While infection may remain dormant for a long period of time (i.e., latent TB), only a person with active TB can spread the infection to others.

What is happening in the region

The number of TB cases in the tri-county area was highest in 2019 with 59 cases and lowest in 2013 with 40 cases. The rate of TB cases in the tri-county area fluctuated somewhat over time, but there was no clear increasing or decreasing trend in the rate between 2010 and 2020. Between 2010 and 2019, the regional average rate of active TB cases was three cases per 100,000 people.

Figure 14. Tuberculosis Case Count, 2010-2020

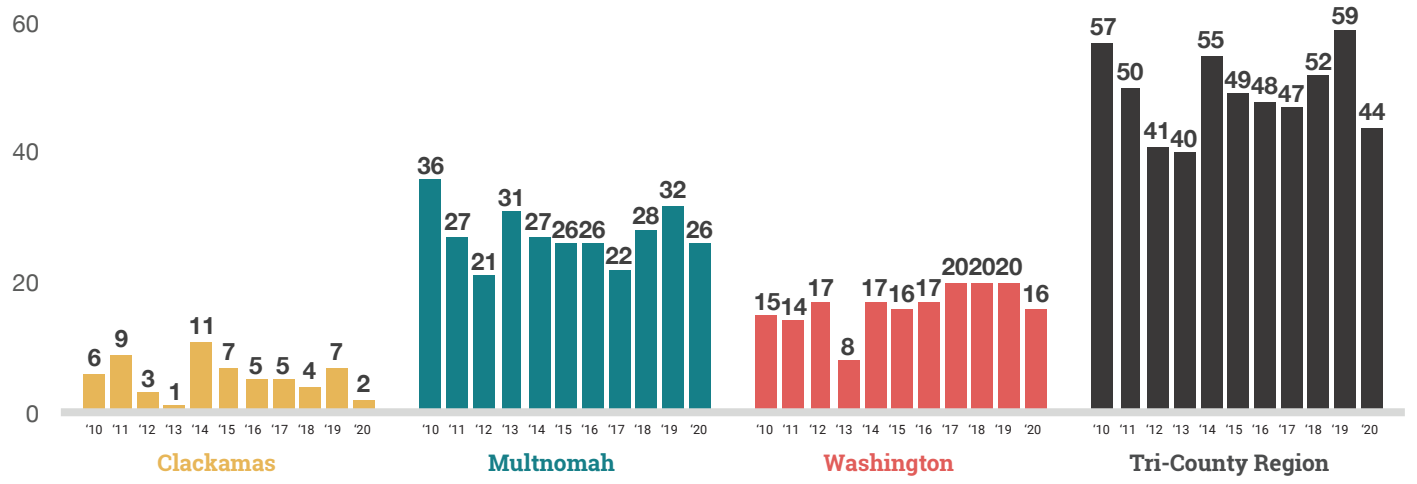
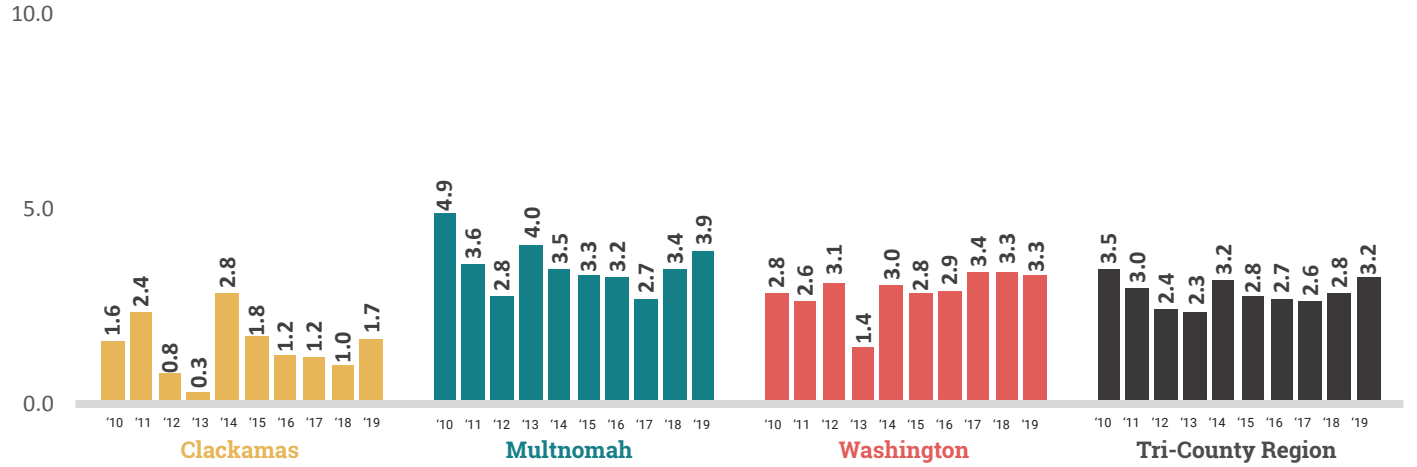


Figure 15. Tuberculosis Case Rate per 100,000 Persons, 2010-2020



Data Details

Data is based on hospital visit records from ORPHEUS. Rates may be affected by underreporting or other misclassification errors.

