



Hurricanes and Health

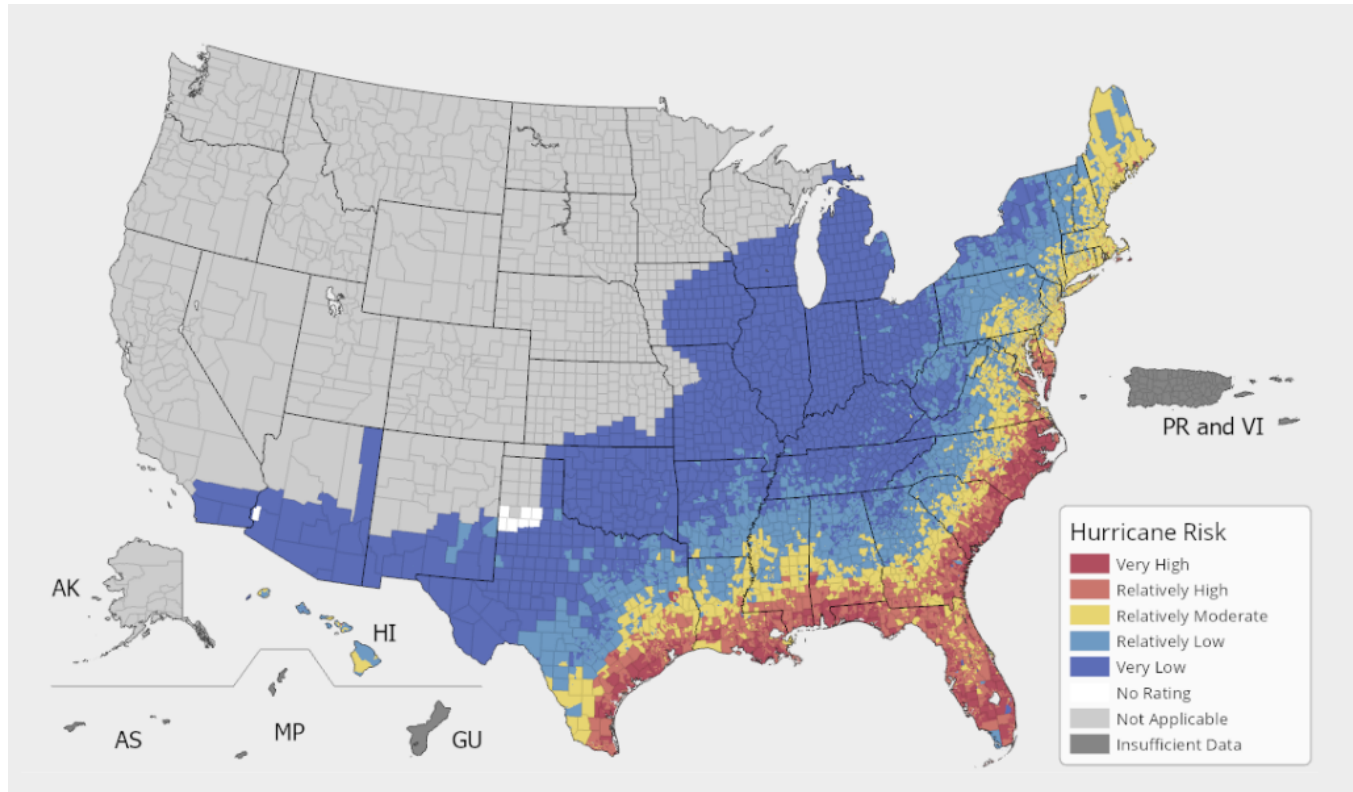
For Providers

This sheet is an overview on hurricanes providing background of how hurricanes impact health and how providers can help patients prepare.

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Hurricanes and climate change

Hurricanes – intense low-pressure tropical storms producing destructive wind speeds and heavy rain – have far-reaching effects on health, especially for individuals with chronic medical conditions. The likelihood of hurricanes making landfall in the United States is illustrated in the map below.



