



12. HEALTH RISKS

12.1 HAZARD PROFILE

12.1.1 HAZARD DESCRIPTION

The health risks covered in this section include vector-borne disease, water-borne disease, respiratory illnesses, infectious disease outbreaks, and bioterrorism hazards that may impact the City's residents and visitors.

The following sections summarize the significant health risks of concern for the City. This is not a comprehensive assessment of all health risks that may affect the City's residents and visitors but a brief overview of risks and vulnerability. Health-related impacts that may result as secondary impacts from other natural hazards are covered in the hazard profile chapters for those hazards. Vog, a specific health hazard, is covered in Chapter 18

Vector-Borne Disease

Vector-borne diseases account for over 17 percent of all infectious diseases worldwide, causing more than 700,000 deaths annually (WHO 2024). Vectors are living organisms that transmit infectious pathogens between humans or from animals to humans. Many vectors are bloodsucking insects that ingest disease-producing microorganisms during a blood meal from an infected host and later transmit them to a new host. Once a vector becomes infectious, it can transmit the pathogen for the rest of its life during each subsequent bite (WHO 2024). Many vector-borne diseases are preventable through protective measures and community mobilization (WHO 2024).

The distribution of vector-borne diseases is influenced by demographic, environmental, and social factors. Global travel, trade, unplanned urbanization, climate change, and the adaptation of vectors have contributed to their spread. Climate change significantly impacts pathogens, vectors, and reservoir hosts, affecting the transmission of many vector-borne diseases. Vectors have expanded their geographic ranges and the length of their active seasons, trends expected to continue as the climate warms (WHO 2024). The State of Hawai'i experiences vector-borne diseases such as leptospirosis and occasional outbreaks of Dengue Fever (McCallen n.d.). It is projected that climate change will increase the risk of mosquito-borne diseases in Hawai'i due to the increasing range of mosquitos that carry these illnesses.

DENGUE FEVER

Dengue fever is a viral illness spread by *Aedes* mosquitoes. The *Aedes aegypti* or *Aedes albopictus* mosquitoes are the primary transmitters of the virus. Symptoms appear four to seven 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 (CDC 2025). O‘ahu also sees sporadic cases of Dengue Fever that are typically linked to travelers who contracted the virus elsewhere and then brought it to the island.

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 seven to ten 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 (HDOH 2024). There have been no recorded cases in Hawai‘i of locally acquired chikungunya virus in Hawai‘i.

ZIKA

Zika is a viral illness that can be spread to people through mosquito bites, 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 (HDOH 2024). All Zika cases in Hawaii have been travel related. (HDOH 2024).

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 (HDOH 2023). The adult form of *Angiostrongylus 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 contains 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 two to eight weeks (HDOH 2023). Most cases of rat lungworm that are identified in Hawai‘i have occurred on Hawai‘i Island, but cases and infected intermediate hosts (snails and slugs), have also been identified on all of the major neighbor islands, including O‘ahu (HDOH 2023).



Water-Borne Disease

Water-borne diseases are caused by pathogenic microorganisms that are transmitted in water. Disease can be spread from swimming, washing, drinking water, or eating food exposed to infected water. Waterborne diseases affect over 7 million people in the U.S. every year and cost the healthcare system over \$3 billion (CDC 2022).

LEPTOSPIROSIS

Leptospirosis, caused by the bacterium *Leptospira*, is found in contaminated water or soil and affects both animals and humans. Without treatment, it can lead to severe health issues such as kidney damage, meningitis, liver failure, respiratory distress, and even death. Annually, approximately 1 million cases occur globally, resulting in nearly 60,000 deaths, with reports across the United States (CDC 2025). Animals can also become infected through contact with contaminated urine or other body fluids in water or soil, with symptoms varying widely. Effective mitigation strategies include improving water and soil sanitation, public education on risks, and ensuring timely medical treatment to prevent severe outcomes (CDC 2024). Leptospirosis in Hawai'i is usually contracted by people swimming or working in contaminated freshwater streams, rivers and lakes (HDOH 2023).

