Major Hurricanes: Potential Health and Medical Implications

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This ASPR TRACIE resource was developed to provide a short overview of the potential health and medical response and recovery needs facing hurricane- and severe storm-affected areas, based on experience and lessons learned from Hurricanes Katrina, Sandy, Harvey, Maria, Ian, Helene, and others.

The list of considerations is not exhaustive but does reflect an environmental scan of publications and resources available on past storm response and anecdotal information from first responders who were on scene. The intent of the document is to aid the "ESF-8 Family" in thinking through the different potential problems that may present as Requests for Assistance and unmet needs. Our hope is that this document can aid readers in anticipating some of these potential issues to either avoid them or be ready to respond as needed. Those faced with leading the response and recovery from a hurricane may use this document as a reference, while simultaneously focusing on the actual assessments and issues specific to their communities and the unmet needs as they develop.

ASPR TRACIE has published several related resources (including the Natural Disasters, Hazard Vulnerability/Risk Assessment, and Healthcare Facility Evacuation/Sheltering Topic Collections and the Utility Failures in Health Care Toolkit) which are all available on their Hurricane Resources Page.

Potential Considerations

Potential considerations are listed under four headings, based on phases of mitigation/ preparedness/response/recovery: overarching considerations (these apply throughout the duration of the disaster response and recovery cycle), and three time-specific categories (immediate, short- term, and long-term/recovery). Relevant informational resources are listed first, followed by potential programs or deployable assets that could be considered to support an unmet need.

Quick Links/Table of Contents

Overarching Considerations

Access and Functional Needs Population Support in Disasters

Before, during, and after a disaster, individuals with disabilities and others with access and functional needs may require additional support from the emergency management system. Ensuring preparedness, response, and recovery operations address the needs of the communities they serve can improve efficiency and outcomes. Pre-event communication as well as dedicated assessments of these at-risk groups can prevent many issues and reduce the potential for harm. Working with local agencies and using programs such as the U.S. Department of Health and Human Services emPOWER Program Platform can assist with identifying at-risk populations.

In addition, healthcare providers can play a role in combatting increases in human trafficking that may follow disasters.

For More Information:

ASPR TRACIE Resources:
Disasters and At-Risk Populations Topic Collection
Populations with Access and Functional Needs Topic Collection

Other Resources:
Cultural and Linguistic Competency for Disaster Preparedness Planning and Crisis Response (ASPR)
Planning for an Emergency: Strategies for Identifying and Engaging At-Risk Groups (CDC)
The Role of Healthcare Providers in Combatting Human Trafficking during Disasters (ASPR)

Disaster Behavioral Health Needs

Disasters can lead to significant mental and behavioral health consequences that can directly impact patients, survivors, responders, providers, and healthcare facilities and systems. The demand for disaster behavioral health services spikes immediately following impact and continues over time and includes those with exacerbation of existing issues and those with new issues.

For More Information:

ASPR TRACIE Resources:
Mental/Behavioral Health Topic Collection
Responder Safety and Health Topic Collection
Disaster Behavioral Health Resources Page
Disaster Behavioral Health: Resources at Your Fingertips

Tips for Retaining and Caring for Staff after a Disaster
Disaster Behavioral Health Self Care for Healthcare Workers Modules
Health and Social Services Recovery Lessons Learned from the 2016 Louisiana Flooding
The Exchange, Issue 4: Disaster Behavioral Health and Resilience

Other Resources:
Substance Abuse and Mental Health Services Administration Crisis Counseling Assistance and Training Program (SAMHSA)

Emergency Information and Risk Communication

As the incident evolves from warning to initial impact, then response, and into recovery, risk communication and messaging focus will shift. Communication includes providing the public with information through verbal, written, or symbolic means. Clear, concise messages provided by trusted leaders before, during, and after an incident can help residents be better informed to make important health-related decisions to help ensure their safety. Messages should be accessible in multiple languages and through multiple media.

For More Information:

ASPR TRACIE Resources:
Risk Communications/Emergency Public Information and Warning Topic Collection
Social Media in Emergency Response Topic Collection

Family Reunification and Patient Tracking

During hurricanes and mass flooding events friends and family can be separated from each other and reuniting them is a priority for healthcare facilities, health officials, and emergency managers. Establishing a coordinated approach for accessing search and rescue data, shelter rosters, and healthcare facility information is key to reuniting those affected by the disaster.

For More Information:

ASPR TRACIE Resources:
Family Reunification and Support Topic Collection
HIPAA and Disasters: What Emergency Professionals Need to Know
Patient Movement, MOCCs, and Tracking Topic Collection
The Exchange, Issue 6: Evacuating Healthcare Facilities
Tips for Healthcare Facilities: Assisting Families and Loved Ones after a Mass Casualty Incident

Health Information Management

During a disaster, patients may be separated from their "medical home" and medical records. Information technology systems may be damaged in the event and access to the systems may

be limited by physical barriers, access issues, power disruptions or other impacts. Patients being evacuated or moved from one healthcare facility to another need medical records transferred with them, but that is not always possible if the facility has experienced significant damage and paper records are damaged or missing and/or electronic records are not accessible. Redundant IT systems and back-up paper records with critical information are ways to mitigate this issue.