Map of relative hurricane risk in the United States. Courtesy of FEMA, June 2024. You can determine your local National Risk Index here: <https://hazards.fema.gov/nri/map>

Climate change warms the oceans, and hurricane strength comes from ocean heat. Climate models project more intense hurricanes and associated coastal flooding and wind damage in this century.¹ Hurricanes are also becoming wetter, with increased intensity, and less forewarning.² Trends show that hurricane peak intensity has been occurring closer to shore and their tracks have been moving north, putting more northern areas, which may be less familiar with or prepared for hurricanes, at greater risk from hurricane strikes.^{3,4}

Health impacts of hurricanes

Hurricanes directly affect health through strong winds, heavy rains, freshwater flooding, and storm surge, all of which can cause injuries. Hurricane-related flooding is a major hazard. The primary direct health impact from flooding is drowning, accounting for up to 75% of mortality after floods.⁵

Patient Case

You see one of your regular patients in clinic for their annual visit and they mention that they have started stocking up for hurricane season, because with their aging knees, it has been increasingly hard for them to get out and about in the aftermath of the storms that frequently affect your region. You ask them where they live, and they report that they live in a beachfront house but are not particularly worried because they have always been fine in previous storms. They are on multiple medications that require refrigeration, including insulin and a new antibody treatment. They do not have any back up power supply currently.

What would you tell them about how hurricanes are changing as a result of climate change, and what steps would you suggest they take to stay safe during future storms? What should they do with their medications if the power goes out?

Hurricanes and associated high winds and flooding can disrupt essential services, including power, water, and healthcare access. Indirect health harm can result from harmful effects on infrastructure, housing, and healthcare, including limited or nonexistent access to prescription medications and regularly scheduled healthcare services. Hurricanes can increase immediate morbidity and mortality for individuals with a variety of medical conditions and can affect perinatal outcomes.

- **Respiratory disease** related mortality has been found to increase 8.3% one month after hurricanes.⁶
- **Cardiovascular disease** hospitalizations doubled in older patients up to 1 year after Hurricane Sandy. Myocardial infarctions and strokes were 22%⁷ and 7% higher, respectively, in areas more severely affected by the storm.⁸ Additionally, negative impacts on cardiovascular disease have been observed for years after hurricanes, including after Hurricanes Sandy and Katrina.^{9,10}
- **Type II diabetes** related emergency room visits increased 84% during the week of Hurricane Sandy.¹¹ Increased diabetic morbidity after hurricanes may result from lack of access to medications and healthy foods.¹²
- **Infectious and parasitic diseases** increase after hurricanes, leading to increases in hospitalizations.¹³
- **Mental health and neuropsychiatric disorders** have both been shown to increase following hurricanes. In one study, hospitalizations for neuropsychiatric disorders transiently decreased, then subsequently increased starting a week after the hurricane.^{13,14}
- **Chronic kidney disease** patients on dialysis have elevated mortality after hurricanes and may be more likely to need emergency department care, be hospitalized, and receive dialysis during hospitalization.^{15,16} Risks to renal patients may result from lack of access to dialysis, concurrent heat wave exposure and associated health risks, infectious diseases, or direct trauma from the storm.¹⁵
- **Traumatic injuries**, both intentional and unintentional, are more likely after hurricanes.^{11, 44}
- **Pregnant people** exposed to hurricanes were more likely to experience **preterm** birth, likely secondary to stress on the mother from the event.^{13, 16}

Although there are many immediate health risks from hurricanes, there is growing evidence of long-term impacts from hurricanes, which may be related to interruptions in critical utilities and job and housing insecurity after these events.²⁰

Populations at greater risk for harm after hurricanes

Studies have shown that hurricane related excess deaths can vary substantially by location, likely at least in part because of demographic factors and social inequities.²¹

