

# Health Risks

Hawai'i is vulnerable to a wide range of health risks, all of which can be exacerbated by natural and human-caused hazards the State faces as well as by the high flow of international and domestic travelers. The islands have limited healthcare infrastructure, which means health risks are a serious concern.

### CHANGES SINCE 2018

+ **1**

Declared Disasters

+ **3**

Health Risk Events

### COUNTIES MOST VULNERABLE



Kaua'i Honolulu Maui Hawai'i

### SOCIALLY VULNERABLE POPULATION

**22.3%** | **316,257**

Of Total Population

Persons

### CLIMATE PROJECTIONS



**Over half of known infectious diseases** can be aggravated by climate change

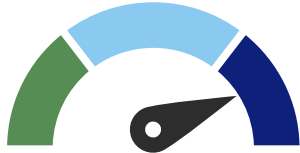


**More flooding** will spread infectious agents in water on a wider scale



**Changes in temperature and precipitation** can influence seasonality, distribution, and prevalence of vector-borne diseases

### HAZARD RANKING



Low Medium High

### COMMUNITY LIFELINES

**1,369**

Total

Health risk impacts on these physical state assets are unknown at this time.



Environmental Resources



State Buildings



Hawaiian Home Lands



Cultural Resources

Miles of State Road





# CONTENTS

---

**SECTION 4. RISK ASSESSMENT ..... 4.8-1**

4.8 Health Risks.....4.8-1

    4.8.1 Hazard Profile.....4.8-1

    4.8.2 Vulnerability Assessment .....4.8-9

# TABLES

---

Table 4.8-1. Seasonal Flu Versus Pandemic Flu .....4.8-6

Table 4.8-2. Significant Health Risk Events in the State of Hawai’i, 2018 to 2022 .....4.8-7

Table 4.8-3. Reported Cases of Notable Diseases in the State of Hawai’i .....4.8-8

# FIGURES

---

Figure 4.8-1 Aedes albopictus (left) and Aedes aegypti (right) mosquitoes are common vectors for disease and illness in Hawai’i .....4.8-2

Figure 4.8-2. Rat Lungworm Host and Infection Cycle.....4.8-2

Figure 4.8-3. Climate Change Impacts on Human Health.....4.8-9

Figure 4.8-4. Hawai’i COVID Hospitalizations, August 2020–December 2022..... 4.8-10







## SECTION 4. RISK ASSESSMENT

### 4.8 HEALTH RISKS

#### 2023 SHMP Update Changes

- ❖ Information has been added about the COVID-19 pandemic.
- ❖ Health risk events that occurred in the State of Hawai'i from January 1, 2018 through December 31, 2022, were researched for this 2023 SHMP Update.
- ❖ New and updated figures from federal and state agencies are incorporated.
- ❖ This section now includes a discussion of how health risks impact socially vulnerable populations and community lifelines.

#### 4.8.1 HAZARD PROFILE

The state is vulnerable to natural hazards. Health-related impacts have occurred with natural hazards, especially where water quality is compromised. Climate-related extreme events have resulted in gastrointestinal illness, respiratory problems (especially from wildfires and volcanic gas emissions), and vector-borne outbreaks, such as dengue fever. It is important to consider potential health-related disasters and to factor these considerations in disaster risk reduction efforts and hazard mitigation planning. These and other risks to human health that occur as a result of natural hazard events are discussed throughout Section 4 (Risk Assessment). This section focuses on the COVID-19 pandemic, infectious disease, pandemic flu, and bioterrorism hazards that may impact the state's resident and visitor populations. Volcanic emissions and volcanic ash, which are hazardous to human health, are discussed in Section 4.14 (Volcanic Hazards); human health impacts related to contaminated flood water are discussed in Section 4.6 (Flood).

#### HAZARD DESCRIPTION

The following provides a brief description of the health risks of concern in the State of Hawai'i. This is not a comprehensive assessment of all health risks that may impact Hawai'i's residents and visitors; rather it is a brief overview of risks and vulnerability in the state.

#### *Coronavirus Disease (COVID-19)*

COVID-19 is an infectious disease caused by the SARS-CoV-2 virus. The virus can spread in small liquid particles from the mouth or nose of infected persons when they cough, sneeze, speak, sing, or breathe. Most people infected with the virus experience mild to moderate respiratory illness and recover without requiring special treatment. However, some become seriously ill and require medical attention. Older people and those with underlying medical conditions such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness. Anyone at any age can get sick with COVID-19 and become seriously ill or die (World Health Organization 2022).





