**Topic Collection: Natural Disasters**

Natural disasters and their consequences (e.g., flooding, injuries experienced during clean up) can wreak havoc on healthcare facilities and the communities they serve. It is important for emergency planners to enroll in alert systems, monitor weather forecasts and have a solid natural disaster or all hazards facility response plan that complements their jurisdiction’s plan. The resources in this Topic Collection highlight lessons learned from recent events, communication tools and information, and checklists, plans, tools, and templates that can be modified to suit specific threats and needs. Articles in this Topic Collection address specific natural disasters and hazards and elements of their planning, but do not address all-hazard planning or specifics of clinical care which may be found in other topic collections.

Each resource in this Topic Collection is placed into one or more of the following categories (click on the category name to be taken directly to that set of resources). Resources marked with an asterisk (*) appear in more than one category.

- **Must Reads**
- **Alerts, Warnings, and Communications**
- **At-Risk Populations**
- **Education and Training**
- **General Hazard Mitigation and Utilities Failure**
- **Lessons Learned** (listed alphabetically)
  - Earthquakes
  - Extreme Heat
  - Extreme Cold
  - Fire/Wildfire
  - Floods and Landslides
  - Hurricanes
  - Tornadoes
  - Tsunamis
- **Mitigation**
  - Plans, Tools, and Templates (listed alphabetically)
    - Earthquakes
    - Excessive Cold
    - Excessive Heat
    - Fires and Wildfires
    - Floods and Landslides
    - Hurricanes
    - Tornadoes
    - Tsunamis
- **Agencies and Organizations**
Must Reads

American Meteorological Society. (2014). *A Prescription for the 21st Century: Improving Resilience to High-Impact Weather for Healthcare Facilities and Services.* This report shares workshop findings on increasing and improving the resilience of healthcare facilities and services to high-impact weather events. The workshop grouped their findings into three main categories: hardening structures, making incremental adaptations, and implementing innovative practices.


This design guide can inform and help design professionals, hospital administrators, and facility managers employ sound mitigation measures that will decrease the vulnerability of hospitals to disruptions from natural hazard events (e.g., earthquakes, high wind events, floods).


The authors review heat wave plans from 18 cities and list recommendations for overcoming challenges (e.g., targeted outreach geared towards the socially isolated, begin prevention efforts before high temperatures arrive, and collect and use data to determine the effectiveness of interventions).


The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.

Children's Hospital and Research Center Oakland. (n.d.) *Children's Hospital Earthquake Response Guide.* (Accessed 10/20/2015.)

The goal of this plan is to maintain hospital operations for at least four days after a major earthquake and to ensure that care continues for patients, visitors, and survivors of the earthquake. This plan can be adapted to meet the needs of hospital emergency response professionals and healthcare preparedness planners.


These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.

This book is a summary of a conference where risk communications experts discussed the public response to mobile alerts.


Healthcare facility emergency planners can use this template when developing their emergency operations plan. It features 12 disaster scenarios, including: hurricane, tornadoes, structure fires, earthquakes, and extreme cold.


The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.


The speaker presents an in-depth overview of the hospital response to earthquakes that struck California in 1971 and 1994. He divided his findings by functional and non-functional hospitals, and presented information on communication challenges, staff behavior (e.g., decisions to report to work), and potential sources of assistance should a similar earthquake strike the Jerusalem area of Israel.


This article documents how facility staff from Memorial Hermann Hospital incorporated lessons learned after Tropical Storm Allison flooded the facility with almost 40 feet of water in 2001.


This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

This editorial provides an overview of factors and issues to consider during heatwaves. The article includes links to the report authored by the World Health Organization and World Meteorological Organization, guidance from the Centers for Disease Control and Prevention, and other applicable webpages.


This report summarizes presentations made at a 2012 workshop organized by the Committee on Public Response to Alerts and Warnings Using Social Media. Chapters cover the fundamentals of alerts, warnings, and social media, how social media is used in emergencies, the dynamics of social media, message credibility, privacy and legal issues, and research gaps and other challenges.


This 86-page document is a guide and toolkit designed to assist healthcare providers, design professionals, policymakers, and others with roles and responsibilities in assuring the continuity of quality health and human care before, during, and after extreme weather events. It is focused on healthcare infrastructure resilience to climate change impacts as manifested primarily by extreme weather events.


This guidebook identifies best practices that have been implemented to save lives during excessive heat events in various urban areas. It provides critical information needed to help local public health officials, emergency managers, meteorologists, and others assess their community’s vulnerability to excessive heat waves, and develop and implement notification and response programs.

