UC San Diego Health

Clinician Information Sheet:

Health Impacts of Floods

RESOURCES FOR PATIENTS	
Americares	• Health Tipsheet • Flood Action Plan
Cal Department of Food and Agriculture	• Flood Recovery Resources
CDC	• Floods Advisory Page • Tips for How You Can Protect Yourself
Ready.gov	• Flood Disaster Preparedness
Red Cross	• Flood Safety Checklist
San Diego County	• Flood Preparedness and Recovery

RESOURCES FOR PHYSICIANS	
Americares	• Americares Toolkit for Floods
CDC	• CDC Flood Guidelines and Disaster Info • CDC Clinician Outreach and Communication Activity
California Dept of Water Resources	• Flood Preparedness Week 2024

I. BRIEF BACKGROUND

Climate change is changing global precipitation patterns, leading to more frequent and intense storms and floods. Certain regions are already witnessing heightened rainfall averages, along with increased occurrences of severe rainstorms and blizzards. The surplus precipitation, ranging from urban flooding to indoor mold and mudslides, adversely affects health. Despite California currently facing historic droughts, climate change is contributing to heightened rainfall, storms, and flooding in specific regions. Scientists estimate that California will experience a 30% increase in extreme precipitation (rain or snow) days by the end of the century due to increasingly frequent "atmospheric rivers" that reach the state.[1] The increased frequency and higher volume of precipitation in southern California inevitably leads to more flooding and ensuing health effects.

II. HEALTH IMPACTS OF FLOODS

Infectious diseases are the most commonly cited healthcare issue associated with flooding. Flooding has been directly linked to increased risks of infections encompassing vector, rodent, waterborne, and fungal diseases. The risk of infectious diseases following hurricanes and floods seems to reach its peak approximately two months after the event, although infections can also be observed in the days immediately following a storm.[2]

Risk Factors Associated with Flooding

Immediate health risks from flooding[2]:

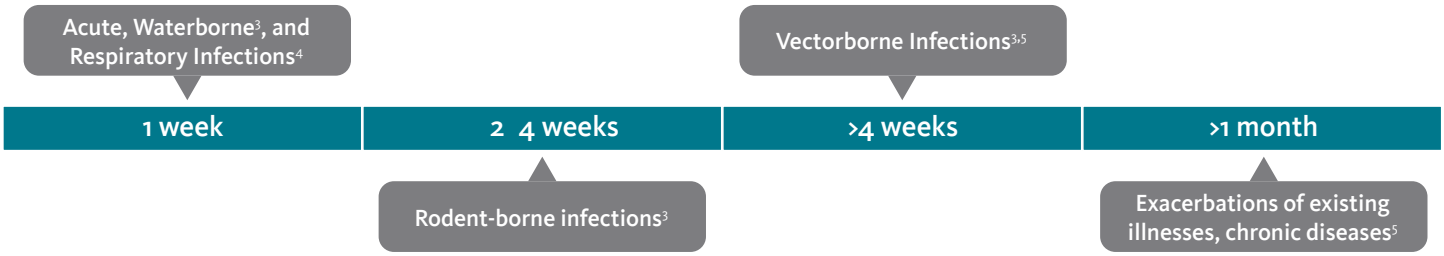
- Drowning
- Electrocution
- Cuts, lacerations, and puncture wounds
- Falls
- Trauma from motor vehicle accidents
- Exposure to mold overgrowth
- Exposure to chemicals, and other environmental contaminants

Flood Specific Vulnerable Populations[1,3]:

- Elderly
  - Living alone, limited mobility, limited transportation
- Children
  - More susceptible to injury and exposure to contaminated water sources
- Immunocompromised
  - At increased risk to Vectorborne, rodent-borne, and waterborne diseases
- Low Income/Minority Neighborhoods
  - More vulnerable infrastructure and housing to damage or mold growth
  - Fewer resources available/Greater barriers to healthcare
- Dialysis Patients
  - Impaired access to treatment

III. TIMELINE OF ILLNESSES AFTER FLOODING

Less than 10 days after flood event[3,4,5]	10 Days after flood event[3,4,5]
• Cellulitis, including from Vibrio	• Mosquito-borne illnesses
• Pneumonias	• Skin infection from atypical organisms including fungi, mycobacteria
• Viral respiratory infections	• Hepatitis A or E
• Gastroenteritis (Viral, Bacterial)	• Mental Health Disorders



IV. COMMON INFECTIONS AS A RESULT OF FLOODS

Cutaneous Infections	Examples of common pathogens include: S aureus, S pyogenes: • Cases of cellulitis have been shown to peak 3–4 days after a flooding event[3] MRSA: • Cellulitis with purulent wound drainage Vibrio species: • V vulnificus and parahaemolyticus[3,4] • High risk of morbidity with patients with chronic diseases such as liver disease and immunosuppression
Gastrointestinal Diseases	Examples of common pathogens include: V. cholerae: • Voluminous watery diarrhea • Hypotension • Dehydration Enterotoxigenic E. coli (ETEC) • Watery diarrhea • Abdominal cramping, Nausea, possibly vomiting • Fever • Decreased appetite
Respiratory Infections	• Immersion, near drowning, or aspiration, can lead to inoculation of the lower respiratory tract. • Frequently polymicrobial; complications: necrosis, abscess formation, and empyema

V. RISKS TO VULNERABLE POPULATIONS

Floods and Pregnancy

- Pregnant women and those with newborns requiring specialized medical care, including prenatal check-ups and postnatal care.
- Unstable living conditions, exposure to contaminated water, and the lack of appropriate maternal and neonatal care can pose significant risks to the health of both mothers and infants.[7]
- **The prevalence of low birth weight increases after flooding.**[8]
- Stress, infections, and limited access to medical care during floods can contribute to an increased risk of preterm birth.