VIBRIO VULNIFICUS

Vibriosis is an illness caused by a bacteria known as *Vibrio*. The bacteria are found in ocean and brackish waters. Large outbreaks of vibriosis are rare, but smaller local outbreaks do sometimes occur. Most cases occur in isolation, with approximately 20 to 40 cases being reported every year in Hawai'i. O'ahu has seen an average of 26 cases per year between 2014 and 2023 (HDOH 2025).

Symptoms of vibriosis include watery, sometimes bloody diarrhea, abdominal cramps, nausea, vomiting, fever, chills, and headache. Symptoms usually appear 12 to 24 hours after eating raw or undercooked seafood that contains the bacteria, and last for two to five days in otherwise healthy individuals. Wounds or cuts exposed to seawater or seafood drippings can also become infected, causing the wound to become red, swollen, or painful (HDOH 2024). People with weakened immune systems, liver disease, and other underlying illnesses are at risk of more severe disease. Severe infections can result in limb amputations or death (HDOH 2024). The spread of the illness is projected to rise, as rainfall events can transport and elevate concentrations of the bacteria, and climate change is expected to lead to increased precipitation (Bullington, et al. 2022).

LEGIONNAIRES' DISEASE

Legionnaires' disease is a severe form of pneumonia caused by the bacterium *Legionella pneumophila* (CDC 2024). It primarily affects the lungs but can also cause infections in other parts of the body, including the heart. The disease is typically contracted by inhaling microscopic water droplets containing the bacteria, which can be found in water systems like air conditioners, hot tubs, and large plumbing systems.

Symptoms usually develop 2 to 10 days after exposure and include high fever, chills, cough, muscle aches, and headaches (CDC 2024). Gastrointestinal symptoms such as nausea, vomiting, and diarrhea, as well as confusion



or other mental changes, can also occur. Certain groups, such as older adults, smokers, and individuals with weakened immune systems, are at higher risk. Prompt treatment with antibiotics is essential, as untreated Legionnaires' disease can be fatal. Preventive measures include maintaining water systems to prevent bacterial growth and ensuring proper sanitation (CDC 2024).

Respiratory Illnesses and Other Infectious Diseases

There are numerous types of respiratory illnesses and infectious diseases, and the strains of these viruses continue to mutate and change. Novel influenza and coronaviruses are 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. This hazard assessment will cover Coronavirus Disease (COVID-19), Avian Flu, and Swine Flu.

AVIAN FLU OR H5N1

Avian influenza, commonly known as bird flu, is a disease primarily affecting birds and is caused by viruses of the Orthomyxoviridae family (PAHO n.d.). 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 the virus through saliva, mucus, and feces. Other animals can also carry the virus in respiratory secretions, organs, blood, or other body fluids. Human infection can occur through contact with contaminated surfaces or inhalation of airborne particles (CDC 2024).

Although avian influenza A viruses typically do not infect humans, rare cases of human infection have occurred. These infections can range from mild to severe, sometimes resulting in death. The most serious illnesses with high mortality have been caused by avian influenza A(H7N9), highly pathogenic avian influenza (HPAI) A(H5N1), and A(H5N6) viruses (PAHO n.d.).

Since March 2024, multiple human cases of influenza A (H5N1) have been identified on the mainland after exposure to infected poultry or dairy cattle. While human-to-human transmission is currently rare, these viruses can mutate quickly and monitoring for potential spread is crucial for public health. Influenza A (H5N1) has been detected in wastewater surveillance on multiple Hawaiian Islands, however, there have been no human cases of avian flu in Hawai'i to date (HDOH 2025). To prevent infection, avoid contact with surfaces contaminated by animal feces, raw milk, litter, or materials from infected birds or animals. The CDC provides guidelines for those exposed to poultry and other potentially infected animals, including specific advice for poultry and dairy workers and responders to bird flu outbreaks (CDC 2024).