Air Quality

Climate Change Connection

Changes in air quality are strongly linked to climate change and events related to hotter, drier conditions as our region experiences more smoke from wildfires. Warmer temperatures and less high-altitude snowpack create dryer and longer summers and increase the risk of wildfires.[44] This risk is expected to continue to increase across Oregon, with one of the largest increases happening throughout the Willamette Valley.[45] Air quality is expected to worsen because of the increase in smoke and other harmful pollutants like smog (ground level ozone).[46]

Asthma symptoms are commonly triggered from exposure to a pollutant or allergen in the air, including smoke from wildfires, exhaust from vehicles, or pollen.[47,48] Fine particles (like PM2.5) released from wildfires and other sources increase the risk of adverse respiratory conditions, including asthma exacerbations.[49]

Warmer conditions also extend the length of pollen season and the geographic area where some plants may grow.[50] Studies show that higher temperature extremes and carbon dioxide levels increase both the amount and allergenic content of pollen that plants produce.[51] Interactions between high levels of pollen, air pollutants, and extreme weather events that stir up particulate matter from the ground or plants are also likely to worsen air quality.[52] Ragweed and grass pollens are common environmental triggers influenced by climate changes in the region.

2020 Wildfires

In September of 2020, abnormally warm weather for the month, dry conditions, and high winds led to explosive growth of ongoing wildfires. The Riverside fire and several smaller fires in North Clackamas burned over 100,000 acres in Clackamas County. Smoke from these fires and others in the state, led to record-setting poor air quality.

On September 13th, EPA monitors registered a 24-hour average Air Quality Index (AQI) of 509 for the tri-county region. Air quality is considered hazardous and a risk to everyone at an AQI of 300. AQI stayed above levels considered unhealthy (200+) for eight days from September 10th through September 17th.

Unequal Impact

Due to historic housing and development policies and practices, communities of color and low-income groups are more likely to live in areas with disproportionately high exposure to air pollution, roads, and industries. They also are less likely to live near greenspaces. Groups who face higher risk of health impacts from poor air quality include[53]:

- Outdoor laborers (e.g., construction, road crews, farm workers)
- Older adults, children, and people with chronic lung conditions like asthma or chronic obstructive pulmonary disease
- Communities of color that have experienced historic redlining, structural exclusion, or lived in areas that have not been prioritized for public works enhancements
- Those living near high traffic areas or near industrial facilities
- Immigrants and communities that are culturally or linguistically isolated and may not have access to emergency communications on poor air quality days

Indicator 11

Asthma-Like Symptom Emergency Department Visits

This indicator measures the number of visits to hospital emergency departments and urgent care clinics (ED) made by people with symptoms of asthma. Asthma is a respiratory condition where the airways in the lungs inflame, causing wheezing, chest tightness, and shortness of breath.

What is happening in the region

Between 2016 and 2019, the region saw an increase in the number of ED visits for asthma-like symptoms. Over the four-year period from 2016 through 2019, the average rate of ED visits for asthma-like symptoms was 2,648 visits per 100,000 people. Data from ED visits show an increase in the rate of asthma-like symptoms in each county and the region overall. Coinciding with the COVID-19 pandemic, there was a decrease in the number of asthma-like symptom cases that presented at regional EDs in 2020.

Figure 16. Asthma-Like Symptom ED Visit Count, May-Sept, 2016-2020

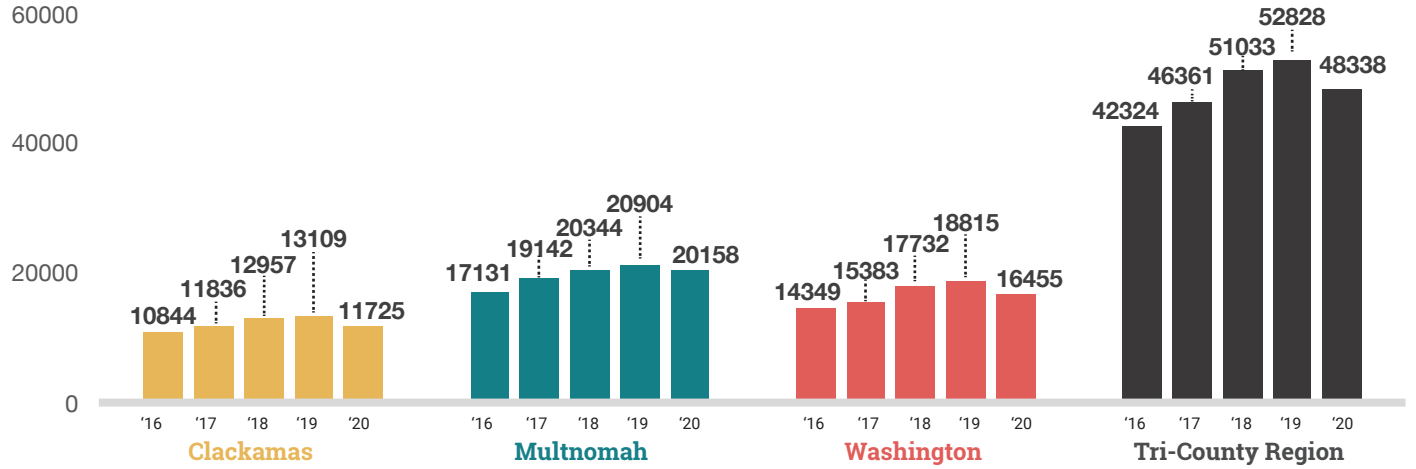
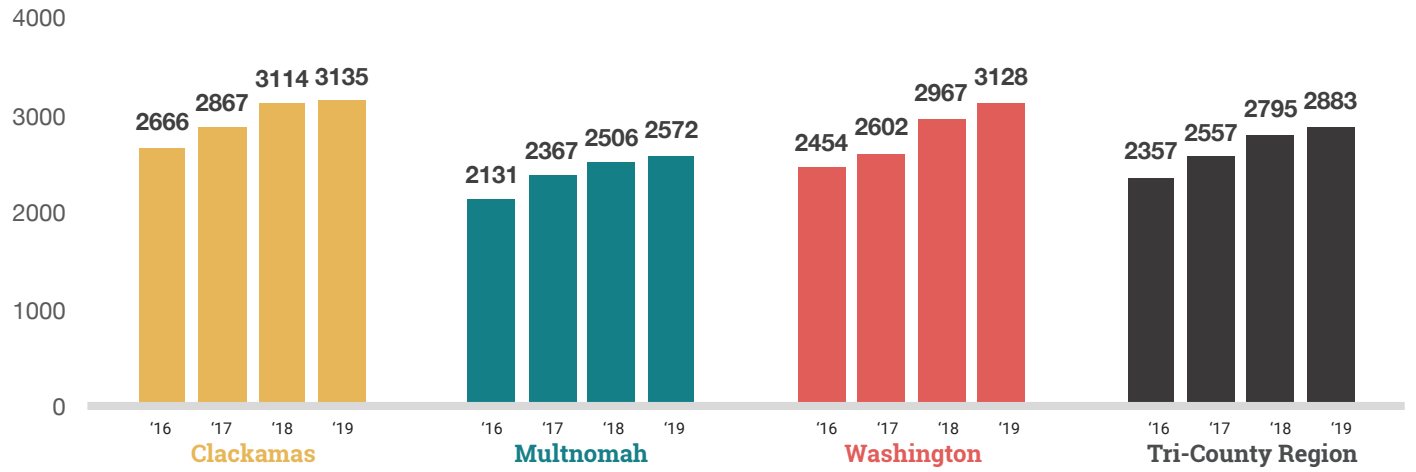