### Vector-Borne Disease

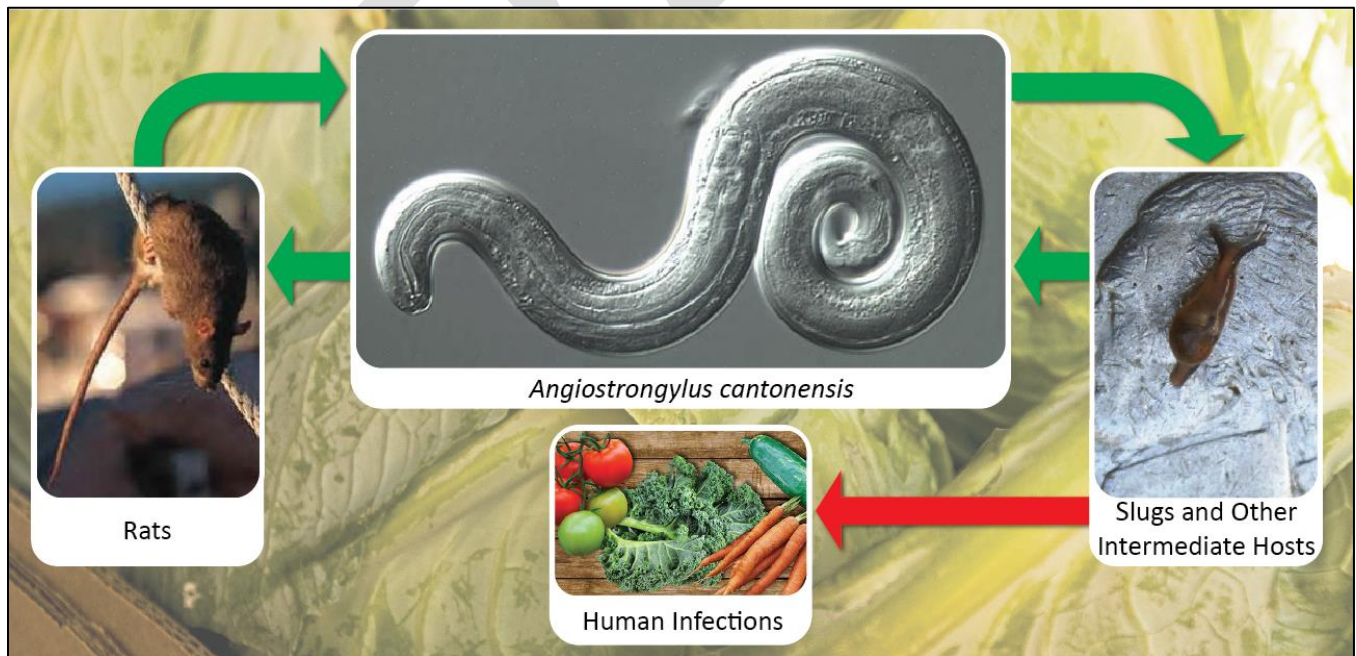
Vector-borne diseases account for more than 17 percent of all infectious diseases worldwide. Vectors are living organisms that can transmit infectious diseases between humans or from animals to humans (World Health Organization 2020). The most common disease vectors in Hawai'i are mosquitoes (Figure 4.8-1) and parasites (Figure 4.8-2). The geographic distribution of these vectors is expected to expand with climate change, potentially increasing the risk of these illnesses in Hawai'i.

Figure 4.8-1 *Aedes albopictus* (left) and *Aedes aegypti* (right) mosquitoes are common vectors for disease and illness in Hawai'i



Source: (Centers for Disease Control and Prevention 2022)

Figure 4.8-2. Rat Lungworm Host and Infection Cycle



Source: (State of Hawaii, Department of Health 2022)





## Dengue Fever

Dengue fever is a viral illness spread by *Aedes* mosquitoes. The *Aedes aegypti* or *Aedes albopictus* mosquito are the primary transmitters of the virus. The last reported dengue outbreak on Hawaii Island was from 2015–2016 (State of Hawaii, Department of Health 2022). Symptoms appear 4 to 7 days after being bitten by a mosquito that is infected with the virus and include high fever, rash on the arms and legs, body aches, and headache. Dengue fever is not transmitted directly from one person to another; however, mosquitoes can transmit the disease by biting an infected individual and becoming a carrier of the virus, capable of infecting other people.

## Chikungunya

Chikungunya is a viral illness spread by being bitten by mosquitoes. Symptoms include fever, severe joint pain, headache, muscle pain, joint swelling, nausea, vomiting, redness around the eyes, and rash. Individuals who have been infected generally recover within 7–10 days. Chikungunya cannot be passed from one person to another. Though there are no vaccines or specific treatment procedures, death from chikungunya is not common (State of Hawaii, Department of Health 2022).

## Zika

Zika is a viral illness that can be spread to people through mosquito bites. It was first discovered in a monkey in the Zika forest of Uganda in 1947. Before 2015, outbreaks were reported in areas of Africa, Southeast Asia, and the Pacific Islands. In 2015, outbreaks of Zika were reported in Brazil and other South American countries. To date, there have been no cases of locally acquired Zika infections in Hawai'i (State of Hawaii, Department of Health 2022).

People are infected with Zika virus primarily through the bite of an infected *Aedes aegypti* or *Aedes albopictus* mosquito, which are the same mosquitoes that spread dengue fever and chikungunya. The mosquito becomes infected when it bites a person who is already infected with the Zika virus. It takes a week or more for the Zika virus to replicate in the mosquito; then, the mosquito can transmit the virus to a new person (State of Hawaii, Department of Health 2022).

## Rat Lungworm

Rat lungworm is a disease caused by a parasitic nematode (roundworm parasite) called *Angiostrongylus cantonensis* and is a disease that can affect the brain and spinal cord (State of Hawaii, Department of Health 2022). The adult form of *A. cantonensis* is only found in rodents. However, infected rodents can pass larvae of the worm in their feces. Snails, slugs, and certain other animals (including freshwater shrimp, land crabs, and frogs) can become infected by ingesting these larvae; these are considered intermediate hosts. Humans can become infected with rat lungworm if they eat (intentionally or otherwise) a raw or undercooked infected intermediate host, thereby ingesting the parasite. Sometimes people can become infected by eating raw produce that contain small infected snails or slugs. Rat lungworm is not spread person-to-person.