SWINE FLU OR H1N1

Swine influenza is a respiratory disease in pigs caused by type A influenza viruses, which regularly lead to outbreaks among pig populations. These viruses, known as “swine influenza viruses” or “swine flu viruses,” have various subtypes and strains, similar to human influenza viruses. In recent years, the primary swine influenza viruses circulating in U.S. pigs have been trH1N1, trH3N2, and trH1N2 viruses. While swine flu viruses typically do not infect humans, there have been sporadic cases of human infections with these viruses. When such infections occur, the viruses are referred to as “variant viruses” and are denoted by adding the letter “v” to the virus subtype designation. Human infections with H1N1v, H3N2v, and H1N2v viruses have been detected in the United States (CDC 2024).

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.

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 (WHO 2024). As of 2025, the City continues to see COVID-19 cases, but the risk remains low. The Department of Health continues to monitor the situation, especially with the potential of new variants.

MPOX (MONKEYPOX)

Mpox (previously called monkeypox) is a contagious disease caused by the mpox virus. There are two different types of mpox virus, clade I and clade II. Though epidemiologic investigations continue, clade I historically has caused a higher percentage of people with mpox to get severely sick or die compared to clade II.

An outbreak of clade I mpox is currently occurring in the Democratic Republic of the Congo (DRC) and has been declared a Public Health Emergency of International Concern. Clade I mpox has not been identified in the United States, but health officials are continuing to monitor the situation.

In 2022-2023, an outbreak of clade II mpox occurred in the U.S. and other countries where this infection had rarely been seen. Since 2023, clade II mpox has continued to spread and sicken a small number of people throughout the U.S. There were 55 total cases in the State of Hawai‘i, 38 of which were on O‘ahu.



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 (HI-EMA 2023). 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 (HI-EMA 2023).

12.1.2 LOCATION

The City'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. 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 infectious disease 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 (HI-EMA 2023). Due to the island's geographic isolation, there are a limited number of medical facilities and capabilities to address large-scale public health risks.

12.1.3 EXTENT

Hazard extent refers to the potential severity or magnitude of hazard events in a given area. This section describes measurements used to indicate the extent of this hazard and the systems in place for monitoring severity and providing warnings as necessary.

Vector-Borne Disease

An outbreak of dengue, chikungunya, or Zika on O'ahu could range from isolated cases to widespread transmission, depending on factors like mosquito populations, climate conditions, and human movement. Given the presence of known vectors on O'ahu, an outbreak could rapidly escalate in densely populated areas, straining healthcare systems and requiring vector control efforts. Warning signs of an impending outbreak include an increase in imported cases from travelers, a rise in mosquito populations, and reports of locally acquired infections. Public health officials would need to monitor mosquito surveillance data, respond to early cases swiftly, and implement community-wide prevention measures to prevent large-scale transmission.



Water-Borne Disease

An outbreak of waterborne diseases like leptospirosis, *Vibrio vulnificus*, or Legionnaires' disease on O'ahu could vary in severity depending on environmental conditions, water quality, and public health interventions. Heavy rainfall and flooding increase the risk of leptospirosis by contaminating freshwater sources with infected animal urine, while warm ocean waters can promote growth of *Vibrio vulnificus*, posing a threat to those with open wounds or weakened immune systems. Warning signs of an outbreak include a rise in reported infections, detection bacteria in water systems, and environmental conditions favoring bacterial growth. Early intervention through water testing, public health alerts, and infrastructure maintenance is essential to prevent widespread illness.

Respiratory Illnesses and Other Infectious Diseases

Pandemics and infectious diseases pose significant threats to public health, safety, and economic stability, ranging from localized outbreaks to global pandemics. Understanding their potential reach and severity is crucial for effective hazard mitigation planning. Diseases like influenza, COVID-19, and emerging zoonotic infections can spread rapidly, causing widespread illness and death. The impact is influenced by factors such as population density, healthcare infrastructure, and public health preparedness, with high-risk groups including the elderly, immunocompromised individuals, and those with underlying health conditions being particularly vulnerable.