Alerts, Warnings, and Communications


This study investigated whether non-traditional data (e.g., tweets and news reports) fill a void in traditional data reporting during hurricane response, as well as whether non-traditional data improve the timeliness for reporting identified HHS Essential Elements of Information (EEI).

The authors examined information sources used for Superstorm Sandy with respect to the storm, evacuation routes, shelters, safety, and health issues in Central New Jersey and Jersey Shore communities. They conclude that the reliance on traditional sources of information (i.e., TV, radio, friends) observed suggests that the extreme power outages made web, cell phones, and social media on cell phones less usable.


The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.


This book is a summary of a conference where risk communications experts discussed the public response to mobile alerts.


Users can register to subscribe to local weather, health, homeland security and cybercrime alerts delivered by email and/or text message.


The authors evaluated official New York City tweets related to Superstorm Sandy (2012) and winter storm Nemo (2013) and how often they were re-tweeted. They found that information was shared beyond existing follower bases; official tweets during Sandy had lower lexical diversity, with links to more information, and were retweeted more than unofficial Sandy tweets; and NEMO-related tweets containing more general information were retweeted more often than those containing actionable information.


The authors describe how they used Twitter for situational awareness during Superstorm Sandy in 2012.

The National Weather Service provides links to federal and external alert and warning sources.


The National Weather Service provides links to sources that provide tsunami event messages.


This webpage provides up-to-date information on wildfires across the country. Users can search by state or incident name. Photographs, announcements, and news articles are also included.


This report summarizes presentations made at a 2012 workshop organized by the Committee on Public Response to Alerts and Warnings Using Social Media. Chapters cover the fundamentals of alerts, warnings, and social media, how social media is used in emergencies, the dynamics of social media, message credibility, privacy and legal issues, and research gaps and other challenges.


This tool provides central access to federal disaster and public health related natural disaster alerts, warnings, and other resources.


Healthcare providers, electric company representatives, and community members can use this map to find the monthly total of Medicare beneficiaries with electricity-dependent equipment claims at the U.S. state, territory, county, and zip code level and enable “real-time” NOAA severe weather tracking services to identify areas and populations that may be at risk of/impacted by power outages.


The U.S. Geological Survey provides this free service that notifies users when earthquakes occur in their area.

These guidelines provide an overview of general heat–health problem and describe how an understanding of the biometeorology, epidemiology, public-health and risk-communication aspects of heat as a hazard can be used to inform the development of a heat–health warning system (HHWS) as part of a wider heat–health action plan (HHAP).

**At-Risk Populations**
(Note: This is a sampling of resources specific to natural hazards. ASPR TRACIE has developed a comprehensive Topic Collection on Access and Functional Needs and is in the process of developing collections on Pediatric Issues and Mental/Behavioral Health.)


The guidelines included on this webpage can help healthcare facility staff ensure they are in compliance with earthquake-related codes.

*City of New York, Department of Health and Mental Hygiene. (2013). Heat Wave Preparedness Checklists for Mental Health Service Providers.*

These checklists can help mental health service providers identify consumers and vulnerable residents at highest risk for heat-related illnesses.


These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.


To facilitate discussions about emergency preparedness, the National Health Care for the Homeless Council has developed a series of weather-specific informational flyers specifically for people who lack housing. These resources were created with input from people who are formerly and currently homeless and may be of interest to public health educators, emergency management officials, homeless service providers, and homeless community leaders.

**Education and Training**

The speakers in this webinar discuss the earthquake risk in the Cascadia subduction zone in the Pacific Northwest. Challenges for planners and communication and mitigation strategies are also discussed.


This 9-hour course covers: weather basics and forecasting; threats analysis and hazards planning; fact sheets for weather and non-weather-related hazards; warning partnership information; and human behavior and community response.


This 10-hour course is targeted to those involved in the decision making process for hurricanes and includes basic information about: how hurricanes form and the hazards they pose; how the National Weather Service (NWS) forecasts future hurricane behavior; and what tools and guiding principles can help emergency managers prepare their communities.


This 30-minute course presents basic information on earthquake science, risk, and mitigation. It also discusses techniques for structural and non-structural earthquake mitigation.


This 6-hour course helps emergency managers prepare their communities for tsunamis. It covers basic tsunami science, hazards produced by tsunamis, regional U.S. tsunami risks, the tsunami warning system, the importance of public education activities, and how to craft good emergency messages and develop tsunami response plans.

**General Hazard Mitigation and Utilities Failure**


This vulnerability assessment highlights structural, non-structural, and functional elements that must be considered to ensure that a health facility can withstand and remain operational in emergencies.