Rat lungworm can cause a rare type of meningitis (eosinophilic meningitis). While some infected people may not have any symptoms or only have mild symptoms, others infected may develop symptoms that are much more severe. There is no specific treatment for the disease, and symptoms usually last between 2 to 8 weeks (State of Hawaii, Department of Health 2022).

## Water-Borne Disease

Water-borne diseases are conditions caused by pathogenic micro-organisms that are transmitted in water. Disease can be spread from swimming, washing, drinking water, or eating food exposed to infected water. Increased flooding expected from climate change is expected to increase exposures to these micro-organisms, resulting in more infections in Hawai'i.

## Leptospirosis

Leptospirosis is a bacterial disease that affects humans and animals. It is caused by bacteria of the genus *Leptospira*. Humans can get leptospirosis through direct contact with urine from infected animals or through water, soil, or food contaminated





with their urine. In humans, leptospirosis causes a wide range of symptoms, and some infected persons may have no symptoms at all. Symptoms of leptospirosis include high fever, severe headache, chills, muscle aches, and vomiting, and may include jaundice (yellow skin and eyes), red eyes, abdominal pain, diarrhea, or a rash. If the disease is not treated, patients may develop kidney damage, meningitis (inflammation of the membrane around the brain and spinal cord), liver failure, and respiratory distress. In rare cases, death occurs. Many of these symptoms can be mistaken for other diseases. Leptospirosis is confirmed by laboratory testing of a blood or urine sample.

Leptospirosis occurs worldwide but is most common in temperate or tropical climates. It is an occupational hazard for many people who work outdoors or with animals, for example, farmers, sewer workers, veterinarians, fish workers, dairy farmers, or military personnel. It is a recreational hazard for campers or those who participate in outdoor sports in contaminated areas and has been associated with swimming, wading, playing in contaminated streams and waterfalls and navigating flood waters. The incidence is also increasing among children who live in urban areas.

### **Legionnaires' Disease**

Legionnaires' illness is caused by *Legionella*, a type of bacterium found naturally in freshwater environments. *Legionella* becomes a health concern when it grows and spreads in human-made building water systems not properly maintained (Centers for Disease Control and Prevention 2021). Legionnaires' disease is a very serious type of pneumonia caused by inhalation of small droplets of water containing the bacteria. Early symptoms of Legionnaire's disease include muscle aches, headaches, loss of appetite, tiredness, and cough, often followed by chills, diarrhea, and high fever. Symptoms of Legionnaire's disease can be difficult to distinguish from other cases of pneumonia and typically begin to occur 5 to 6 days after exposure to *Legionella* bacteria; however, the incubation period can range from two days to almost two weeks (State of Hawaii, Department of Health 2022).

Outbreaks of Legionnaires' disease are often associated with large or complex water systems, like those found in hospitals, hotels, and cruise ships. The disease is typically treated with antibiotics that kill the bacteria in the body. Most people healthy people exposed to *Legionella* do not get sick. Those with increased risk of getting sick are people over 50 years of age, smokers, and people with compromised immune systems, cancer, lung disease, or other underlying illnesses (Centers for Disease Control and Prevention 2021).

### **Pandemic Flu**

There are numerous types of pandemic flu, and the strains of the virus continue to mutate and change. Novel influenza represents the emergence of new subtypes of the influenza virus that have not previously been identified and represent a class of viruses against which there is little to no pre-existing immunity or vaccine. Each county has been required to develop procedures for dealing with this type of threat. While many of the recommendations include social distancing, it is important to plan for the eventuality of a pandemic to determine how to maintain businesses and services to prevent economic collapse in addition to the health threats.

### **H5N1 or Avian Flu**

Avian influenza is an infection caused by avian influenza (bird flu) viruses. These influenza viruses occur naturally among birds. Wild birds worldwide carry the viruses in their intestines but usually do not get sick from them. However, avian influenza is very contagious among birds and can make some domesticated birds, including chickens, ducks, and turkeys, very sick and kill them.

Infected birds shed influenza virus in their saliva, nasal secretions, and feces. Susceptible birds become infected when they have contact with contaminated secretions/excretions or with surfaces that are contaminated with secretions/excretions from infected birds. Domesticated birds may become infected with avian influenza virus through direct contact with infected





waterfowl or other infected poultry or through contact with surfaces (such as dirt or cages) or materials (such as water or feed) that have been contaminated with the virus.

Scientists are concerned that H5N1 virus one day could be able to spread easily from one person to another. Because these viruses do not commonly infect humans, there is little or no immune protection against them in the human population. If H5N1 virus were to gain the capacity to spread easily from person-to-person, an influenza pandemic could begin.

### **H1N1 or Swine Flu**

During the period from 2007 to 2010, there were incidents of swine flu (H1N1) outbreaks in the State of Hawai'i. Of particular concern is the 2009 outbreak of H1N1 pandemic that resulted in several deaths. Similar to other outbreaks, the virus spread with international travelers. This is particularly concerning for the state since it is among the most remote places on the planet, and it will be difficult to sustain livelihoods should the state lose connection with the United States mainland or international travel due to quarantines or travel restrictions.