For More Information:

ASPR TRACIE Resources:
Communications Systems Topic Collection
Electronic Health Records and Downtime Procedures Topic Collection
Healthcare Facility Evacuation/Sheltering Topic Collection
HIPAA and Disasters: What Emergency Professionals Need to Know
Information Sharing Topic Collection
Medical Operations Coordination Centers Toolkit (Third Edition)
Patient Movement, MOCCs, and Tracking Topic Collection

Regulatory Concerns

Healthcare facilities in areas affected by hurricanes and flooding will likely be forced to operate outside their normal operating conditions. This situation could include a surge of patients requiring the healthcare facility to implement mass casualty protocols, crisis standards of care, and/or activate their emergency plans. It could also include impacts that cause the facility to be inoperable forcing evacuation, closure, or other alteration of regular operations. Some of these impacts will have regulatory repercussions at the local, State, and Federal level and may require waivers (e.g., Section 1135 waivers), executive orders, or other actions to relieve burdens and support the response strategies.

For More Information:

Healthcare-Related Disaster Legal/Regulatory/Federal Policy Topic Collection

Immediate Considerations

Extended Loss of Water and Power

If communities face extended loss of power and/or water, residents with chronic medical conditions may experience exacerbated symptoms, people can become sick from lack of water or contract waterborne illness from drinking contaminated water, food can spoil, and medications that need to be refrigerated can lose potency or be ruined. Local healthcare systems may experience those, and a host of additional secondary and tertiary effects. Healthcare facilities must have potable water and power in order to continue operations. Rapid

needs assessment of healthcare and residential care facilities and supplementation with external generators may be critical to preventing evacuation.

For More Information:

ASPR TRACIE Resources:
Continuity of Operations (COOP)/ Failure Plan Topic Collection
Durable Medical Equipment in Disasters
The Exchange, Issue 17: Health Care Facility Water and Other Utility Outages
Utility Failures in Health Care Toolkit
Utility Failures Topic Collection

Other Resources:
Drinking Water Advisory Communication Toolkit (CDC)
Planning for Power Outages: A Guide for Hospitals and Healthcare Facilities (ASPR)

Exacerbation of Chronic Medical Conditions

Any chronic medical condition can be exacerbated in a disaster due to the stress of the event, loss of physical support systems, lack of access to medications, and/or loss of access to equipment or systems needed to support daily medical care. In particular, the following patients are particularly vulnerable during hurricanes/flood events:

- Dialysis Patients
- Patients dependent on medical devices that require electricity (e.g., oxygen concentrators, ventilators, and home dialysis systems).
- Patients who are receiving hospice care.
- Patients who are receiving oncology care.
- Patients whose conditions must be continually managed by prescription medications (e.g., seizure disorders, diabetes).
- Patients with mental health diagnoses and/or alcohol or drug dependency.

Patients need access to healthcare facilities and services, chronic or maintenance medications or therapies, and access to operational medical equipment to return to their pre-disaster health conditions.

The HHS emPOWER Program provides federal data, mapping, and artificial intelligence tools, as well as training and resources, to help communities nationwide protect the health of at-risk Medicare beneficiaries, including 4.2 million individuals who live independently and rely on electricity-dependent durable medical and assistive equipment and devices, and or essential health care services. State, territorial, and certain major metropolitan areas' public health authorities receive monthly de-identified datasets. These datasets provide population-level situational awareness that enables public health authorities to conduct targeted emergency

preparedness, response, recovery, and mitigation activities to protect those that may be rapidly at-risk in the event of a prolonged power outage or other emergency. In the event of an incident, emergency, or disaster, statutorily authorized state or territorial public health authorities that meet certain requirements may submit a disclosure request for official review and approval of a minimum necessary HHS emPOWER Emergency Response Outreach Individual Dataset to support critical life-saving assistance and response outreach public health activities.

The ASPR TRACIE fact sheet Durable Medical Equipment (DME) in Disasters provides information on general DME categories and focuses on electricity-dependent DME that may be affected by disasters and emergencies, including power failures. It also includes information to assist healthcare system preparedness stakeholders plan for medically vulnerable populations who rely on DME.

The Emergency Prescription Assistance Program (EPAP) is a potential resource available for affected areas to support access to prescription medications. In addition, national pharmacy chains have mobile pharmacy units available to deploy to local communities. Rx Open, managed by Healthcare Ready helps patients find nearby open pharmacies in areas impacted by disaster. ASPR TRACIE's EPAP Overview Fact Sheet contains related information.