The author recounts the challenges associated with providing care in a university hospital’s neonatal intensive care unit before, during, and after Hurricane Katrina made landfall.


This plan describes how to identify, assess, and mitigate natural hazards in New Mexico. It also addresses mitigation planning requirements for federal hazard mitigation grant funding.


Healthcare facility emergency planners can use this template when developing their emergency operations plan. It features 12 disaster scenarios, including: hurricane, tornadoes, structure fires, earthquakes, and extreme cold.


This 86-page document is a guide and toolkit designed to assist healthcare providers, design professionals, policymakers, and others with roles and responsibilities in assuring the continuity of quality health and human care before, during, and after extreme weather events. It is focused on healthcare infrastructure resilience to climate change impacts as manifested primarily by extreme weather events.


This tool provides central access to federal disaster and public health related natural disaster alerts, warnings, and other resources.


This document highlights issues for healthcare facilities to consider regarding power outages. It also provides a checklist of key planning considerations, and recommendations for fostering a relationship with a facility’s utility company.

This document provides information on the impact of water loss on healthcare facilities, and a series of questions for planners to use to prepare their facilities for water service interruptions.


This fact sheet summarizes steps a healthcare facility can take to ensure communication during incident response when normal technologies fail.

Lessons Learned

Earthquakes


The authors describe their experiences and lessons learned working in the emergency department of the only regional acute care hospital following the 2011 New Zealand earthquake. They note that emergency department response plans should account for patients arriving in atypical ways; loss of power; the need for paper registration and tracking systems; volunteer management; and teamwork with clear leadership, among other things.


The authors describe their experiences in a pediatric field hospital in Haiti following the 2010 earthquake. They discuss requirements for equipment, manpower, medical records, and systems addressing volunteer stress, as well as ethical issues. They also note that 93% of casualties initially were surgical admissions with 40% undergoing operations in the first week after the event, mostly for fractures and wound care.


The authors discuss lessons learned from the 2011 Japanese earthquake and tsunami, and present a graphic entitled the "chain of survival for disasters" to help guide decision-makers and emergency response planners during natural disasters.

The authors present four examples of initiatives that helped communities recover from Japan's earthquake/tsunami "3/11 Disaster." They stress the important role of healthcare providers in ensuring access to care and reducing stressors in survivors.


The authors conducted a medical analysis of injuries and diseases after an earthquake that struck a remote, high-altitude region. They listed related challenges and suggestions for future healthcare provider training topics.


The authors describe loss of functions and structural damage experienced by hospitals in Chile following a major earthquake. Loss of communications capability was cited by hospital administrators surveyed as being most problematic.


The authors analyzed the medical response to earthquakes and tsunamis in tropical regions and found that shock, infection, and heat stroke were frequently encountered by survivors.


The authors discuss how the assumptions and planning for their orthopedic surgery team deployed to assist after the 2010 Haiti earthquake were "naïve," and they present their lessons learned.


The authors reviewed data on the disease burden for exacerbation of chronic diseases following natural disasters, focusing on renal, cardiac, and diabetic patients. They note that it is critical for healthcare providers to anticipate the need for care in this population and to educate patients on their diseases so that they can better manage their conditions following a disaster.
The authors discuss how lessons learned from the 1995 Hanshin earthquake and effective use of the Internet for communication and coordination assisted with the response to the 2011 earthquake and tsunami. They also describe and compare the injuries and causes of death for the two events.


The authors discuss lessons learned from recent earthquakes worldwide and explore how resources spent on search and rescue missions may diminish resources available for other needs, including healthcare.


The authors describe the injuries encountered in the weeks following the Pakistan earthquake in 2005, and the joint efforts by orthopedic and plastic surgeons that were required to treat them.

Sanford, C. (2010). Post-Earthquake Medicine in Haiti: Disaster Relief at a Field Hospital. (Free registration required.) University of Washington, Northwest Center for Public Health Practice.

In this one-hour Hot Topics webinar, Dr. Sanford shares his experiences and reflects upon lessons learned that may have important implications for public health planning and response to major disasters.


The speaker presents an in-depth overview of the hospital response to earthquakes that struck California in 1971 and 1994. He divided his findings by functional and non-functional hospitals, and presented information on communication challenges, staff behavior (e.g., decisions to report to work), and potential sources of assistance should a similar earthquake strike the Jerusalem area of Israel.


The authors incorporate lessons learned from the Fukushima disaster into response recommendations for pediatric surgeons and physicians.