### **Bioterrorism**

The Center for Disease Control (CDC) defines a bioterrorism attack as the deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants. These agents are typically found in nature, but it is possible that they could be changed to increase their ability to cause disease, make them resistant to current medicines, or increase their ability to be spread into the environment. Biological agents can be spread through air, water, or food. Terrorists may use biological agents because they can be extremely difficult to detect and may not cause illness for several hours to several days. Some bioterrorism agents, such as the smallpox virus, can be spread from person-to-person and some, such as anthrax, cannot.

## **LOCATION**

The state's central location between the continental United States and Asia, with hundreds of thousands of visitors each month, leads to considerable exposure to and potential for the introduction of new or re-emerging health risks. Health events can cover a wide geographic area and can affect large populations, including any of the Hawaiian Islands. Size and extent of an infected population depends on how easily the illness is spread, mode of transmission, and amount of contact between infected and uninfected individuals. Locations with higher density populations are more susceptible to outbreaks, as disease can be transmitted easier between people due to their proximity to infected individuals. Additionally, facilities that group vulnerable populations, such as daycare centers, schools, senior centers and medical facilities, may also contribute to disease transmission.

## **EXTENT**

The U.S. Centers for Disease Control and Prevention have defined levels of disease as follows (Centers for Disease Control and Prevention n.d.):

- *Sporadic* refers to a disease that occurs infrequently and irregularly.
- *Endemic* refers to the amount of a particular disease that is usually present in a community. This level is not necessarily the desired level but rather is the observed level.
- *Hyperendemic* refers to persistent, high levels of disease occurrence.
- *Epidemic* refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- *Outbreak* carries the same definition of epidemic but is often used for a more limited geographic area.







- *Cluster* refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known.
- *Pandemic* refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

Severity of a disease depends on a number of factors. These include the size of the vector populations (the population size and distribution of insects or animals capable of transmitting a disease, e.g., mosquito-borne illnesses), aggressiveness of the disease, ease of transmission, and factors associated with the impacted community (e.g., access to medical care, demographic data, and population density). High-risk populations considered more vulnerable to various health hazards are described in the vulnerability assessment.

The magnitude of an infectious disease outbreak is also related to the ability of the public health and medical communities to stop the spread of the disease. Most disease outbreaks that cause catastrophic numbers of deaths are infectious in nature, meaning that they are spread from person-to-person. The public health and health care providers in Hawai'i routinely utilize known and established methods to reduce morbidity and mortality from infectious disease. However, the capacity of the health care system is limited and varies from county to county.

The severity of the impact of influenza depends on the nature of the outbreak, whether it is pandemic flu or seasonal flu. Pandemic flu should not be confused with seasonal flu. Seasonal flu is a less severe concern because of its regularity of occurrence and predictability. Table 4.8-1 lists key differences between pandemic and seasonal flu.

**Table 4.8-1. Seasonal Flu Versus Pandemic Flu**

Seasonal Flu	Pandemic Flu
<b>Influenza (flu) is a contagious respiratory illness caused by flu A and B viruses that infect the human respiratory tract. Annual flu epidemics occur among people worldwide.</b>	A flu pandemic is a global outbreak of a new flu A virus in people that is very different from current and recently circulating seasonal flu A viruses.
<b>Epidemics of seasonal flu happen every year. Fall and winter are the time for flu in the United States.</b>	Flu pandemics happen rarely. Four flu pandemics have happened in the past 100 years, but experts agree another one is inevitable.
<b>Flu viruses are thought to spread mainly from person-to-person through droplets made when someone with flu coughs, sneezes, or talks near a person (within 6 feet).</b>	Pandemic flu viruses would spread in the same way as seasonal flu, but a pandemic virus will likely infect more people because few people have immunity to the pandemic flu virus.
<b>Seasonal flu vaccines are made each year to vaccinate people against seasonal flu. Everyone 6 months and older should get a flu vaccine every year. For most people, only one dose of vaccine is needed.</b>	Although the U.S. government maintains a limited stockpile of some pre-pandemic flu vaccines, vaccines may not be widely available in the early stages of a pandemic. Two doses of pandemic flu vaccine will likely be needed.
<b>Prescription medications called antiviral drugs can treat seasonal flu. During a severe flu season, there can be spot shortages of these drugs.</b>	Flu antiviral medications may be used to treat pandemic flu if the virus is susceptible to these drugs. While a limited amount of flu antiviral drugs are stockpiled for use during a pandemic, supplies may not be enough to meet demand during a pandemic.
<b>Young children, people 65 years and older, pregnant women, and people with certain long-term medical conditions are more likely to have serious flu complications.</b>	Because this is a new virus not previously circulating in humans, it is not possible to predict who would be most at risk of severe complications in a future pandemic. In some past pandemics, healthy young adults were at high risk for developing severe flu complications.

Source: (Centers for Disease Control and Prevention 2018)

Health-related events, such as pandemics, are inevitable and arrive with very little warning. Identification, containment, and treatment of pandemic outbreaks and even cases of bioterrorism are further complicated by the highly transient nature of





the tens of thousands of daily visitors, the state's isolation, and the associated delay in importing the necessary medical supplies, medicines, and resources (County of Kaua'i 2015).