The severity of a disease depends on several factors, including the size and distribution of vector populations (e.g., insects or animals capable of transmitting diseases like mosquito-borne illnesses), the aggressiveness of the disease, ease of transmission, and community-specific factors such as access to medical care, demographic data, and population density. High-risk populations, more vulnerable to various health hazards, are detailed in the vulnerability assessment (HI-EMA 2023).

The magnitude of an infectious disease outbreak is also influenced by the ability of public health and medical communities to control its spread. Most catastrophic disease outbreaks are infectious, spreading from person to person. Public health and healthcare providers on O'ahu use established methods to reduce morbidity and mortality from infectious diseases, but the healthcare system's capacity is limited.

The Centers for Disease Control and Prevention (CDC) has defined levels of diseases as the following (CDC 2012):

- Disease Occurrence Terminology:
 - *Sporadic*: A disease that occurs infrequently and irregularly.
 - *Endemic*: The constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.
 - *Hyperendemic*: Persistent, high levels of disease occurrence.
- Disease Outbreak Terminology:
 - *Epidemic*: An increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
 - *Outbreak*: Similar to an epidemic but often used for a more limited geographic area.



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

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 City's isolation, and the associated delay in importing the necessary medical supplies, medicines, and resources (HI-EMA 2023). As experienced at the start of the COVID-19 pandemic, air travel increases the speed of spread of a new virus and decreases the time available for implementing interventions. To slow the spread, air passenger travelers were subject to quarantine or testing in order to enter the state.

Infectious disease 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 (HI-EMA 2023).

12.1.4 PREVIOUS OCCURRENCES

This section provides an overview of hazard occurrences since the publication of the previous LHMP, which covers the period between January 2020 and February 2025. It identifies significant events that resulted in federal disaster declarations and/or state or local emergency proclamations. For events prior to 2020, refer to the 2020 LHMP. Table 12-1 shows recent events for O'ahu.



Table 12-1. Health Risks Events in the City and County of Honolulu (2020 to 2025)

Event Date	Disaster Declaration/ Proclamation			Description
	Federal	State	Mayoral	
January 20, 2020 to January 2, 2025	EM-3431-HI DR-4510-HI	—	Yes	Covid-19 Pandemic 304,106 total cases, 1,607 reported deaths
2020	—	—	—	Rat Lungworm: Two reported cases Dengue: Two reported cases Influenza: 2,463 lab confirmed reported cases Leptospirosis: Three reported cases Legionnaires’ Disease: 13 reported cases
2021	—	—	—	Rat Lungworm: One reported case Influenza: 22 lab-confirmed reported cases Legionnaires’ Disease: Nine reported cases
2022	—	—	—	Dengue: One reported case Influenza: 6,097 lab-confirmed reported cases Leptospirosis: One reported case Legionnaires’ Disease: Ten reported cases
2023	—	—	—	Dengue: Four reported cases Influenza: 6,772 lab-confirmed reported cases Leptospirosis: One reported case Legionnaires’ Disease: 19 reported cases

Source: (HDOH Disease Outbreak Control Division 2025)

Note: COVID-19 numbers are displayed for the City only, even though the impacted area is Statewide. COVID data as of January 2, 2025; Zero reported cases were not displayed on table; This information is based off a 10-Year Summary report for years 2014-2023, only years listed on table were reviewed; Influenza is lab-confirmed

Federal Disaster Declarations

Under the Stafford Act, the President of the United States may issue an Emergency Declaration (EM) or Major Disaster Declaration (DR) for health related events and activate certain federal assistance programs based on factors related to the magnitude of the hazard threat or impacts. Table 12-1 indicates recent events that received EM or DR declarations under the Stafford Act.

state and Local Emergency Proclamations

State law authorizes the Governor to issue emergency proclamations if an emergency or disaster has occurred, or there is imminent danger or threat of an emergency or disaster in any portion of the state. County Mayors have the authority to issue local emergency proclamations when such conditions exist within any part of their respective jurisdictions. Table 12-1 indicates recent events for which state or local emergency proclamations were issued.