The authors characterize the bacteria isolated from trauma patients following the 2008 Wenchuan earthquake, and associated antibiotic susceptibilities. They found that the distribution spectrum of pathogens isolated from trauma patients after the earthquake was different from that for non-earthquake trauma patients in the same hospital at the same time.

**Excessive Heat**


The authors of this report analyze the results of independent peer-reviewed scientific papers and present the findings of increasing heat-related mortality due to global warming for the 40 largest U.S. cities. Their findings indicate that rising temperatures, driven by persistent climate change, will increase the number of life-threatening excessive heat events.


The authors applied time-series models to a 14-year dataset featuring 107 U.S. communities to relate cold, heat, and heat wave effect estimates to community-specific variables (e.g., socioeconomic factors and urbanicity).


The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.


This editorial provides an overview of factors and issues to consider during heatwaves. The article includes links to the report authored by the World Health Organization and
World Meteorological Organization, guidance from the Centers for Disease Control and Prevention, and other applicable webpages.


This guidebook identifies best practices that have been implemented to save lives during excessive heat events in various urban areas. It provides critical information needed to help local public health officials, emergency managers, meteorologists, and others assess their community’s vulnerability to excessive heat waves, and develop and implement notification and response programs.

**Extreme Cold**


The authors describe a recent snowstorm that exceeded weather forecasts and contributed to 11 deaths in Southern Erie County (NY). Most of these deaths were "potentially preventable," and the Centers for Disease Control and Prevention developed a winter weather checklist to emphasize the importance of preparing for similar weather events.


Cardiovascular disease (CVD) admissions from four hospitals over 5 years were merged with weather data to determine if temperature affected hospital admissions among elderly people with CVD. The authors found that CVD admissions increased in the elderly during a period of 4-15 days following exposure to extreme cold, peaking at around a week’s time after exposure.


The authors looked at syndromic surveillance data from England for the 2010-11 and 2011-12 winters to characterize cold weather-related Emergency Department visits. The authors found that the strongest fit with temperature was cold-related fractures in females, and strongest fit for snowfall was cold-related fractures in both sexes.

The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.


This MMWR describes three selected cases of hypothermia-related deaths in Wisconsin, and summarizes risk factors based on all cases that occurred in the state during the period of active surveillance in 2014. A summary of hypothermia-related deaths for the United States during 2003–2013 also is presented for comparison.


The authors looked at 197, 680 deaths from natural causes, air temperature, and air pollution rates from November to April for 9 consecutive years. They found that individuals aged 85 and older, and those with cardiovascular diseases (including hypertensive diseases, stroke, congestive heart failure, chronic obstructive pulmonary disease (COPD), and pneumonia) had the greatest risk of death from exposure to extreme cold temperatures.

Fires/Wildfire


The information on this webpage can help first responders and community members understand the risk and protect themselves from the effects of wildfire smoke.


The authors conducted a comprehensive literature review of international research on wildfire-related health effects and led several focus groups with study authors. Results indicated that certain populations are especially vulnerable; wood smoke has high toxicity levels; respiratory morbidity is the leading health effect, wildfire exposure is also associated with burns (and related effects) and cardiovascular, ophthalmic, and psychiatric problems.

Readers can learn about how smoke from wildfires—both near and far—can have an effect on health. Maps that show how smoke from wildfires in 2011 affected many areas of the U.S. are included.

**Floods and Landslides**


In this article, the authors discuss infection prevention and control experiences related to the reopening of medical facilities after recent disasters in Thailand and the U.S.


The authors provide information for clinicians caring for flood victims. They describe the conditions seen in patients following floods, and characterize the causative agents of these conditions. Treatment is also discussed.


This one-hour webinar features Gary Goldbaum of the Snohomish (Washington) Health District, who discusses how his health district worked with partner agencies in response to the Oso mudslide in March 2014.


This article discusses the impact of the Mumbai floods and the provision of shelter-based and community care for over 150,000 cases of diarrhea, many consistent with leptospirosis by hospital staff and medical students, detailing the substantially increased risk of communicable disease during flooding events with poor sanitary conditions.


The author discusses infectious disease risks associated with extreme weather events, drawing on recent experiences, including Hurricane Katrina in 2005 and the 2010 Pakistan mega-floods. Historical examples from previous centuries of epidemics and
“pestilence” associated with extreme weather disasters and climatic changes are also discussed.


Ms. Quinn, a Medical Reserve Corps (MRC) Coordinator with Snohomish Health District, discusses the MRC response to the 2014 flooding and mudslide in Washington State.