As experienced at the start of the COVID-19 pandemic, air travel increases the speed of spread of a new virus and decrease the time available for implementing interventions. Passengers traveling through the state's airports are monitored for disease by airline crews, the federal Transportation Security Administration (TSA) staff, and state health officials. The Centers for Disease Control and Prevention (CDC) staff responds to reports of illnesses on airplanes, cruise, and cargo vessels at international ports of entry. The CDC operates a quarantine station at the Daniel K. Inouye International Airport in Honolulu. The station's jurisdiction includes all ports in Hawai'i, Guam, American Samoa, the Freely Associated States and the Commonwealth of the Northern Mariana Islands (Centers for Disease Control and Prevention 2021).

Outbreaks are expected to occur simultaneously throughout much of the United States, potentially limiting the availability of federal and or inter-state assistance in the form of human and material resources that usually occur in response to other disasters. Warning time for a disease outbreak will depend on the origin of the virus, virus incubation time (the duration required before an individual begins to develop symptoms of an illness), and the amount of time needed to identify the virus.

## PREVIOUS OCCURRENCES AND LOSSES

According to the Hawai'i State Department of Health, 369,914 cases of COVID-19 were reported through December 14, 2022. The state also saw 8,067 cases of influenza in 2018, 240 cases of the mumps in 2018, 32 cases of Leptospirosis in 2019, and 25 cases of Legionellosis in 2022 (see Tables Table 4.8-2 and Table 4.8-3).

### Disaster and Emergency Declarations

The following disaster declarations or emergency proclamations related to public health have been issued for Hawai'i:

- **Federal disaster (DR) or emergency (EM) declarations, 1955 – 2022:** 1 event, classified as "biological (COVID)"
- **Hawai'i State Emergency Proclamations, 2018 – 2022:** 38 proclamations and supplementary proclamations related to COVID-19
- **DHHS Public Health Emergency Declarations, 2018–2022:** 2 nationwide events, classified as COVID-19 and Monkeypox
- **USDA agricultural disaster declarations, 2012 – 2022:** none

Table 4.8-2 shows significant health events that have occurred in the state between 2018 and 2022. Records of health risks prior to 2018 as documented in the 2018 SHMP are provided in Appendix E (Hazard Profile Supplement).

**Table 4.8-2. Significant Health Risk Events in the State of Hawai'i, 2018 to 2022**

Date(s) of Event	Event Type	Counties Affected	Description
January 2020–December 14, 2022	COVID-19	Kaua'i, Honolulu, Maui, Hawai'i	369,914 cases; 1,748 deaths

Source: (Hawai'i State Department of Health 2022)

Table 4.8-3 shows the number of reported cases of notable illnesses and diseases in Hawai'i. For this 2023 SHMP Update, this includes chikungunya, dengue fever, influenza, leptospirosis, legionellosis, mumps, rat lungworm, and Zika.



**Table 4.8-3. Reported Cases of Notable Diseases in the State of Hawai‘i**

Disease	2018	2019	2020	2021	2022
Chikungunya <sup>a</sup>	2	3	0	0	0
Dengue Fever <sup>a</sup>	18	20	5	0	3
Influenza <sup>a</sup> (lab-confirmed)	8,067	4,673	3,104	28	5177
Legionellosis <sup>a</sup>	23	22	16	15	25
Leptospirosis <sup>a</sup>	22	32	10	13	9
Mumps <sup>a</sup>	240	4	3	0	3
Rat Lungworm	11	11	6	7	1
Zika <sup>a</sup>	7	2	0	0	0

Source: (Hawai‘i State Department of Health 2022)

Note: a. Statistics are provided to the CDC to monitor national public health

## PROBABILITY OF FUTURE HAZARD EVENTS

### Overall Probability

The best predictor of the probability of future health risks is the state’s history of these events. The state can expect thousands of cases of COVID-19 and the flu, and several cases of mosquito-borne illnesses each year, with periodic outbreaks (15 years passed between the last two outbreaks of dengue fever).

The popularity of the State of Hawai‘i as a tourist destination will also drive future health events. The Daniel K. Inouye International Airport currently serves 2.5 million international passengers annually. The Kahului Airport serves 156,000 each year, and Ellison Onizuka Kona International Airport at Keāhole serves 30,000 each year. Additionally, 67,000 cruise and cargo ship passengers and crew visit the state each year (Centers for Disease Control and Prevention 2021). As the number of people traveling into and out of the state increases, so does the possibility of disease transmission.

Additionally, infrastructure and environmental quality have significant contributions to public health. Deterioration of either man-made or environmental systems can result in adverse impacts to public health, increasing the state’s vulnerability to public health emergencies.