12.1.5 PROBABILITY OF FUTURE OCCURRENCES

The best predictor of the probability of future health risks is the City’s history of these events. The City 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) (HI-EMA 2023).

The popularity of O’ahu as a tourist destination will also drive future health events. The Daniel K. Inouye International Airport currently serves 2.5 million international passengers annually. Additionally, 67,000 cruise and cargo ship passengers and crew visit O’ahu each year (Centers for Disease Control and Prevention 2021). As the number of people traveling into and out of O’ahu 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 City’s vulnerability to public health emergencies (HI-EMA 2023). Environmental impacts from climate change also threaten public health in Hawai’i.

Information on previous health risk occurrences in the City was used to calculate the probability of future occurrence of such events, as summarized in Table 12-2. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on these records and input from the Hazard Mitigation Working Group, the probability of occurrence for health risks in the City is considered “frequent.”

Table 12-2. Probability of Future Health Risk Events in City and County of Honolulu

Hazard Type	Number of Occurrences Between 2014 - 2023	Percent Chance of Occurring in Any Given Year
Covid-19	304,106	100.00%
Chikungunya ^a	40	53.33%
Dengue ^a	94	100%
Zika ^a	41	54.67%
Rat Lungworm ^a	5	6.67%
Influenza (lab-confirmed) ^a	22,232	100.00%
Leptospirosis ^a	51	68.00%
Legionnaires’ Disease ^a	113	100.00%
Total	326,682	100%

Source: (HDOH Disease Outbreak Control Division 2025)

Note: Covid-19 cases reported between January 2020 and January 2, 2025. This number includes confirmed and probable cases. 100% probability indicates that it is statistically likely for an event to occur every year. It does not indicate that the occurrence of an event is a certainty in any given year.

a. Historical summary of reported cases for Honolulu between 2014 - 2023. This includes resident and non-residential reported cases.



12.2 VULNERABILITY AND IMPACT ASSESSMENT

12.2.1 LIFE, HEALTH, AND SAFETY

The entire population of the City, including residents and visitors, is exposed and potentially vulnerable to various health risks. These risks can cover a wide geographic area and affect large populations. The size and extent of an infected population depend on how easily the illness is spread, its mode of transmission, and the amount of contact between infected and uninfected individuals. Locations with higher-density populations are more susceptible to outbreaks, as diseases can be transmitted more easily (HI-EMA 2023).

Vulnerable populations, especially the young, pregnant people, kūpuna, those with underlying health conditions or weaker immune systems, Native Hawaiians, COFA residents, and those that are required to report to work in person are at greater risk for both contracting diseases and suffering fatal or severe consequences.

In addition to the populations outlined above, many households are multi-generational, often due to the high cost of living and limited housing. This makes those households more vulnerable to disease transmission when there is an outbreak, as kūpuna often live with school age children and working adults who may bring disease home. Many households contain essential workers even if children are kept home from school. Additionally, stay at home orders can create or exacerbate financial burdens on households. Additional medical costs or the need to take time off work from jobs without paid leave can exacerbate the economically fragile situation of many Hawaii households.

12.2.2 ECONOMY AND GENERAL BUILDING STOCK

Travel related pandemics such as this are particularly concerning for the City since Hawai'i is among the most remote places on the planet, and it will be difficult to sustain livelihoods should the City lose connection with the United States mainland or international travel due to quarantines or travel restrictions, which happened during the COVID-19 pandemic. According to the Hawai'i Tourism Authority, tourism is the largest single source of private capital into the City's economy. A health risk such as a pandemic would have a significant impact on the economy. As a point of reference, in 2019, O'ahu had around 6 million visitors and in 2020, this dropped to about 1.5 million, a decrease of about 75 percent (DBEDT). This led to harsh economic impacts and high rates of unemployment. Unemployment in the City rose from approximately 2% in January of 2020 to 21.9% in April of 2020 due to the pandemic (UHERO).