Population	Risk
Chronic diseases	<p>May be more likely:</p> <ul style="list-style-type: none"> to have biological exacerbations of their diseases¹³ <p>Have worsened health from:</p> <ul style="list-style-type: none"> supply chain disruptions and medication shortages difficulty accessing treatment or care power outages affecting electric medical devices²⁴
Disabilities	<p>Face barriers to:</p> <ul style="list-style-type: none"> receiving emergency communications evacuation due to inaccessible transportation options or lack of necessary mobility assistance access to evacuation shelters²⁵ <p>May be more likely to live in public housing or in higher flood risk areas.²⁶</p>
Minoritized, low-income, and socioeconomically disadvantaged communities	<p>More likely to live:</p> <ul style="list-style-type: none"> closer to industrial facilities and toxic waste sites that may release pollution after a storm²⁷ in areas with high flood risk^{22, 23}
Older adults	<p>More likely to have:</p> <ul style="list-style-type: none"> medical comorbidities limited capacity to evacuate or be resilient to a hurricane or flood, especially if they lose their homes^{28, 29}
Children	<p>More likely to:</p> <ul style="list-style-type: none"> experience post-traumatic stress and mental health problems³⁰ be at risk for asthma exacerbations³¹
Rescue workers and first responders	<p>More likely to:</p> <ul style="list-style-type: none"> sustain unintentional injuries during and after hurricane²⁴
Pregnant persons and newborns	<p>More likely to:</p> <ul style="list-style-type: none"> experience higher rates of preterm birth^{18, 19}

Immediate health risks from hurricanes

Immediate impacts of hurricanes are often due to high wind speeds and flooding. Unintentional injuries are also common during and immediately following hurricanes, as well as during rebuilding efforts.

Common unintentional injuries due to hurricanes include:

- Drowning
- Electrocutation
- Cuts, lacerations, and puncture wounds
- Falls
- Traumatic head injuries from falling debris
- Trauma from motor vehicle accidents³²

Deaths from injuries after hurricanes have been found to peak about 1 month after a storm occurs.⁶

Infectious diseases associated with flooding

Hurricanes can cause widespread freshwater flooding and, in some cases, saltwater flooding due to storm surges. Flooding has been found to increase risks of infections, including vector, rodent and waterborne diseases, as well as illnesses associated with exposure to fungi. Infectious disease risk after hurricanes appears to peak 2 months after the event, but infections can be seen in the days after a storm occurs.⁶

Timing of post-flood infectious diseases in the United States

Early (<10 d after event)

- Cellulitis, including from *Vibrios*
- Pneumonias (may be aspiration related and polymicrobial)
- Viral respiratory infections
- Gastroenteritis (SSYCE, *Vibrios*, viruses)

Late (>10 d after event)

- Mosquito-borne illnesses
- Skin infection from atypical organisms (fungi, mycobacteria, mold)
- Hepatitis A or E

Adapted from Paterson et al. Clin Inf Dis. doi:10.1093/cid/ciy227 and Ivers and Ryan. Curr Op Inf Dis. doi:10.1097/01.qco.0000244044.85393.9e.

Floods have been commonly associated with outbreaks of waterborne diseases, including from bacterial and viral pathogens.³³ Individuals who obtain water from private wells may be at particularly high risk, but even public water systems can be contaminated during extreme storms.³⁴

Standing water may create breeding grounds for disease-carrying mosquitoes³⁵ and fungal growth. Flooded homes are much more likely to have higher levels of molds, such as *Aspergillus*, *Penicillium*, and *Cladosporium*.³⁶ Patients with allergic disorders may be more likely to develop symptoms from mold exposures.³⁷ Fungal infections are less common, but immunocompromised individuals have developed respiratory fungal infections after flood induced mold exposures.³⁷

Population displacement that occurs after hurricanes and floods can result in overcrowded homes and shelters, sometimes with inadequate sanitation. These conditions can result in the spread of many different infections, especially those transmitted by respiratory or fecal-oral routes.³

Toxic exposures

Hurricanes have caused large releases of toxic industrial, wastewater, and agricultural substances into the environment. Which toxins may be most prevalent in a community after a flood may reflect what is stored in local toxic substance impoundments. The EPA tracks sites in your community that may contain hazardous substances which can be mobilized by flooding [here](#).