### Climate Change Impacts

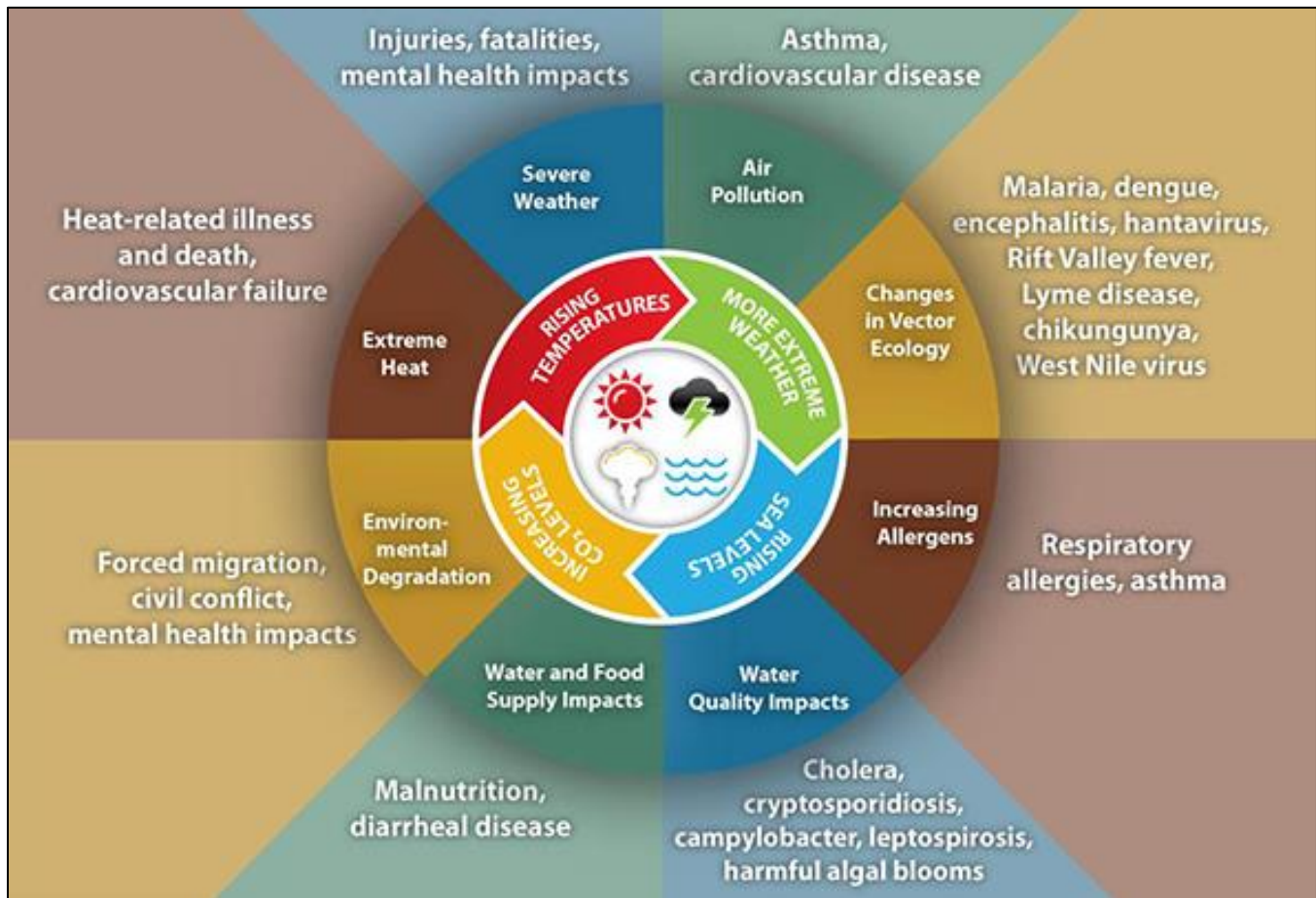
Studies at the University of Hawai‘i at Mānoa have shown that over half of known infectious diseases can be aggravated by climate change (Mora, et al. 2022).

Changes in temperature and precipitation can influence seasonality, distribution, and prevalence of vector-borne diseases, which are influenced significantly by high and low temperature extremes and precipitation patterns (Rocklöv and Dubrow 2020). A changing climate may also create conditions favorable for invasive mosquitoes in Hawai‘i. Research into modeling vector-borne diseases and climate change has shown an accelerating invasion potential of the *Aedes aegypti* mosquito (Iwamura, Guzman-Holst and Murray 2020) and subsequent potential spread of related illnesses. In addition, infectious agents and chemical toxins in water will spread on a wider scale as more flooding results from climate change. Floodwaters that remain in small, still pools after flooding has subsided can provide additional habitat for mosquito reproduction. This leads to more mosquitoes that can carry diseases such as dengue fever, chikungunya, and Zika (Kulkarni, Duguay and Ost 2022). More flooding will also expose more people to waterborne infectious diseases such as leptospirosis.





Figure 4.8-3. Climate Change Impacts on Human Health



Source: (Centers for Disease Control and Prevention 2022)

## 4.8.2 VULNERABILITY ASSESSMENT

No spatial data was available to assess health risk vulnerability. Therefore, a qualitative assessment was conducted.

### ASSESSMENT OF STATE VULNERABILITY AND POTENTIAL LOSSES

This section discusses statewide vulnerability of exposed state assets (state buildings and roads) and critical facilities to health risks.

#### State Assets

State buildings and roads are not exposed or vulnerable to this hazard. While the actual structures will not be impacted, the effect of absenteeism on state workers will impact the delivery of state services. The impacts and potential losses from this hazard are largely economic and are dependent on the type, extent, and duration of the illness.