For More Information:

ASPR TRACIE Resources:
Considerations for Oxygen Therapy in Disasters
Dialysis Centers Topic Collection
Durable Medical Equipment in Disasters
Homecare and Hospice Topic Collection
Medical Product Shortages and Scarce Resources Resource Page
Pharmacy Topic Collection
Populations with Access and Functional Needs Topic Collection
Post-Disaster Lessons Learned: Dialysis Patient Management

Other Resources:
CMS: Reminder of Pharmacy and Provider Access during a Federal Disaster or Other State or Public Health Emergency Declarations (CMS)

Fatality Management

Hurricanes and flooding have the potential to cause mass fatalities and these weather events present challenges to death scene investigation, patient identification, decedent transport and storage, and notification of family. Fatality management resources may also be limited due to the storm.

In addition, flooding events can cause damage to cemeteries and burial locations causing disinterment.

For More Information:

ASPR TRACIE Resources:
Family Reunification and Support Topic Collection
Fatality Management Topic Collection
Mental/Behavioral Health Topic Collection
The Exchange, Issue 16: Decedent Management during Disasters

Other Resources:
Death Scene Investigation After Natural Disaster or Other Weather-Related Events (CDC)

Flood Water and Other Health Concerns

Flood water can contribute to numerous health hazards including, but not limited to:

- Contaminated drinking water
- Infectious disease outbreaks
- Air quality issues
- Disease carrying mosquitoes
- Skin disease/wound infections from contact with contaminated flood waters
- Mold

> After Hurricane Ian made landfall in Florida in 2022, the state's Department of Health recorded 38 cases and 11 vibriosis-related deaths, "representing a 1,100% increase over the 5-year median."

Public health surveillance will be required to test the water and air, and monitor populations for infectious disease outbreaks. Public information and risk communication is necessary to let the public know what to do to mitigate the hazards.

For More Information:

ASPR TRACIE Resources:
After the Flood: Mold-Specific Resources
Emergency Public Information and Warning/Risk Communications Topic Collection
Social Media in Emergency Response Topic Collection

Other Resources:
Water, Sanitation, and Hygiene (WASH)-Related Emergencies and Outbreaks (CDC)
Responding to Environmental Health Threats Following Hurricanes (ASTHO)

Food Safety After Power Outages and Flood/Storm Damage

Prolonged power outages, lack of running potable water, submersion in flood water, and "pop up" or "just-in-time" food service establishments all pose potential hazards related to food preparation and consumption. Poor hand hygiene due to lack of clean water or disinfectants can also contribute to illness related to food consumption.

Public messaging on how to examine food and when to throw it out is critical. Additional staff will likely be necessary to provide inspections for re-opening closed food service establishments and to inspect new facilities, such as shelters and other new incident-related services.

For More Information:

Food and Water Safety During Power Outages and Floods
Keep Your Food Safe During Emergencies: Power Outages, Floods, and Fires

Healthcare Facility Evacuations

Healthcare facilities may need to evacuate prior to, during, or even after the impact of the storm. Anticipating the need to evacuate to avoid emergency evacuation is ideal. The longer a facility has to evacuate, the more orderly the process can be. Sheltering patients in place carries risk, though so does evacuation. These risks must be balanced along with consideration for capacity of the region to transport, track, and accommodate patients. Healthcare coalitions and health systems can be excellent resources in making systematic decisions and supporting evacuation operations.

For More Information:

ASPR TRACIE Resources:
Federal Patient Movement: Overview Fact Sheet
Healthcare Facility Evacuation/Sheltering Topic Collection
Patient Movement, MOCCs, and Tracking Topic Collection
Post Storm Healthcare Facility Assessment Resources
Pre-Hospital Topic Collection
The Exchange, Issue 6: Evacuating Healthcare Facilities

Medical Services Replacement or Augmentation

Healthcare facilities can be forced to close during hurricanes due to damage or flooding, loss of utilities, or other physical issues and be "off-line" for an indefinite amount of time. Individual healthcare providers may be personally affected by the storm and unable to report to work. Individual or small-office practitioners may not be able to open their offices/clinics because of lack of staff, physical damage, or loss of communications.

There will be a need to coordinate replacement healthcare services for those that are temporarily unavailable and those that have been permanently damaged. There will also be a need to augment existing healthcare facilities as they see a surge of patients seeking routine care (non-storm related) in new locations, due to a lack of ability to seek care from their pre-disaster providers.