Figure 16. Asthma-Like Symptom ED Visit Rates per 100,000 Persons, May-Sept, 2016-2020



Data Details

This indicator was collected from a statewide data system (ESSENCE)[54] for analyzing visits to emergency departments and urgent care clinics (ED). This indicator documents ED visits for cases with any mention of an asthma-like symptom in addition to asthma as the chief complaint during the warm season — May through September — for the years 2016 through 2020.Complete data became available beginning in the 2016 season, meaning that comparisons to earlier years are not reliable. Records are for visits, not patients, meaning that one person could be counted multiple times if they visited the emergency department more than once for the same complaint or for different complaints. Missing or incomplete records could result in undercounting. The number of urgent care clinics that report visits fluctuates over time.

Spotlight
2020 Wildfire Health Impacts

Despite an overall decrease of asthma-like symptoms ED visits for the year of 2020, there were increases in ED visits in direct response to the September 2020 wildfires. In the four weeks during and after the wildfires (September 6th-October 3rd), the average daily count of visits was 199, which compares to an average daily count of 154 visits during the previous four weeks (August 9th-September 5th). This represents a **29% increase**. Daily visits reached a peak of 270 visits on September 14th, 75% higher than the average over the previous four weeks.

At the county level, average daily visits increased by 20% in Washington County, 29% in Multnomah County, and 40% in Clackamas County during the same period. From September 10th through September 17th, while AQI was categorized as Unhealthy at above 200, the average number of daily ED visits for asthma-like symptoms was 240 visits.