Procedures for continuity of government operations will need to be implemented during a public health emergency, such as a pandemic. The most recent U.S. Department of Health and Human Services update of the national Pandemic Influenza Plan assumed a disease attack rate between 20 and 30 percent depending on the severity of the outbreak (U.S. Department of





Health and Human Services 2017). According to the State of Hawai'i Department of Business, Economic Development & Tourism, in 2022 there were 68,800 state government jobs (DBEDT 2022). A 20 to 30 percent absentee rate would mean that a shortage of 13,600 and 20,640 state government employees would impact state facilities and the services they provide.

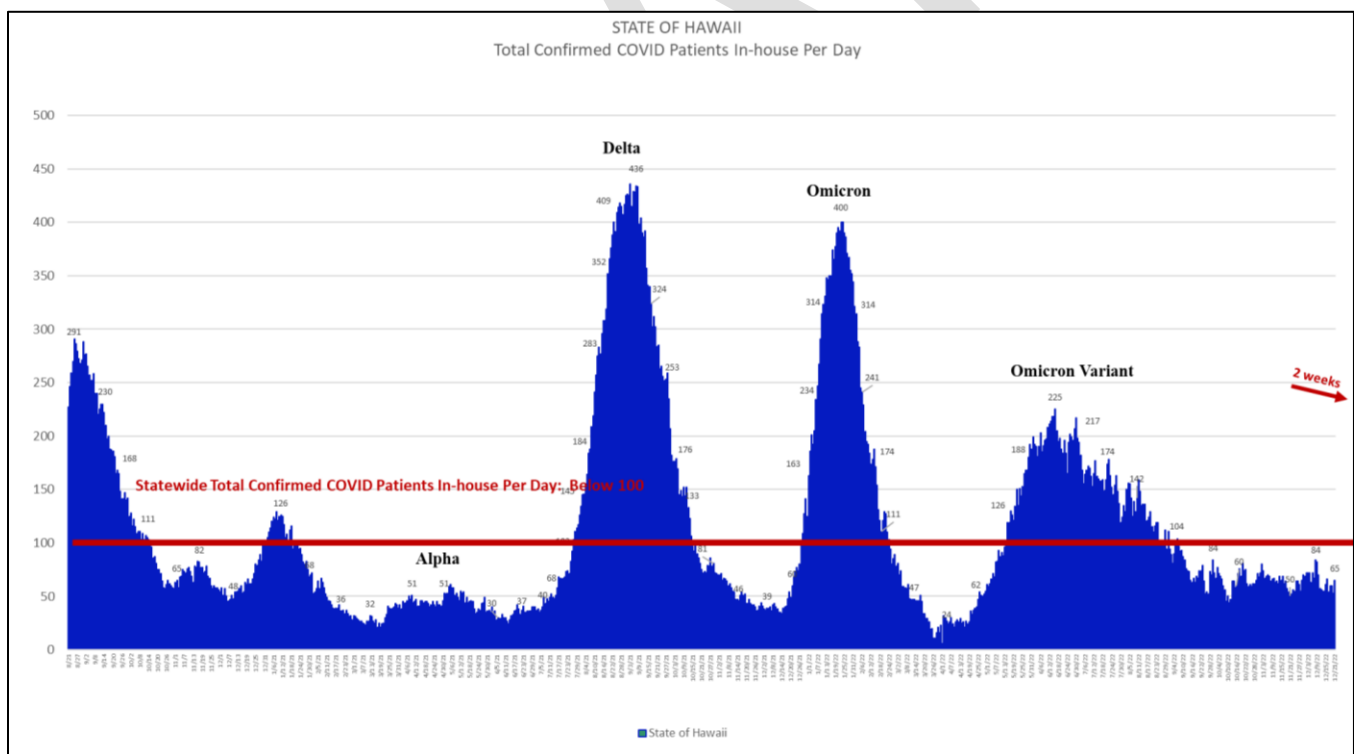
### Community Lifelines and Critical Facilities

The impacts and potential losses from this hazard are largely economic and are dependent on the type, extent, and duration of the illness. A pandemic outbreak could result in a temporary closure to ports of entry to the state impacting the state's "just in time" supply management system and the import and export of goods and vital resources.

Similar to state assets, the actual community lifelines and critical facilities themselves will not be impacted; however, the delivery of critical services and the running of critical infrastructure will be due to absenteeism of workers (e.g., dock employees, airport staff and schoolteachers). Healthcare workers in public health and in direct patient contact are essential during a health risk event. According to the State of Hawai'i Department of Business, Economic Development & Tourism, in 2022, there were 73,400 healthcare jobs in the state (DBEDT 2022). A 20 to 30 percent absentee rate would mean that a shortage of 14,680 and 22,020 healthcare employees would impact critical health-related facilities and the services they provide.

In addition, an increase in hospitalization and emergency room visits may take place as a result of a health risk, creating a greater demand on these critical facilities, their staff and resources. Figure 4.8-4 shows that during the COVID-19 pandemic, up to 436 confirmed COVID patients were hospitalized each day (Healthcare Association of Hawai'i 2022).

