

Infectious Diseases After Hydrologic Disasters

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KEYWORDS

- Flood • Hurricane • Tsunami • Infectious diseases • Soft tissue infections
- Respiratory infections • Gastrointestinal infections • Vector-borne diseases

KEY POINTS

- Skin and soft tissue infections following a hydrologic disaster can arise in the setting of traumatic injury and exposure to contaminated water.
- Gastrointestinal and respiratory infections are common among displaced populations, and are shaped by living conditions, access to clean water, and pre-existing endemic diseases.
- Leptospirosis is a zoonotic infection that has been associated with severe floods and population displacement.
- Vector-borne diseases can be influenced by hydrologic disasters; outbreaks are often multifactorial in nature.
- Disaster responders can reduce their risk of illness due to infectious diseases through careful planning, preparation, and preventive measures.

INTRODUCTION

Natural disasters are defined as disturbances in the ecosystem that impede a native community's ability to adapt, often requiring external interventions for survival.¹ They can arise from hydrologic, atmospheric, or geologic events.² Hydrologic events include hurricanes, tsunamis, and storm surges, as well as excessive rainfall, floods, and even drought. Recent hydrologic disasters such as hurricanes Harvey, Irma, and Maria in the latter half of 2017 are poignant reminders of the power and destruction these events can unleash. When hydrologic disasters occur, concerns about the threat of infectious diseases associated with human remains often arise.^{2,3} However, endemic infectious diseases affecting vulnerable and displaced populations pose the greatest

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risk to human health, particularly in resource-poor settings.²⁻⁵ This article discusses general principles of infectious diseases following a hydrologic disaster. Next, it focuses on skin and soft tissue infections, gastrointestinal infections, respiratory infections, and zoonotic and vector-borne infectious diseases commonly encountered among survivors. Finally, it provides personal safety guidance for emergency physicians and other disaster responders providing care after a hydrologic disaster.

PRINCIPLES OF INFECTIOUS DISEASE AFTER HYDROLOGIC DISASTERS

The risk for infectious diseases following a hydrologic disaster can be contextualized using the classic epidemiologic triad or triangle, comprised of an external agent (microorganism), a susceptible host, and an environment that brings the host and agent together. In most instances, agents responsible for infections are ones that existed naturally in the affected region prior to the disaster, albeit with varying levels of contribution to human disease.³ For this reason, it is possible to generate a rational differential diagnosis of microorganisms responsible for specific infectious disease syndromes based on geography and individual exposure history. Hosts, including survivors and responders alike, are susceptible to infection through traumatic injury and exposure to contaminated environments following a hydrologic event. Poor hygiene, poor sanitation, and lack of access to clean water and uncontaminated food further increase host vulnerability to various common communicable infectious diseases.^{2,3} A hydrologic event disrupts the environment on multiple levels and can eliminate pre-existing barriers separating hosts and agents. Water sources can become contaminated with microbe-laden sewage, wastewater, and agricultural runoff.⁵ Standing water can serve as a breeding site for arthropod vectors (eg, mosquitos). Displaced human populations lacking shelter are likely to encounter contaminated water, animals, and arthropod vectors, while those in temporary shelter may be subject to infections associated with crowded living conditions.

The timeline following a natural disaster is often broken down into an impact (0–4 days), postimpact (4 days to 4 weeks), and recovery phase (after 4 weeks).³ Infections during the impact phase are likely to be associated with traumatic injuries (eg, lacerations, punctures) sustained while escaping imminent danger or performing initial clean-up and repairs after a hydrologic event. However, most acute infections including those involving wounds or related to population displacement are likely to emerge during the postimpact phase.⁶ Vector-borne diseases (eg, dengue, malaria), uncommon infections related to environmental contamination (eg, leptospirosis), and infections with longer incubation or latent periods are more apt to emerge during postimpact and into the recovery phase.^{3,6}

SKIN AND SOFT TISSUE INFECTIONS

Skin and soft tissue infections (SSTIs) are common after hydrologic disasters.⁷⁻¹⁰ Compromised skin integrity in the setting of environmental water exposure, traumatic wounds, and water-related dermatologic conditions (eg, contact dermatitis, immersion foot) provide skin and waterborne pathogens an avenue for infecting underlying soft tissue. Gram-positive organisms including *Staphylococcus aureus* and *Streptococcus* species are typical bacterial pathogens associated with these infections, which may be exacerbated in crowded living conditions. During Hurricane Katrina in 2005, a cluster of methicillin-resistant *S aureus* (MRSA) SSTIs involving adults and children occurred at an evacuee facility in Dallas, Texas.¹¹ Empiric antibiotic therapy directed against these common pathogens, paired with incision and drainage of

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