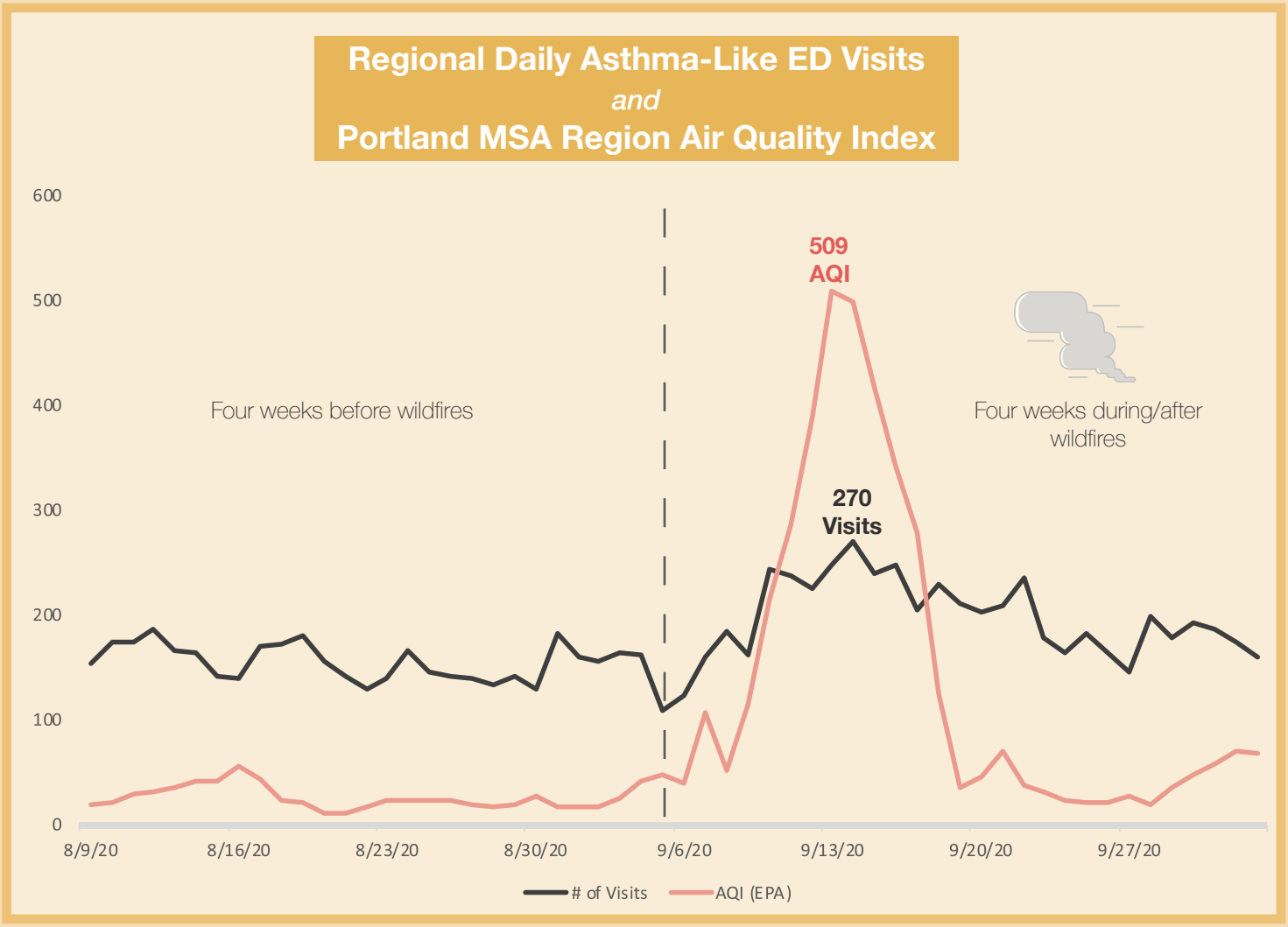


Figure 17. Number of daily ED visits for asthma-like symptoms and Air Quality Index for the tri-county region from August 9th through October 3rd. ESSENCE, EPA.

Indicator 12

Allergic Disease Emergency Department Visits

This indicator measures the number of visits to hospital emergency departments and urgent care clinics (ED) made by people with symptoms of allergic disease. Allergic disease is a broad term that refers to the response of the immune system to external allergens like mold, dust, or pollen. Symptoms include sneezing, runny nose, shortness of breath, wheezing, and itchy eyes.

What is happening in the region

Between 2016 and 2019, the number of ED visits for allergic-disease symptoms grew progressively higher. Over the four-year period from 2016 through 2019, the average rate of ED visits related to allergic disease was 980 visits per 100,000 people. Data from ED visits suggested an increase in the rate of visits for allergic disease in each county and the region overall. Coinciding with the COVID-19 pandemic, there was a decrease in the number of allergic disease cases that presented at regional EDs in 2020.

Figure 18. Allergic Disease ED Visit Counts, May-Sept, 2016-2020

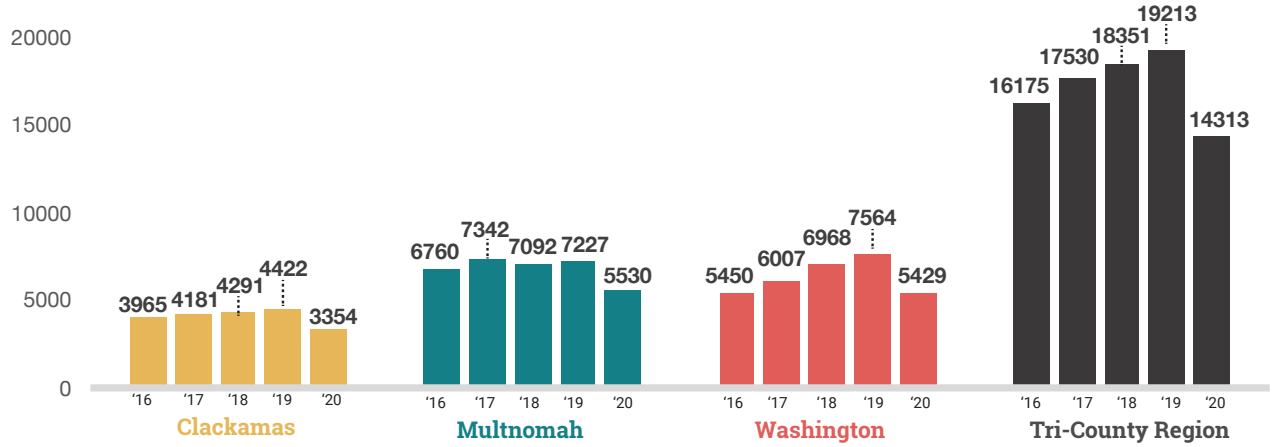
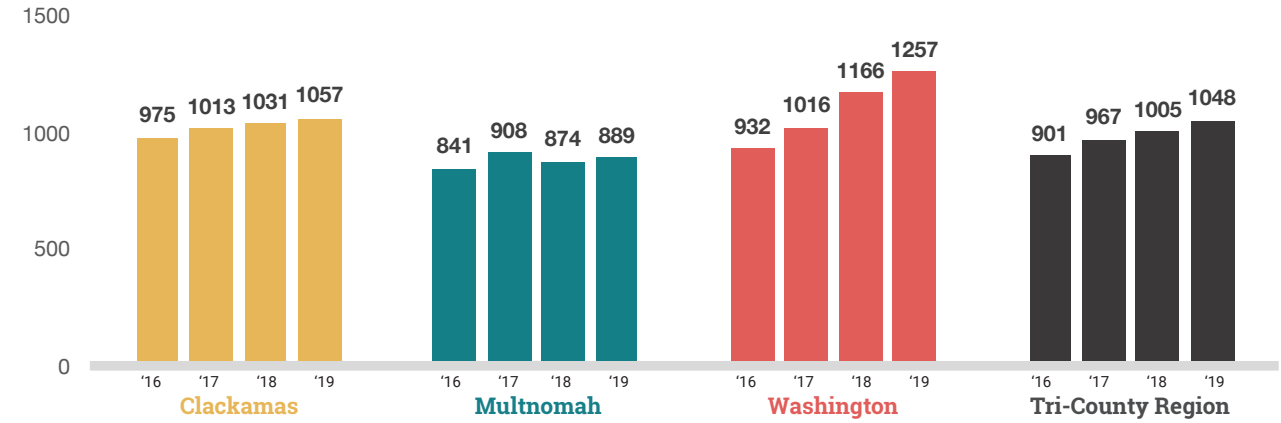


