


The Environmental Health and Emergency Preparedness Impacts of Hurricane Katrina

 See also Kim-Farley, p. 1448, and the *AJPH* Hurricane Katrina 15 Years After section, pp. 1460–1503.

Fifteen years ago, Hurricane Katrina made landfall as a powerful category 3 storm in southeast Louisiana, bringing record storm surges exceeding 27 feet in Mississippi and approaching 20 feet in New Orleans, Louisiana. The surge into Lake Pontchartrain battered the city's outflow canals, leading to failure and the eventual technological disaster that poured over New Orleans. We reflect on Katrina's impacts on environmental public health and the emergency preparedness landscape.

Katrina's effects on environmental health from a chemical and heavy metal perspective were substantial. Storms of this magnitude coupled with floodwater inundation reveal how complex the sources and types of chemical and elemental hazards can be, hazards that include pollutants mobilized from hazardous waste sites, oil spills, and formaldehyde off-gassing in temporary housing units.¹

Adverse respiratory outcomes associated with both acute and chronic exposures to particulate matter, including biological and chemical hazards, were prevalent in Katrina disaster victims, first responders, and the workforce, including transient volunteers, who are typically involved in

remediation, demolition, and cleanup of affected residential and industrial areas.² Noise exposure and heat stress associated with heavy equipment use and physical labor during summer months in hurricane-prone regions are consistent sources of disaster-related injury.

Care must be taken in assigning many health effects to the myriad environmental exposures caused by Katrina. Duration and frequency of exposures must be considered in addition to the levels or concentrations of the pollutants. Because proper and accurate exposure assessments were and continue to be poorly documented before and after disasters, it remains a public health challenge to clearly associate exposures with particular chemicals or toxins with adverse health outcomes.

Significant effects on microbial water quality and increased risks associated with exposure to pathogens in contaminated urban floodwaters are challenges induced by hurricanes and other severe weather disasters. Decreased population and increased use of low-flow plumbing devices following Katrina led to less water being consumed and a proliferation of opportunistic

pathogens, including *Naegleria fowleri*,³ in the drinking water systems of St. Bernard Parish, part of the Greater New Orleans region. Four of 16 water distribution system samples collected by the Centers for Disease Control in 2013 tested positive for *N. fowleri*. Contributing factors included no detectable total chlorine residual and a water temperature greater than 30 degrees centigrade at three of the four positive sampling locations,³ indicating opportunistic environments for pathogens of concern years after Katrina.

Excessive standing floodwaters, flooded swimming pools, and warmer temperatures after Katrina provided optimal conditions for mosquito larvae, including the vector of West Nile virus; cases of West Nile fever nearly doubled compared with previous years but have since stabilized to average ranges.⁴ The crowding of infected and

susceptible hosts, interruptions of ongoing control programs, and a weakened public health infrastructure further increased risk factors for the transmission of vector-borne diseases.

Katrina's impact initiated significant changes in emergency preparedness. Practitioners in coastal jurisdictions were forced to rethink prestorm evacuation strategies for people with and without individual means to do so and to consider rostering individuals with access and functional needs. Coordination, collaboration, and communication across multiple sectors and stakeholders needed strengthening to assist with a more robust common operating picture, threat visibility, and situational awareness of the disaster from an emergency operations center perspective—all of which were provided as local and state areas of improvement after Katrina.

Foundational to preparedness is identifying hazards or threats facing a jurisdiction, especially those posing the greatest risk. However, viewing these threats and hazards—such as those identified during and after Katrina—through an environmental and public health lens is often less common. Complex exposure risks caused by Katrina became a focal point for local and state public health officials during

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and following the storm. Questions related to exposure, toxicity, and risk were consistently posed to, and by, local health officials throughout the response to and recovery from Katrina.⁵

The current Threat and Hazard Identification Risk Assessment, conceptualized in 2012, is an example of a structured methodology formalized after Katrina; this assessment standardizes the process used by state, local, tribal, and territorial authorities to effectively address area-specific risks. The preparedness capabilities and gaps for each of these risks are aligned to one or more of the five core mission areas of the national preparedness goal: prevention, protection, mitigation, response, and recovery. Further specificity is accomplished by aligning these areas to the 32 core capabilities, which provides jurisdictions a roadmap on how to optimize capabilities and bridge gaps.

Although the Threat and Hazard Identification Risk Assessment process often remains generically public safety-centric, it continues to show hurricanes as a prioritized natural hazard in areas close to the Atlantic Hurricane Basin. Risk assessments associated with environmental exposure, including associated risk communications, may not be adequately incorporated into Threat and Hazard Identification Risk Assessments; this is evidenced by hurricanes Sandy, Harvey, and Florence, which all had complex environmental health concerns similar to Katrina's. Examples of such complexities include environmental health threats, such as oil spills and other mobilized pollutants from an industrial, agricultural, or previously contaminated site; many of these remain extremely vulnerable to climate change, presenting significant future challenges to local jurisdictions.

Of the 1571 nonfederal sites on the National Priorities List, 713 are currently located in areas with 1% or higher annual chance of flooding and 187 are at risk for major hurricane-related storm surges.⁶ Exposure risk posed by the combination of an active hurricane season, congregate evacuation-related sheltering strategies, and COVID-19 adds further complexity to hurricane threats. Despite the increasing frequency of major hurricanes and large preparedness advancements made explicitly in emergency management and the public health sector (which serves as colead for Emergency Support Function 8 in the National Response Framework in support of the national preparedness goal⁷), experts in exposure assessment or applied environmental health are not commonly integrated into state, local, tribal, and territorial comprehensive planning processes or teams.

Emergency Support Function 8 extensively engages in preparedness—this cannot be denied or argued—and the reality of experiencing a complex environmental health disaster can result in advanced Emergency Support Function 8 integration. In post-Katrina New Orleans, significant efforts related to integrating public health into overall public safety have occurred as a result of the experiences the Gulf Coast has endured. We argue, however, that nationwide gaps continue to persist in comprehensively integrating environmental and public health expertise into the preparedness system, including the Threat and Hazard Identification Risk Assessment process. A literacy gap persists on both sides between the disciplines of environmental and public health and that of emergency management. The disciplines should no longer be ships

passing in the night, but rather the same ship advancing preparedness, response, and resilience.

The 2019 Pandemic and All-Hazards Preparedness and Advancing Innovation Act is a step in the right direction and explicitly suggests integrating environmental health into situational awareness and bio-surveillance, strengthening response to environmental hazards, advancing the consultation of environmental health agencies during crises, and infusing environmental health as major expertise in zoonotic disease transmission and investigation. In a time of elevated, complex threats, state, local, tribal, and territorial actions should expand to include the identification of environmental health experts, researchers, and practitioners and their integration into task forces or strike teams to bolster preparedness, incident management, and situational awareness. Policy supports this; however, successful implementation, challenges, and barriers remain unknown. **AJPH**

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M. J. Wilson led the writing. S. A. Murphy led the revision. All authors contributed equally to this editorial.

CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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