Figure 4.8-4. Hawai'i COVID Hospitalizations, August 2020–December 2022



Source: (Healthcare Association of Hawai'i 2022)





## ASSESSMENT OF LOCAL VULNERABILITY AND POTENTIAL LOSSES

This section provides a summary of statewide exposure and potential losses to population, general building stock, environmental resources, and cultural assets. The local SHMPs were reviewed, and their discussions of health risks are summarized below:

- Kaua'i County—The 2021 County of Kaua'i Multi-Hazard Mitigation and Resilience Plan includes an entire appendix containing a qualitative assessment of health-related hazards.
- City and County of Honolulu—The 2020 Multi-Hazard Pre-Disaster Mitigation Plan for the City and County of Honolulu briefly discusses the health impacts of vog but does not address health risks as a separate hazard.
- Maui County—The 2020 County of Maui Hazard Mitigation Plan Update provides a qualitative discussion on health risks.
- Hawai'i County—The 2020 County of Hawai'i Multi-Hazard Mitigation Plan discusses pandemic outbreaks as a hazard of interest.

### *Socially Vulnerable and Total Populations*

The entire population, residents, and visitors, of the State of Hawai'i is exposed and potentially vulnerable to any of the health risks discussed above. Health risks can cover a wide geographic area and can affect large populations. The size and extent of an infected population depends on how easily the illness is spread, mode of transmission, and amount of contact between infected and uninfected individuals. Locations with higher-density populations are more susceptible to outbreaks, as the disease can be transmitted more easily.

Because of concerns about COVID-19, an estimated 41 percent of U.S. adults delayed or avoided medical care, including urgent or emergency care (12 percent) and routine care (32 percent). Avoidance of urgent or emergency care was more prevalent among unpaid caregivers for adults, persons with underlying medical conditions, Black adults, Hispanic adults, young adults, and persons with disabilities (Czeisler, et al. 2020).

Food insecurity can impact those who lose employment during a pandemic, who are not eligible for Supplemental Nutrition Assistance Program benefits due to immigration status, or who may not be able to access food at stores because of supply chain issues or lack of stock. Food banks may be the only option for these families. Since the onset of the COVID-19 pandemic, food insecurity in Hawai'i has grown by more than 50 percent, which is the largest percentage increase in the nation (Hawai'i Food Bank 2021).

Vulnerable populations, especially the young, pregnant women, the elderly and those who have underlying health conditions or a weaker immune system, are at greater risk for both contracting a disease and suffering fatal or severe consequences. Refer to Section 3 (State Profile), which summarizes demographics exposed to health risks by county.

In addition to the physical impacts of a health risk event, mental health impacts are also prevalent. A survey published in 2021, conducted by the Hawai'i State Department of Health, indicated that about half of the respondents began experiencing mental health conditions during the COVID-19 pandemic. Mental health impacts were especially noted among young adults and those with a household income of less than \$50,000 (Hawai'i State Department of Health 2021). Mental stress and anxiety may be experienced by both the population directly impacted or first responders. Associated economic impacts include health care costs and lost productivity at work or in the home.

### *General Building Stock and Economy*

The general building stock is not exposed or vulnerable to the identified health risks of a disease outbreak as a disease affects only persons susceptible to the illness. However, the general building stock may contribute to the transmission of disease





during an outbreak as a result of various design conditions (i.e., homes without window screens are more vulnerable to the spread mosquito-borne diseases), while aging infrastructure of the state's building stock could play a significant role in the spread of water-borne illness, such as Legionnaire's disease.

According to the Hawai'i Tourism Authority, tourism is the largest single source of private capital into the state's economy. A health risk such as a pandemic would have a significant impact on the economy. As a point of reference, in April 2020, the state's tourism decreased 99.5 percent due to the COVID-19 pandemic (Department of Business, Economic Development & Tourism 2021).

## ***Environmental Resources and Cultural Assets***

The type of health risk will determine the effect on the environment.

Air pollution dropped suddenly during the COVID-19 lockdown between March 19 and May 7, 2020. Overall improvement of air and water quality, reduction of noise, and restoration of ecology were all noted during the pandemic (Rume and Didar-UI Islam 2020, Cheng 2021).

An increased demand for single-use plastic products during the pandemic led to more than 8 million tons of pandemic-associated plastic waste generated globally, with more than 25,000 tons entering the global ocean. Most of the plastic is from medical waste generated by hospitals (Peng, et al. 2021). Powerful disinfectants end up in water supplies. Microplastics from degrading personal protective equipment (e.g., masks, gloves) can contribute to high concentrations found in fish, water, sediments, soils, and the air (Hartman 2021).

A bioterrorism attack may not only impact the general population but animals and plants as well because agents can spread through the air, water or in food. Livestock and poultry populations may become infected due to a health risk impacting the local economy and available food sources. Bacteria, pathogens, and other pollutants introduced into the local hydrology of the state's water cycle can also have long-term impacts on water resources, further contributing to adverse public health impacts.

## **FUTURE CHANGES THAT MAY IMPACT STATE VULNERABILITY**

Understanding future changes that impact vulnerability in the state can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The state considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

As the population characteristics of the state change, there will be more people in age categories that are more susceptible to infectious diseases (elderly and young populations). The ability to withstand impacts will depend on preparedness of the state as well as local communities.

In addition, the continued robust international tourism industry in Hawai'i makes it more vulnerable to health risks. Air travel could increase the speed of spread of a new virus and decrease the time available for implementing interventions. Economically, another pandemic or a disease outbreak would likely have a significant impact on tourism as people decrease their travel. Scares of infectious disease and pandemic flu could collapse the tourism economy again.