Figure 19. Allergic Disease Symptom ED Visit Rate per 100,000 Persons, May, Sept, 2016-2020



Data Details

This indicator was collected from a statewide data system (ESSENCE)[55] for analyzing visits to emergency departments and urgent care clinics (ED). This indicator documents ED visits for allergic disease during the warm season — May through September — for the years 2016 through 2020. Complete data became available beginning in the 2016 season, meaning that comparisons to earlier years are not reliable. Records are for visits, not patients, meaning that one person could be counted multiple times if they visited the emergency department more than once for the same complaint or for different complaints. Missing or incomplete records could result in undercounting. The number of urgent care clinics that report visits fluctuates over time.

Mental Health

Climate Change Connection

There is a growing body of evidence on the ways past, present, and future climate change-related events affect mental health. In general, mental health refers to our emotional, psychological, and social well-being that influences how we feel, relate to stress, and make daily choices. Mental health outcomes in response to climate change are affected by how individuals relate to and experience climate change events.[57] Different types and lengths of climate change events can create a wide variety of mental health impacts, including:

- **Short and acute events that last a few hours to a few weeks like heatwaves, extreme storms, or wildfires.** These events can lead to anxiety, depression, PTSD, sleep deprivation, trauma, shock, and thoughts of suicide. If an event creates property damage, causes displacement, or affects economic livelihood of a group it can lead to a sense of loss of place, loss of control, and loss of personal or occupational identity.[58] Heat events specifically can lead to increases of aggression and worsening of existing mental health conditions, as well as create negative side effects for some psychiatric medications.[59]
- **Long periods of extended climate change events like drought or recovery periods from acute events.** In addition to the mental health impacts of short events, extended events or recovery periods place ongoing and compounding stress on mental and emotional well-being. It can create disruption in access to physical and mental health care services, school, and social networks, all of which are protective factors for good mental health.[60]
- **Ongoing direct or indirect exposure to the hazards of climate change like rising temperatures, rising sea levels, and other global and regional threats.** Whether someone has direct experience with a climate change-related event or not, the continued exposure to media coverage and threat of climate disasters can affect mental health. A broad range of terms have evolved to describe these impacts, including eco-anxiety (severe worry and frustration about risks from environmental impacts to future generations and the planet)[61, 62, 63] and climate grief (sadness, loss, and hopelessness about future generations and the planet).[64]

Unequal Impact

Mental health outcomes related to climate change are affected by a wide range of social, cultural, environmental, and economic factors. Groups at higher risk of affected mental health outcomes related to climate change are[56]:

- Youth, who will face greater exposure to severe climate change impacts and have limited control over actions to mitigate them today
- People who have been personally impacted by a climate disaster or in an area at risk of a climate disaster
- Native Americans and indigenous tribes who have lost or are at risk of losing traditional ways of life and self-determination due to climate change and other social factors
- People with pre-existing mental health conditions like anxiety or depression
- People with limited social connections to resources
- People who have limited means to recover from a climate disaster, or whose livelihood would be significantly affected by a climate disaster, such as the agricultural industry
- Communities of color who carry past and current traumas of interpersonal and structural racism
- Health care professionals providing care and treatment to people affected by climate change events

Strong social supports and environments that foster collective action towards addressing climate change can tip the scales and leverage the positive potential of anxiety-like symptoms.[65]

What is Happening in the Region

There are limited sources of data available at the local level that explicitly connect the mental health impacts of health to climate events. Mental health outcomes also tend to be underreported in general. An initial review of possible data sources for the tri-county area did not identify a reliable indicator that allowed for comparison over time and was explicitly tied to climate change.

However, two reviewed data sources do provide a snapshot of the tri-county area: 1) a survey of mental health-related perceptions on climate change, and 2) a survey of mental health conditions of students.These data points are intended to provide context, but not to serve as indicators. There is a need in the region to track mental health outcomes more consistently on an annual basis and in relation to specific climate events.

Yale Climate Opinion Survey

The survey provides estimates of U.S. climate change beliefs, risk perceptions, and policy preferences at the state and local levels. It is modeled data that uses the results from a large national survey dataset (n>25,000) in combination with county-level demographic and geographic population characteristics. It is released every two years. Data points included are:

- Estimated Percentage of People Worried about Global Warming
- Estimated Percentage of People Who Think Global Warming Will Harm Future Generations
- Estimated Percentage of People Who Think Global Warming Will Cause Personal Harm