For More Information:

ASPR TRACIE Resources:
Alternate Care Sites Topic Collection
Ambulatory Care and Federally Qualified Health Centers (FQHC) Topic Collection
Considerations for the Use of Temporary Surge Sites for All-Hazards Incidents
Crisis Standards of Care Topic Collection
Health Care Facility Onboarding Checklist
Hospital Mass Casualty Response Plan Considerations
Hospital Surge and Immediate Bed Availability Topic Collection
Mental/Behavioral Health Topic Collection
Pre-Hospital Topic Collection
The Exchange, Issue 8: Supporting Hospital Surge—Meeting Patient and Staff Needs
The Exchange, Issue 18: Innovations in Health Care Surge Capacity Management
Virtual Medical Care Topic Collection

Select Programs/Assets to Consider:

State Medical Response Teams (Inter- or Intrastate)
Emergency Management Assistance Compact

Shelter and Congregate Living Health and Public Health Concerns

Widespread flooding and/or structural damage can create the need for large and sustained shelter operations. While the goal for emergency management is to return people to their homes or to provide transitional housing, that process can take time.

The priority for health and medical response and recovery personnel is to ensure the shelter environment is safe and that shelter residents have access to basic hygiene and healthcare services, clean water, and safe food.

Depending on how long people will reside in shelters, potential health hazards must be monitored (e.g., food safety and hygiene [toilets and showers]). Ensuring surveillance is in place to monitor for infectious disease outbreaks, specifically respiratory and gastrointestinal diseases, is critical.

For More Information:

ASPR TRACIE Resources:
Access and Functional Needs Topic Collection
Alternate Care Sites Topic Collection
Disaster Veterinary Issues Topic Collection, Shelter Animal Care
Family Reunification and Support Topic Collection
HIPAA and Disasters: What Emergency Professionals Need to Know

Staff Fatigue and Replenishment

In the first few days of a response, staff are focused on rescue and response operations and often can't or won't rest or remove themselves from operations. Staff who maintain facility operations are a critical component of the response phase and expected to care not only for their own loved ones, but community members and the facility, too. Cognitive abilities decline rapidly with fatigue, stress, and inadequate nutrition and hydration. Incident management should prioritize staffing planning including adequate rest and replenishment cycles.

For More Information:

ASPR TRACIE Resources:
Disaster Behavioral Health: Resources at Your Fingertips
Disaster Behavioral Health Self Care for Healthcare Workers Modules
Responder Safety and Health Topic Collection
Tips for Retaining and Caring for Staff after a Disaster

Storm-Related Health Emergencies

The typical health-related impacts of hurricanes and floods include:

- Carbon monoxide poisoning due to poor ventilation of gas generators
- Gastro-intestinal illnesses from food sources and person-to-person spread
- Drowning and/or hypothermia from water immersion
- Orthopedic trauma from clean up injuries, crashes, and other incidents
- Heat illness related to exertion or lack of power for air conditioning
- Respiratory illness from typical and atypical organisms
- Skin rashes and wound infections
- Soft tissue injuries from debris and clean up

Emergency department visits in the Dallas-Fort Worth area increased nearly 4% per day following Hurricane Harvey. Many visits were due to evacuees; many patients reported gastrointestinal symptoms.

Hospitals and other healthcare providers should be prepared to handle an increase in patient numbers with a wide range of chief complaints. There are typically three surges of patients related to the storm: those seeking care before the storm due to injuries sustained while preparing for the storm, stress, support for chronic conditions, and/or fear of being alone; patients ill or injured during the storm; and the surge of patients who become ill, injured, or lack specific resources (e.g., power for oxygen concentrator) post-storm. Many patients seen in the days and weeks following the storm will display exacerbations of underlying disease due to disruptions in their care or their environment.

State, local, and federal staff should be prepared to receive requests for staff and medical service delivery augmentation to support this storm-related surge of patients.

For More Information:

ASPR TRACIE Resources:
Alternate Care Sites Topic Collection
Ambulatory Care and Federally Qualified Health Centers Topic Collection
Crisis Standards of Care Topic Collection
Homecare and Hospice Topic Collection
Hospital Surge and Immediate Bed Availability Topic Collection
Incident Management Topic Collection
Mental/Behavioral Health Topic Collection
Pre-Hospital Topic Collection
Virtual Medical Care Topic Collection

Other Resources:
Carbon Monoxide Poisoning Basics (CDC)
Emergency Wound Care After a Natural Disaster (CDC)
Preparing for and Responding to Infectious Disease Threats Following Hurricanes (ASTHO)
The Microbial Aftermath of Hurricanes (American Society for Microbiology)
What to Do to Prevent Getting Hurt or Sick After a Disaster (CDC)

Select Programs/Assets to Consider:

State Medical Response Teams (Inter- or Intrastate)
Emergency Management Assistance Compact

Transportation

Emergency medical services (EMS) may have difficulty accessing patients and/or their fleet may have suffered storm-related damage. Residents may not be able to use traditional modes of transportation to access their healthcare providers or emergency services. Their vehicles may have been damaged or inaccessible, buses may not be running, taxis and car services may not

be operational, and para-transit, Handi-vans and other medical transportation providers may be otherwise committed to response operations.