12.2.3 COMMUNITY LIFELINES AND OTHER CRITICAL FACILITIES

Pandemics and infectious diseases can have profound impacts on community lifelines and critical facilities. The COVID-19 pandemic, for instance, strained healthcare systems, disrupted supply chains, and affected essential services such as water, electricity, and transportation. Workforce shortages due to illness or quarantine measures further exacerbated these disruptions, leading to reduced capacity and efficiency in critical



infrastructure (CISA 2021). Essential services may be disrupted by insufficient staffing, insecure supply chains, and fragile critical infrastructure. These vulnerabilities can lead to significant disruptions in vital services during pandemics.

12.2.4 FUTURE CHANGES THAT MAY AFFECT RISK

Understanding future changes that affect vulnerability can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The following sections examine potential conditions that may affect hazard vulnerability.

Potential or Planned Development

Any areas experiencing growth could potentially be impacted by health risk hazards, as the entire planning area is exposed. As the population changes in the City, the risk of certain diseases may increase. Higher concentrations of people using public transportation could become more vulnerable to airborne diseases. Additionally, increased development in rural areas may expose a larger portion of the population to insect-borne diseases.

Projected Changes in Population

O'ahu's healthcare system faces significant challenges due to a rapidly aging population and the escalating impacts of climate change. Projections indicate that by 2035, one in four Hawai'i residents will be aged 65 or older, necessitating substantial enhancements in healthcare infrastructure and services to meet the complex needs of this demographic. Additionally,

As climate change drives more frequent and severe disasters across the Pacific Islands, Hawai'i is poised to become an increasingly important destination for climate migrants—particularly from countries and territories already experiencing rising sea levels and resource loss. This influx of people, while grounded in shared regional responsibility and humanitarian concern, may also strain Hawai'i's already limited housing and healthcare infrastructure. Increased human movement raises the risk of communicable disease transmission, particularly when combined with crowded living conditions and inadequate access to health services. Hawai'i's proximity and cultural ties to Pacific nations make it a natural hub for environmental migrants, yet the state must prepare to manage the public health implications of these migrations. Without adequate planning and investment, the convergence of population shifts, and disease vulnerabilities could pose serious challenges to community resilience and health equity.

Climate Change

Climate change introduces or exacerbates the health risks that face O'ahu. The Hawaii Department of Health emphasizes the importance of developing a robust Climate Change & Health Program to address climate change impacts on these health risks challenges effectively. To safeguard public health and ensure resilience against



future health hazards, including potential pandemics and climate-related health problems, strategic investments in healthcare infrastructure, workforce development, and emergency preparedness are imperative (DBEDT).

LOCATION

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 (U.S. Global Change Research Program 2016). A changing climate may also create conditions favorable for invasive mosquitoes on O‘ahu. Research into modeling vector-borne diseases and climate change has shown an accelerating invasion potential of the *Aedes aegypti* mosquito and subsequent potential spread of related illnesses (Iwamura, et al. 2020). In addition, infectious agents 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 (HI-EMA 2023). More flooding will also expose more people to waterborne infectious diseases such as leptospirosis.