Oregon Healthy Teen Survey

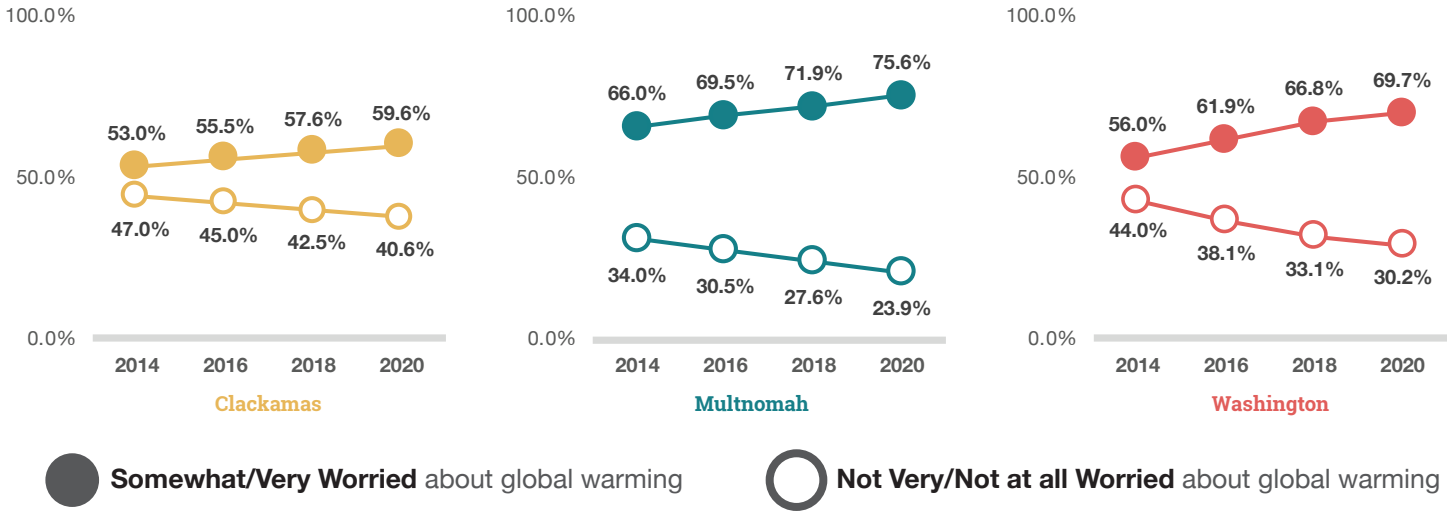
Oregon Healthy Teens (OHT) is Oregon's effort to monitor the health and well-being of adolescents. An anonymous and voluntary research-based survey, OHT is conducted among 8th and 11th graders statewide. Data is collected every two years from a sample of schools in each county. Data point included:

- Student Self-Rating of General Emotional and Mental Health

Estimated Percentage of People Worried about Global Warming

Between 2014 and 2020, the estimated percentage of people somewhat to very worried about global warming increased every year in each county. The estimated percentage of people not very worried or not worried at all decreased every year in each county over the same time.

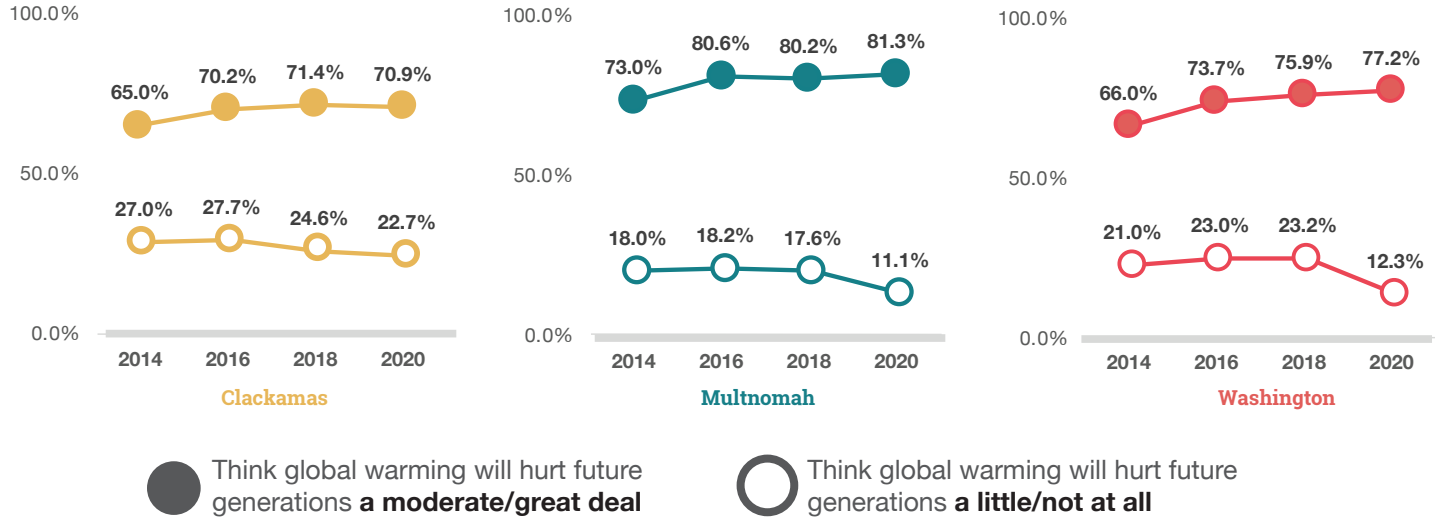
Figure 20. Estimated percentage who are **worried** about global warming, 2014-2020



Estimated Percentage of People Who Think Global Warming Will Harm Future Generations

Between 2014 and 2020, the estimated percentage of people who think climate change will harm future generations a moderate to great deal increased every year in each county. In 2020, less than a quarter of residents in each county were estimated to think that future generations will be harmed a little or not at all.