Roads may not be passable, so physical access to facilities for both ambulances and self-referred patients can be an issue. "Water taxis" may be needed to ferry the injured to ambulances and/or functioning hospitals that have become isolated by floodwaters.

Many services that provide support to healthcare facilities will have access issues including courier services that handle lab specimens and delivery services that bring supplies, equipment, linen, blood, food, fuel, and other necessary resources. These services and vendors may also have difficulty crossing security barriers into affected neighborhoods if they lack proper paperwork or identification. Jones Act waivers have been granted to facilitate shipping between U.S. ports by any vessel available for transit after recent hurricanes (e.g., Fiona in 2024 and Harvey in 2017).

Access the Post-Storm Hospital Assessment Tool Resources List in this document for related considerations, checklists, and information.

For More Information:

ASPR TRACIE Resources:
Medical Operations Coordination Centers (MOCCs) Resources Page
Patient Movement, MOCCS, and Tracking Topic Collection
Pre-hospital Topic Collection
The Exchange, Issue 6: Evacuating Healthcare Facilities

Short-Term Considerations

Assessment of Healthcare Facilities for Re-Opening After Storm Damage

If a healthcare facility was forced to close due to flooding or other damage sustained during the incident, that closure may require a re-inspection prior to opening. Additional inspectors and clarification of the federal, state, and local laws and regulations might need to be circulated to all affected healthcare facilities. Coordination of patient repatriation can be complicated. Healthcare coalitions can be a valuable asset in these operations.

For More Information:

ASPR TRACIE Resources:
Healthcare Facility Evacuation/Sheltering Topic Collection
Healthcare-Related Disaster Legal/Regulatory/Federal Policy Topic Collection
Hospital Reimbursement Guidance after Evacuation
Recovery Planning Topic Collection

Healthcare System Recovery Timeline White Paper

Exacerbation of Chronic Medical Conditions

Refer to the Immediate Considerations section.

Food Safety After Power Outages and Flood/Storm Damage

Refer to the Immediate Considerations section.

Medical Services Replacement or Augmentation

Refer to the Immediate Considerations section.

Mold and Other Re-habitation Health Concerns

After a flood, mold can present a significant health concern for residents/business owners, emergency responders/managers, and public health officials. Mold and mildew can start growing within 24 hours. The most effective way to support an affected community is to provide them with educational materials on how to manage mold in their homes and businesses.

For More Information:

After the Flood: Mold-Specific Resources (ASPR TRACIE)
Dealing with Mold and Mildew in Your Flood Damaged Home (FEMA)
Mold (EPA)
Mold (NIH National Institute of Environmental Health Science)
Mold Resources and Publications (CDC)
Prevention of Toxic Molds in Army Facilities Using Surface-Applied Biocides (U.S. Army Corps of Engineers)
Responding to Environmental Health Threats Following Hurricanes (ASTHO)
Water, Sanitation, and Hygiene (WASH)-related Emergencies and Outbreaks (CDC)

Mosquito Abatement and Other Environmental Health Impacts

Flooding leads to large pools of standing water and damp earth, presenting ideal breeding grounds for many types of mosquitoes. An increase in standing water could cause an increase in mosquitoes in the affected area.

Post-storm outdoor air and water pollution are additional potential concerns. Environmental health assessments, inspections of hazardous materials sites, and monitoring of air quality will likely be required to assess the environmental impacts. Responders must be made aware of

additional hazards that might be present in the community. Water can be contaminated by leaking diesel fuel from submerged vehicles, sewage, and impacted chemical storage facilities.

For More Information:

Mosquito Control (CDC)
Responding to Environmental Health Threats Following Hurricanes (ASTHO)

Staff Fatigue and Replenishment

Refer to the Immediate Considerations section.

Long-Term Considerations and Recovery

Change to the Baseline Level of Health

If consistent access to healthcare is impeded due to the impact of a hurricane, the overall health of a community can decline. If the healthier members of the community choose to relocate, leaving behind those with pre-existing conditions and a lack of resources, the baseline health of the community can be affected but with disproportionate effects on those with chronic conditions and those with access and functional needs. During recovery, efforts to assure continuity of services for these populations are critical to health maintenance.

For More Information:

ASPR TRACIE Resources:
Access and Functional Needs Topic Collection
Ambulatory Care and Federally Qualified Health Centers Topic Collection
Healthcare System Recovery Timeline White Paper
Recovery Planning Topic Collection

Loss of Facilities

Many of the healthcare facility closures or disruptions during and immediately following the storm impact are temporary and normal operations can resume relatively quickly, but there will be facilities that will not be able to quickly or easily re-open. Those with significant flooding or structural damage may need major repairs or rebuilding to be operational again. Emergency planners must consider how to support these individual facilities in recovery and also plan to address the impact their loss will have on the overall delivery of healthcare to the community. This impact involves all healthcare facilities, not just hospitals and nursing homes, but clinics, labs, outpatient offices, and individual physician practices. System and facility re-design offers opportunities to enhance service provision and protect critical infrastructure against future threats.