Relevant Links for Flooding and Pregnancy

» Perinatal Care Network

Floods and Mental Health

- Individuals with mental health disorders may experience heightened anxiety, stress, and trauma during and after floods.
- Evacuation and displacement can exacerbate existing mental health issues. Disaster linked to poorer mental health outcomes.
- Disruptions in routine care, access to mental health professionals, and the lack of privacy in emergency shelters can further impact the well-being of this population.

Relevant Links for Flooding and Mental Health

» Cal Hope Connect – Confidential Peer Support

» Helping Survivors Cope with Grief After a Disaster or Traumatic Event

Floods and Patients with Chronic Renal Disease

- **Floods can lead to the closure or inaccessibility of dialysis centers, disrupting the regular treatment schedule for chronic renal patients, resulting in increased risk of life-threatening complications.**
- Flood-related disruptions limits access to clean water.
- Floodwaters can harbor contaminants and pathogens that pose a heightened risk of infections for individuals with compromised immune systems.
- Chronic renal patients often require specialized transportation and facilities for dialysis treatments, making evacuation logistics more complex.

Relevant Links for Floods and Patients with Chronic Renal Disease

» Dialysis Patient and Disaster Planning

» Kidney Community Emergency Diet Plan

Floods and Patients with Chronic Respiratory Disease

- Floods can exacerbate respiratory conditions, such as asthma or chronic obstructive pulmonary disease (COPD), due to increased mold, dust, and airborne pollutants.
- Evacuation and displacement during floods can disrupt the supply chain, making it difficult for chronic respiratory patients to access essential medications.
- Power outages and infrastructure damage can interrupt the supply of oxygen to patients who rely on oxygen therapy at home.
- Floodwaters can infiltrate homes and buildings, causing indoor air quality to deteriorate, especially in areas with accumulated moisture.

Relevant Links for Floods and Patients with Chronic Respiratory Disease

» Lung HelpLine at 1-800-586-4872

» Keeping Your Lungs Safe During Flood

Floods and Child and Adolescent Health

- Children are more likely to come into contact with contaminated floodwaters, exposing them to a higher risk of waterborne diseases.
- **Children may experience trauma, anxiety, and emotional distress during floods, impacting their mental health.**
- **Children will have increased vulnerability to malnutrition.** The limited access to food, disruptions in the availability of nutritious meals, and potential food shortages can increase the risk of malnutrition.
- An analysis of flood-related fatalities across the United States unveiled that a **significant portion of deaths resulted from flash floods, with a notable vulnerability observed among young adults aged 10 to 19 years.**[9]

Relevant Links for Floods and Child and Adolescent Health

» SAMHSA Children and Disaster

» CDC Caring for Children during a disaster

» National Child Traumatic Stress Network

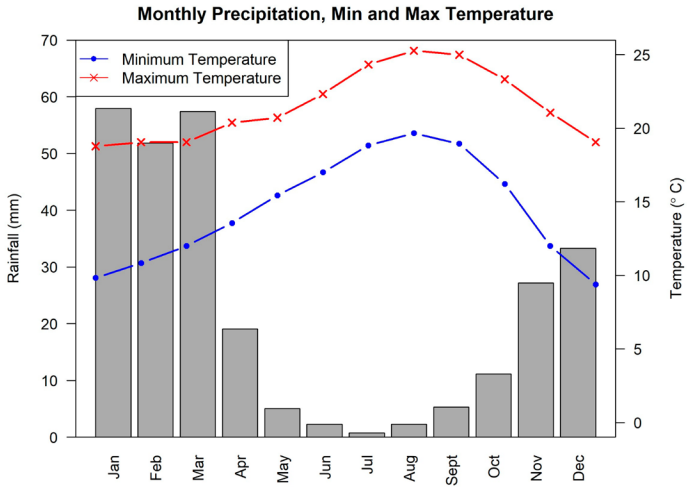
Microplastics, flooding, and effects on health

- Plastics do not easily biodegrade but they erode into micro- and nano-plastics that persist in the environment and have been found to be ubiquitous in nature.
- Individuals encounter tens of thousands to millions of microplastics annually, translating to several milligrams per day.[13]
- Flooding significantly alters the distribution, abundance, size, and types of microplastics in a local environment.
- Microplastics in rivers may return to land during flooding events.
- **Exposure to microplastics induces oxidative stress, metabolic disorders, immune responses, neurotoxicity, as well as reproductive and developmental toxicity.[14,15,16] It has recently been shown to be associated with cardiovascular events as well.[17]**

VI: CASE STUDY, SAN DIEGO AND FLOODS

California is vulnerable to climate change, and extreme weather events from climate change are interconnected. Wildfires, for example, increase risk of flooding due to destruction of watershed trees and shrubbery that normally hold onto rainwater or melted snow.[10] One in five Californians live in a high risk flood zone.[11]

Figure 1: Average monthly rainfall in San Diego between 1985–2017[12]



Historically, heaviest rainfall periods and highest risk of flooding occur around November through March for the San Diego region. The recent flooding in San Diego due to record rainfall has been facilitated by atmospheric rivers. These aerial rivers, spanning hundreds of miles, transport humid air from the tropics to the US. According to UCLA climate scientist Daniel Swain, the intensification of events like this is facilitated by climate change, as a warmer atmosphere holds increased moisture. Swain explained to USA TODAY that this phenomenon makes storms at least 10% wetter than they would be under normal conditions. The San Diego Regional Climate Collaborative and other entities have cautioned that heightened temperatures, even amid prolonged and more severe drought periods, increase the likelihood of experiencing extreme rainfall events.

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