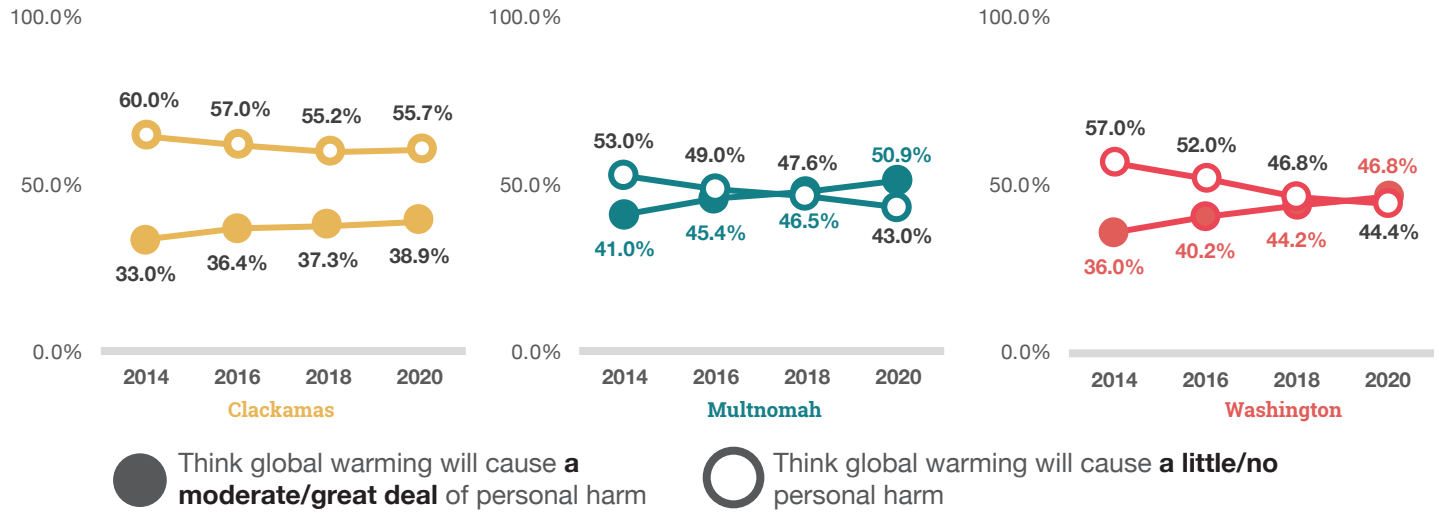
Figure 21. Estimated percentage who are think global warming will harm future generations



Estimated Percentage of People Who Think Global Warming Will Cause Personal Harm

Between 2014 and 2020, the estimated percentage of people who think climate change will cause a moderate to great deal of personal harm increased every year in each county.

Figure 22. Estimated percentage who are think global warming will cause personal harm

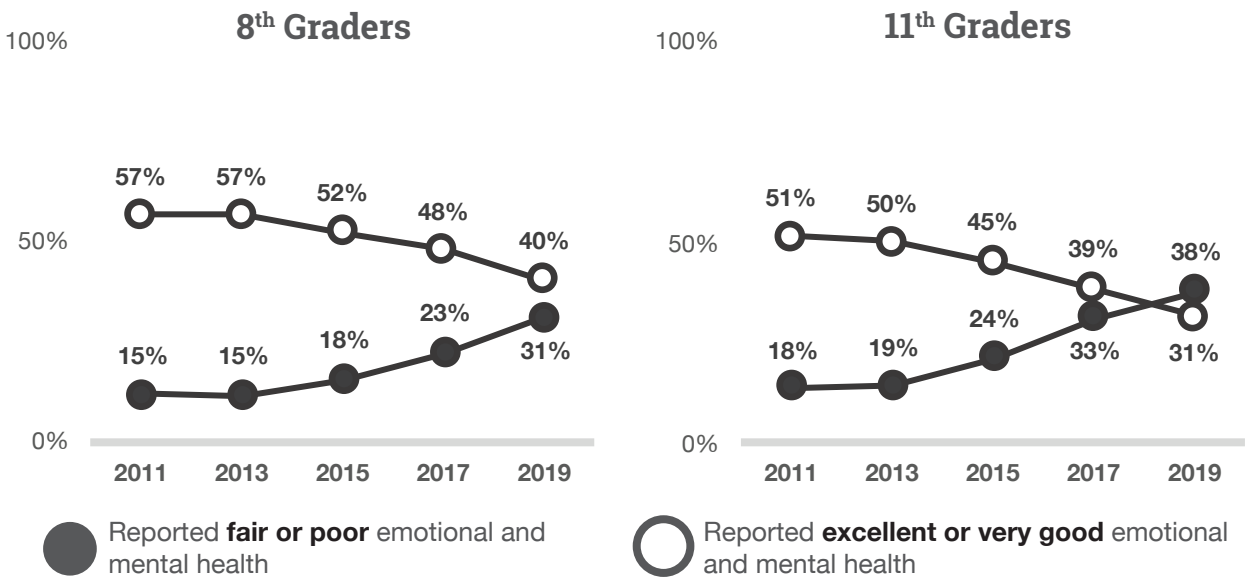


Student Self-Rating of General Emotional and Mental Health

General and emotional and mental health is affected by personal, social, and environmental factors. The stress and trauma of climate change events can make existing mental health conditions worse. The OHTS asks students to self-rate their emotional and mental health.

Between 2011 and 2019, in every county in the region, for both 8th graders and 11th graders, the percentage of students that report 'excellent' and 'very good' mental health has decreased and the percentage of students that report 'fair' and 'poor' mental health has increased. In 2019, at roughly a third of 8th and 11th graders in the region reported 'fair' or 'poor' mental health.