For More Information:

ASPR TRACIE Resources:
Alternate Care Sites Topic Collection
Ambulatory Care and Federally Qualified Health Centers Topic Collection
Continuity of Operations (COOP)/Failure Plan Topic Collection
Crisis Standards of Care Topic Collection
Hospital Reimbursement Guidance after Evacuation Topic Collection
Hospital Surge and Immediate Bed Availability Topic Collection
Mental/Behavioral Health Topic Collection
Recovery Planning Topic Collection
Virtual Medical Care Topic Collection
Healthcare System Recovery Timeline White Paper Topic Collection

Other Resources:
Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings (FEMA)

Select Programs/Assets to Consider:

State Medical Response Teams (Inter- or Intrastate)
Emergency Management Assistance Compact

Loss of Providers

In addition to the loss of healthcare facilities, the impacted area may experience a loss of individual healthcare providers. Those providers may have relocated due to their own personal loss during the storm or may have relocated because there was no available work in the short-term recovery phase due to facility damage or lower patient volumes. Providers who have relocated, found a new job, and resettled may be reluctant to return to the disaster impacted area once their previous facility is operational again.

There were 4,500 doctors serving three of the parishes surrounding New Orleans prior to Hurricane Katrina's impact. One year later only 1200 had returned to practice.

For More Information:
ASPR TRACIE Resources:

Healthcare System Recovery Timeline White Paper
Healthcare Provider Shortages-Resources and Strategies for Meeting Demand

Acknowledgements

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Appendix A: Cited Resources

Visit the ASPR TRACIE-Developed Resources Page to access the ASPR TRACIE resources that were cited throughout this document and other related products.

Administration for Strategic Preparedness and Response (2025). emPOWER Program Platform. U.S. Department of Health and Human Services.

> This mission-critical partnership between the Administration for Strategic Preparedness and Response (ASPR) and the Centers for Medicare and Medicaid Services (CMS) provides federal data, mapping, and artificial intelligence tools, as well as training and resources, to help communities nationwide protect the health of at-risk Medicare beneficiaries, including over 4.6 million individuals who live independently and rely on electricity-dependent durable medical and assistive equipment and devices, and/or certain essential health care services. Public health authorities and their partners in all 50 states, 5 territories, and the District of Columbia use HHS emPOWER Program data and tools to strengthen emergency preparedness, response, recovery, and mitigation and take action to protect at-risk populations prior to, during, and after incidents, emergencies, and disasters.

Administration for Strategic Preparedness and Response. (2023). Cultural and Linguistic Competency for Disaster Preparedness Planning and Crisis Response. U.S. Department of Health and Human Services.

> This webpage includes links to resources and tools that enhance and address cultural and linguistic competency to help mitigate the impact of disasters and emergency events.

Administration for Strategic Preparedness and Response. (n.d.). The Role of Healthcare Providers in Combatting Human Trafficking during Disasters. (Accessed 7/2/2025.) U.S. Department of Health and Human Services.

> The materials on this webpage can be used by disaster responders and health professionals: understand the relationship between human trafficking and disasters; recognize signs of human trafficking; identify the resources that exist for further training on this topic; and determine next steps if human trafficking is suspected.

Arnold, C., Holmes, W., Quinn, R., et al. (2007). Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings. Federal Emergency Management Agency.

> This guide focuses on hospital safety specific to earthquakes, floods, and high winds. It comprises four main chapters that cover topics such as standard industry requirements to new developments, known vulnerabilities and related damage; potential earthquake

damage to hospitals; the nature of flood forces and their effects on buildings, regulatory design requirements that help reduce risk of hospitals that must be located in flood hazard areas; and the effects of wind on hospital's structural and nonstructural building components.

Carlson, E. and Porter, N. (2024). Responding to Environmental Health Threats Following Hurricanes. Association of County and City Health Officials.

This webpage provides information on recognizing and handling environmental threats (e.g., mold, carbon monoxide poisoning, and mosquitos) after a hurricane or flood.

Centers for Disease Control and Prevention. (2024). Data Show Widespread ED Surge After Hurricane Harvey.

In 2017, Hurricane Harvey battered Houston and surrounding areas, leading to 88 fatalities and more than $125 billion in damages. Syndromic surveillance data from August 6 to September 23, 2017 revealed that emergency department visits in the Dallas-Fort Worth area increased significantly (due in part to evacuees seeking care), by nearly 4% per day.

Centers for Disease Control and Prevention. (2024). Carbon Monoxide Poisoning Basics.