Hurricanes Katrina and Harvey damaged fossil fuel processing and storage facilities, which released hydrocarbons (known to cause respiratory irritation and arrhythmias), volatile organic compounds (which can be carcinogenic), and heavy metals, such as lead, into air, water, and soil. Hurricane Florence breached a coal ash pit in North Carolina.

Coal ash is a byproduct of coal combustion and coal ash pits are present across the country. Coal fly ash contains volatile organic compounds and heavy metals, including mercury, arsenic and/or chromium.

Infrastructure failures can cause additional unique and harmful exposures. Gasoline shortages after Hurricane Sandy led to increased gastrointestinal and pulmonary symptoms due to gasoline-siphoning related exposures.³⁸ Acute intoxication from gasoline fumes can cause confusion, giddiness, nausea, headache, blurred vision, dizziness, and weakness. Severe exposure can result in respiratory depression, seizures, loss of consciousness, and coma.

Carbon monoxide poisonings often increase after disasters, most often from indoor or inadequately ventilated electrical generator use combined with absent or non-functional carbon monoxide monitors.³⁹ Patients may also attempt to cook or heat their homes by burning fuels, such as wood or propane, indoors, or to run their vehicle for air conditioning in an enclosed garage, which can also lead to carbon monoxide poisoning.

Mental health concerns associated with hurricanes

Increases in PTSD, depression, and anxiety symptoms have been documented after hurricanes.²⁴ Prevalence of diagnoses after hurricanes vary with the intensity of the storm. A meta-analysis of tropical cyclone survivors globally found ~18% had PTSD with more severe storms.⁴⁰ Need for psychiatric care can extend for prolonged periods after hurricanes make landfall. Reports of psychiatric concerns were elevated for years following Hurricanes Sandy and Katrina.⁴¹⁻⁴³

Children, females, and older individuals may be most at risk of mental health symptoms after hurricanes.⁴⁴ Individuals in certain occupations, such as farm workers and first responders (e.g., emergency medical personnel, police officers, and fire fighters), may also be at higher risk. Mental health symptoms after exposure to a hurricane have also been found to be associated with lack of necessities, including medications and access to medical care as discussed above, personal physical exposure to hurricane forces (e.g., wind, rain, storm surge), evacuation, loss of a loved one or pet, repeat exposure to hurricanes, existing mental health disorders or recent personal adversity.⁴⁵⁻⁴⁷

Disruption of health-systems infrastructure and displacement

Hurricanes often impede healthcare delivery as they can damage healthcare facilities, cut off essential utilities, disrupt supply chains, and inundate roads. Patients who are displaced by storms may be unable to refill medications, and lack of access to medications after hurricanes and floods has been associated with increased morbidity.^{32,48}

Patients with chronic conditions, including diabetes and cancer, may delay necessary healthcare services because of healthcare facility closure, difficulty with transportation, or competing demands on time,²⁸ and may have worse outcomes as a result.³¹

Hurricane action plans for patients

We recommend that you familiarize yourself with the **Hurricane Action Plan and Tip Sheet** provided in the toolkit and review it with any patient at risk of experiencing a hurricane. The action plan can be provided during care visits with adolescents and adults and can be the basis for a discussion around safety planning and care management in the event of a hurricane. Action plans should be completed before hurricane season in your locale.

Anticipatory guidance for providers to give to patients

Anticipatory guidance for hurricanes may contribute to improved health outcomes. The strategies and resources below may be helpful for you to provide to patients who are at risk from hurricanes and reflect the **Hurricane Action Plan and Tip Sheet** available in the toolkit.