Figure 23. 8th and 11th grade student self-rating of general emotional and mental health, Tri-County Region, 2011 - 2019



Looking Forward

The health outcomes of climate change continue to be one of the primary ways residents in the region feel the impacts of an increasingly warming planet. The ED visits from the September 2020 wildfires and fatalities from the June 2021 heat dome foreshadow how the region will experience future climate events, and provide stark contrast to trends documented in this report over the past 5-10 years.

The time for action is now. Collective and coordinated strategies to create policies, systems, and conditions that reduce inequities and bolster resiliency across sectors will help reduce climate change-related health impacts. The tri-county health departments are accelerating adaptation efforts to meet the need created by complex and increasingly severe environmental threats. Collaboration with departments at the state level, as well as community groups and organizations at the hyper-local level, is critical in building informed and effective interventions.

The 2021 public health modernization investment will support local and regional efforts in building environmental resilience and reducing health inequities. This report can provide a template for regional coordination and data assessment to understand the health impacts of climate change. It indicates the need for more resources in addressing air quality, wildfire, and heat impacts, as well as routine mental health monitoring and support systems to meet the need of increasing climate anxiety and stress. Strategies to address climate change and its potential health impacts include:

- Increasing knowledge of climate change and capacity to mitigate its health impacts at the community level
- Educating the public and policy makers on the health benefits of climate change mitigation strategies
- Building cross-sector partnerships and interventions to address factors and practices that cause or exacerbate climate change
- Increasing the representation of groups that are unjustly impacted by climate change in mitigation and adaptation planning

Appendix A. Data Tables - Counts

Heat-Related ED Visit Counts, May-Sept (p. 7)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	n/a	n/a	n/a	n/a	n/a	n/a	61	78	79	49	39
Multnomah	n/a	n/a	n/a	n/a	n/a	n/a	107	128	112	84	71
Washington	n/a	n/a	n/a	n/a	n/a	n/a	106	127	89	68	66
Region	n/a	n/a	n/a	n/a	n/a	n/a	274	333	280	201	176

Heat Stress Hospitalizations Counts (p. 8)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	7	3	6	0	3	7	5	1	4	4	n/a
Multnomah	5	6	7	7	6	8	7	10	5	5	n/a
Washington	3	3	2	0	5	3	6	7	2	4	n/a
Region	15	12	15	7	14	18	18	18	11	13	n/a

Heat Deaths Counts (p. 9)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	0	0	0	0	0	0	1	0	0	n/a	n/a
Multnomah	0	0	0	0	0	0	1	0	1	n/a	n/a
Washington	0	0	1	0	0	0	0	1	0	n/a	n/a
Regional	0	0	1	0	0	0	2	1	1	n/a	n/a

Extreme Weather-Related Injuries (p. 11)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	0	1	0	0	1	0	0	0	0	0	0
Greater Portland Metro	0	0	0	0	4	2	8	0	0	0	0
Coast Range	0	0	0	0	0	2	0	0	0	0	0
Regional	0	1	0	0	5	4	8	0	0	0	0

Extreme Weather Related Fatalities Count (p. 12)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	0	0	1	0	2	2	0	0	0	0	0
Multnomah	0	0	0	0	0	0	0	4	0	0	0
Washington	0	0	0	0	0	0	1	0	0	0	0
Regional	0	0	1	0	2	2	1	4	0	0	0

West Nile Virus Count (p. 14)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Clackamas	0	0	0	0	1	0	0	0	1	0	0
Multnomah	0	0	1	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0	0	0
Regional	0	0	1	0	1	0	0	0	1	0	0

Lyme Disease Counts (p. 15)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	1	2	2	2	5	9	5	16	10	2	1
Multnomah	16	9	8	13	8	6	11	15	11	11	2
Washington	3	0	2	0	3	3	3	3	5	5	3
Region	20	11	12	15	16	18	19	34	26	18	6

Salmonella Counts (p. 17)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	39	46	42	40	41	53	45	50	55	44	39
Multnomah	110	68	84	61	75	111	95	110	113	65	53
Washington	57	53	53	43	52	66	74	71	108	66	46
Region	206	167	179	144	168	230	214	231	276	175	138

Campylobacter Counts (p. 18)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	75	102	86	87	85	99	101	102	94	95	80
Multnomah	199	201	197	239	216	222	217	265	208	216	143
Washington	112	131	116	88	104	122	129	145	114	126	87
Region	386	434	399	414	405	443	447	512	416	437	310

Tuberculosis Counts (p. 19)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	6	9	3	1	11	7	5	5	4	7	2
Multnomah	36	27	21	31	27	26	26	22	28	32	26
Washington	15	14	17	8	17	16	17	20	20	20	16
Regional	57	50	41	40	55	49	48	47	52	59	44

Asthma-Like Symptoms ED Visit Counts, May-Sept (p. 21)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	n/a	n/a	n/a	n/a	n/a	n/a	10844	11836	12957	13109	11725
Multnomah	n/a	n/a	n/a	n/a	n/a	n/a	17131	19142	20344	20904	20158
Washington	n/a	n/a	n/a	n/a	n/a	n/a	14349	15383	17732	18815	16455
Regional	n/a	n/a	n/a	n/a	n/a	n/a	42324	46361	51033	52828	48338

Allergy-Like Disease ED Visit Counts, May-Sept (p. 23)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Clackamas	n/a	n/a	n/a	n/a	n/a	n/a	3965	4181	4291	4422	3354
Multnomah	n/a	n/a	n/a	n/a	n/a	n/a	6760	7342	7092	7227	5530
Washington	n/a	n/a	n/a	n/a	n/a	n/a	5450	6007	6968	7564	5429
Regional	n/a	n/a	n/a	n/a	n/a	n/a	16175	17530	18351	19213	14313

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