This webpage highlights the symptoms, risk factors, and considerations related to preventing, identifying, and mitigating risk for carbon monoxide poisoning.

Centers for Disease Control and Prevention. (2024). Mosquito Control.

This website provides link to resources on protecting the home and community from mosquitos.

Centers for Disease Control and Prevention. (2024). What to Do to Prevent Getting Hurt or Sick After a Disaster.

These tips cover preventing injury and illness related to floodwaters, disaster cleanup, power outages, insects and stray animals, and electrical hazards.

Centers for Disease Control and Prevention. (2017). 2017 Hurricane Harvey Key Messages.

This document contains the messaging that has been cleared for use in developing internal and external materials related to the emergency response to Hurricane Harvey.

Centers for Medicare & Medicaid Services. (2017). CMS: Reminder of Pharmacy and Provider Access during a Federal Disaster or Other State or Public Health Emergency Declarations. U.S. Department of Health and Human Services.

This memo "reminds Medicare Advantage Organizations…and Part D Plan sponsors of their obligations to maintain access to the Part A/B, supplemental Part C, and Part D benefits (as applicable) for beneficiaries in areas affected in the event of a Presidential emergency declaration, a Presidential (major) disaster declaration, a declaration of emergency or disaster by a Governor, or an announcement of a public health emergency by the Secretary of Health and Human Services."

Centers for Disease Control and Prevention. (n.d.). Emergency Wound Care After a Natural Disaster. (Accessed 7/3/2025.)

This infographic illustrates protective steps and provides directions for taking care of wounds contracted during and after hurricanes and other natural disasters.

Government Accountability Office. (2006). Status of the Health Care System in New Orleans and Difficult Decisions Related to Efforts to Rebuild it Approximately 6 Months After Hurricane Katrina.

The sudden closure of hospitals and other healthcare facilities after Hurricane Katrina left many residents—some uninsured—without healthcare services, also delaying their return to the area. The authors examined variables associated with rebuilding facilities (primarily estimates, assessments, and cost) and provide a snapshot of considerations associated with making the decisions.

Healthcare & Public Health Sector Coordinating Councils. (n.d.). Planning for Power Outages: A Guide for Hospitals and Healthcare Facilities. (Accessed 7/2/2025.) U.S. Department of Health and Human Services, Administration for Strategic Preparedness and Response.

This checklist can help emergency planners prepare for and respond to power outages in their facilities.

Kaiser Family Foundation. (2005). Addressing the Health Care Impact of Hurricane Katrina.

Written at the early stages of recovery from Hurricane Katrina, this report served as a kickoff for a more thorough assessment of the ongoing health needs and resources available to meet them.

Manuel, J. (2013). The Long Road to Recovery: Environmental Health Impacts of Hurricane Sandy. Environmental Health Perspectives.

This article describes the damage caused by Hurricane Sandy due to flooding and fires; the toll power outages took on humans and animals (e.g., research animals); and the risks associated with contaminated water. Long-term considerations (e.g., respiratory health of volunteer responders) and the importance of resilience are covered in the last portion of the article.

Poulin, A. and Christian, S. (2022). Preparing for and Responding to Infectious Disease Threats Following Hurricanes. Association of State and Territorial Health Officials.

This webpage highlights how state and territorial health officials can plan for and manage vector-borne, water-borne, and respiratory diseases in addition to wounds, injuries, and other dermatologic issues transmission after a hurricane.

Redman, S., Fromknecht, C., Hodge, S., et al. (2017). Death Scene Investigation After Natural Disaster or Other Weather-Related Events. Centers for Disease Control and Prevention.

The authors conducted a literature review and discovered variance in the tools used in disaster death scene data collection. They formed a work group comprised of medical examiners and coroners, forensic pathologists, death scene investigators, forensic anthropologists, and epidemiologists that developed and pilot tested this toolkit. The toolkit includes templates and checklists by hazard.

Rudowitz, R., Rowland, D., and Shartzer, A. (2006). Health Care in New Orleans Before and After Hurricane Katrina. (Abstract only.) Health Affairs. 25(1).

The authors describe how Hurricane Katrina "devastated the New Orleans health care safety net, entirely changing the city's health care landscape and leaving many without access to care a year after the storm."

Saulnier, D., Ribacke, K., and von Schreeb, J. (2017). No Calm After the Storm: A Systematic Review of Human Health Following Flood and Storm Disasters. Prehospital and Disaster Medicine. 32(5):568-579.

The authors conducted a literature review on morbidity or mortality and flood or storm disasters and describe the findings (and lack thereof on the relationship of floods alone on health). While changes in some conditions could be explained by the disasters, the long-term effects were not covered or well understood; the authors called for more comprehensive research examining the relationship between storms/flooding and short- and long-term illness and injury.