At the start of hurricane season

Review this document to understand health risks and high-risk conditions associated with hurricanes and subsequent flooding. If you can, create lists of patients who are at higher risk during hurricanes, such as those with electricity dependent medical conditions or mobility impairment and other high-risk groups. Your whole healthcare team can help with this task and proactively reach out to higher risk patients to create Hurricane Action Plans. Also review local emergency service guidelines and resources to share with patients.

Before a hurricane

Forecasts

Baseline and future flooding risk for many properties in the United States can be found at [riskfactor.com](https://www.riskfactor.com). Hurricane forecasts are available from several outlets including the [National Hurricane Center](https://www.nhc.noaa.gov).

A “hurricane watch” indicates that hurricane conditions (winds greater than 74 mph) are possible. A “hurricane warning” indicates that hurricane conditions are expected. Hurricane warnings are given 36 hours prior to the expected hurricane impact to give residents time to prepare or evacuate. Understand forecasts and share how to understand with patients.

Reduce health risks from hurricanes

We encourage you to provide patients with the patient handout available in this toolkit (**Hurricane Action Plan and Tip Sheet**). Pay particular attention to your higher risk patients.

In addition, [hurricane](#) and [flood](#) preparedness guidance is available from CDC and FEMA in multiple languages. CDC also has an infographic for [hurricane](#) preparedness and for [keeping safe after hurricanes](#).

During a hurricane

Evacuation

Evacuation may be the best choice when hurricanes are expected near a patient's home. Patients can be encouraged to pay attention to local media outlets for evacuation orders (i.e., through newscasts, social media, or automated alerts on a smartphone).

Responsiveness to evacuation alerts has been found to vary by age, gender, and other factors. Men and full-time residents may be more likely to want to stay and protect their property, whereas homes with children, elderly individuals, pregnant women, individuals with health concerns, or part-time residents are more likely to evacuate early.³⁸

Providers can ask whether a patient would be willing to evacuate when asked to do so. For those individuals who are unwilling to evacuate, especially for individuals with chronic medical conditions or who rely on electronic devices such as ventilators, reviewing the risks from hurricanes and floods may be helpful in motivating and enabling evacuation to safety when necessary. Be sure to talk about risks associated with flooding, and the importance of never walking or driving through floodwaters.

If a high-risk patient will not have the needed assistance to evacuate, a provider can ask permission to share the patient's contact information with local emergency managers.

Extensive, multilingual [guidance on evacuation planning](#) is available from FEMA.

After a hurricane

Short-term

If patients have evacuated, they should only return home when authorities say it is safe.

There can be substantial dangers associated with returning home, including exposure to floodwaters, which can lead to infectious diseases and toxic exposures as described above. In addition, there can be similar toxic exposures when cleaning up after a flood, particularly because of mold. Debris from hurricanes can also be dangerous and lead to traumatic injuries. Counsel patients on NOT using electrical equipment in water as it could lead to electrocution. Additionally, counsel on using generators only outdoors or in well-ventilated spaces to avoid carbon monoxide exposure.

Patients with respiratory conditions like asthma or other immunological conditions or immune suppression should be particularly careful with toxic, mold, and infectious exposures during cleanup.

Long-term resilience and recovery

Consider speaking with your patients about long term plans to improve their resilience to future hurricanes. This can include how and where to build their home and what types of building materials may be more able to withstand hurricane winds. It can also include ensuring backup power sources and creating plans for critical utility interruptions.

There may be available local resources to help with long-term resilience that can be shared, or there are federal resources such as FEMA's flooding risk map available here: <https://www.fema.gov/flood-maps/tools-resources/risk-map> that help make you aware of risks in the community to promote informed development or the National Flood Insurance Program to reduce the long term impacts of floods.

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