SEVERITY

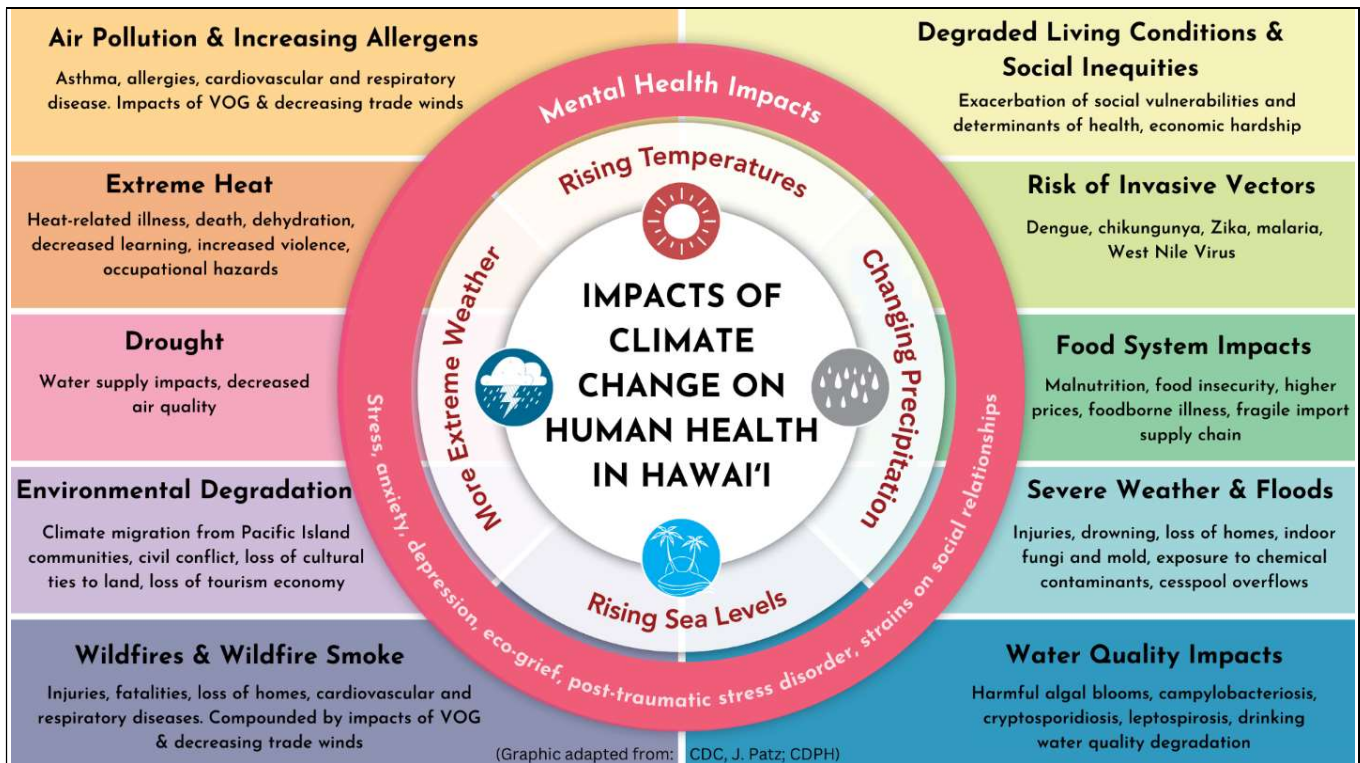
Future climate change is expected to exacerbate health risks in several ways. Over half of known infectious diseases can be aggravated by climate change, with changes in temperature and precipitation influencing the seasonality, distribution, and prevalence of vector-borne diseases. Conditions may become more favorable for invasive mosquitoes in the City, increasing the potential spread of illnesses such as dengue fever, chikungunya, and Zika. Additionally, more frequent flooding can spread infectious agents and chemical toxins in water, creating habitats for mosquito reproduction and exposing more people to waterborne diseases like leptospirosis. Extreme heat events, which are increasing in frequency and duration, pose serious health risks, including the potential for heat-related illnesses and death.

FREQUENCY

Extreme heat events are increasing in frequency and duration. When extreme heat persists for more than two days, the population is more likely to experience serious health risks or even death, see Figure 12-1



Figure 12-1. Climate Change Impacts on Human Health



Source: HDOH 2024