Sodders, N., Stockdale, K., Baker, K., et al. (2023). Notes from the Field: Vibriosis Cases Associated with Flood Waters During and After Hurricane Ian — Florida, September–October 2022. Morbidity and Mortality Weekly Report. 72(18): 497-498.

The authors note that vibrio bacteria thrive on warm salty or brackish water and can lead to gastrointestinal illness or a skin infection following exposure of an open wound. After Hurricane Ian made landfall in Florida in 2022, the state's Department of Health recorded 38 cases and 11 vibriosis-related deaths, "representing a 1,100% increase over the 5-year median."

Substance Abuse and Mental Health Services Administration. (2024). Substance Abuse and Mental Health Services Administration Crisis Counseling Assistance and Training Program. U.S. Department of Health and Human Services.

The Crisis Counseling Assistance and Training Program (CCP) is a short-term disaster relief grant program available to states, U.S. territories, and federally recognized tribes. CCP funding provides states, territories, and tribes additional assistance to address the behavioral health needs of disaster survivors through community-based outreach, crisis counseling, public education, resource and referral linkages, and other supportive behavioral health services to survivors of natural and human-caused disasters.

U.S. Department of Agriculture. (n.d.).Food and Water Safety During Power Outages and Floods. (Accessed 7/3/2025.)

The video and information on this webpage can help individuals take proper food precautions during and after a power outage.

U.S. Department of Agriculture. (n.d.). Keep Your Food Safe During Emergencies: Power Outages, Floods, and Fires. (Accessed 7/3/2025.)

These comprehensive tips cover how to handle refrigerated and frozen food before, during, and after a power outages related to floods and fires.

Post-Storm Hospital Assessment Tool Resources

American College of Emergency Physicians. (n.d.). Hospital Disaster Preparedness Self-Assessment Tool. (Accessed 7/1/2025.)

> Though not an assessment for post-disasters specifically, this tool may provide some helpful information on categories that should be considered in a post-disaster assessment (particularly sections 3-7). This assessment was developed to assist hospitals in revising and updating existing disaster plans or in the development of new plans.

California Emergency Medical Services Authority. (n.d.). Hospital Incident Command System 251- Facility Systems Status Report. (Accessed 7/1/2025.)

> This HICS form is to be used to determine the status (functional, partially functional, nonfunctional) of a healthcare facility after an emergency event.

Centers for Disease Control and Prevention. (2005). Checklist for Infection Control Concerns when Reopening Healthcare Facilities Closed Due to Extensive Water and Wind Damage.

> This checklist provides guidance for completing building and life safety inspections prior to restoration work, and guidance for infection control review of facilities to be done before the hospital can reopen. Attachment A includes a site-specific checklist for selected areas of the facility (e.g., laboratory, pharmacy, etc.).

Harvard School of Public Health, Emergency Preparedness and Response Exercise Program. (2013). Essential Functions and Considerations for Hospital Recovery Version 2. Federal Emergency Management Agency.

> This document helps hospitals prepare to manage recovery from all types of events. Recovery planning benchmarks are included starting on page 34 to help hospitals independently assess their recovery capabilities. The benchmarks are drawn from a variety of sources including the ASPR Healthcare Preparedness and Response Capabilities, Joint Commission Hospital Accreditation Standards, the NDRF, and lessons learned from both recovery-focused exercises and real-world disasters. The document also includes questions to consider during recovery planning starting on page 38.

Pan American Health Organization, World Health Organization. (2017). Hospital Administrator, Post Disaster Functional Checklist.

> This checklist is meant to be used by a CEO or Hospital Administrator within 24 hours after the impact of a natural or man-made disaster. Its objective is to determine the immediate level of safety and functionality of the hospital. The facility is assessed in three segments: structural, non-structural, and functional capacity.

Rudowitz, R., Rowland, D., and Shartzer, A. (2006). Health Care In New Orleans Before And After Hurricane Katrina. Health Affairs. 25(5).

This article highlights healthcare data in New Orleans before and after Hurricane Katrina to illustrate the effects of the storm on the medical field, the city, and the State of Louisiana.

South Carolina Department of Health and Environmental Control. (2019). Post-Disaster Hospital Reopening Procedures.

This document provides a step-by-step guide for hospitals to follow prior to reopening. It includes five primary steps with action items under each.

Zane R, Biddinger P, Gerteis J, Hassol A. (2010). Hospital Assessment and Recovery Guide. AHRQ Publication No. 10-0081.

This guide is designed to help organize the initial assessment of a hospital after an evacuation/closure due to an emergency event. The guide is divided into 11 sections, each with its own team and assessment assignment: Administration, Facilities, Security and Fire Safety, Information Technology and Communications, Biomedical Engineering, Medical, Ancillary Services, Materials Management, Building and Grounds Maintenance/ Environmental Services, and Support Services.