The authors discuss lessons learned from this flood and landslide event in 2011, with a focus on pre-hospital and hospital organization and management of patients. They also describe the most common injuries treated (injuries were to the extremities, most requiring only wound cleaning, debridement, and suture), and note that the primary cause of death was from asphyxia due to drowning or mud burial.


This article documents how facility staff from Memorial Hermann Hospital incorporated lessons learned after Tropical Storm Allison flooded the facility with almost 40 feet of water in 2001.

**Hurricanes**


The authors interviewed 30 key informants (KI), including health and social service providers that provide healthcare to the under- and uninsured along the Mississippi and Alabama Gulf Coast. Pre-disaster issues of importance were patient education and preparedness; evacuation guidance and support; planning for special medical needs shelters; and health care provider preparedness. Post-disaster issues were communication; volunteer coordination/credentialing; and donation management, particularly for medications.

The authors interviewed 30 key informants, including health and social service providers that provide healthcare to the under- and uninsured along the Mississippi and Alabama Gulf Coast. Respondents indicated that mental health, diabetes mellitus, hypertension, respiratory illness, end-stage renal disease, cardiovascular disease, and cancer were medical management priorities after a disaster. The most frequently mentioned barrier to providing care was maintaining continuity of medications. Inaccessible medical records, poor patient knowledge, and financial constraints also impacted care. Implemented or suggested solutions included better pre-disaster patient education; support for electronic medical records at community health centers; and better management of donated medications/medical supplies.


The author recounts the challenges associated with providing care in a university hospital’s neonatal intensive care unit before, during, and after Hurricane Katrina made landfall.


The author describes her experience in Charity Hospital following Hurricane Katrina, with a focus on the unexpected necessities (e.g., shoes, extra underwear, shift work/sleep, morale-boosting activities, a team of professionals who care about patients and each other, etc.) that arose, and how they were addressed.


The authors retrospectively reviewed their hospital's disaster plan and compared it with actual events that occurred after Hurricane Katrina. They evaluated and scored vital support areas as adequate (3 pts), partially adequate (2 pts), or inadequate (1 pt), with the following results: water-3.0, food-2.4, sanitation-1.5, communication-1.4, and power-1.5. The authors concluded that, despite writing and exercising plans, the hospital was still not fully prepared.


This website contains links to all hurricane-related MMWRs, including valuable epidemiologic information from multiple hurricanes, mold-related and other post-hurricane illnesses and injuries, and longer-term health effects.

The authors describe a novel approach to reestablishing connectivity with the electronic health records server for a hospital affected by Superstorm Sandy through resource-sharing of a disaster response asset from a hospital in a neighboring state.


The author discusses infectious disease risks associated with extreme weather events, drawing on recent experiences, including Hurricane Katrina in 2005 and the 2010 Pakistan mega-floods. Historical examples from previous centuries of epidemics and “pestilence” associated with extreme weather disasters and climatic changes are also discussed.


The authors reviewed data on the disease burden for exacerbation of chronic diseases following natural disasters, focusing on renal, cardiac, and diabetic patients. They note that it is critical for healthcare providers to anticipate the need for care in this population and to educate patients on their diseases so that they can better manage their conditions following a disaster.


The authors describe how their hospital system’s response plans were revised after Hurricane Rita in anticipation of Hurricane Ike in 2008. They note that, despite planning and exercising their plan, there were still a number of lessons learned that could be helpful to other hospitals during future disaster responses.


The authors surveyed 174 Medicare-certified hospitals located in declared disaster areas in Connecticut, New Jersey, and New York during Superstorm Sandy and conducted 10 site visits and collected other types of data. They found that a small percent of hospitals (7%) evacuated during the storm (the rest sheltered in place). The report describes several cases of flooded hospitals and recommends continued community disaster collaboration.

The author discusses the circumstances surrounding the arrest of a physician and two nurses for allegedly euthanizing four elderly patients at Memorial Hospital in Louisiana after Hurricane Katrina. Issues such as altered standards of care, scarce resource allocation, triage, and indemnification and/or immunity for health professionals are included.


The authors describe the challenges associated with evacuation of a morbidly obese patient during Superstorm Sandy, and how those challenges influenced the decision not to evacuate the patient, even in the absence of power and running water.


This article discusses lessons learned from the evacuation of two NYC area hospitals in response to Hurricane Sandy in 2012.


The authors discuss the challenges and benefits of transferring their patients to other hospitals along with their care teams in preparation for, and following Hurricane Sandy.


Red Cross disaster mental health volunteers used an evidence-based tool called PsySTART to collect data on risk factors for post-traumatic stress disorder (PTSD), depression, and anxiety among survivors at shelters, emergency aid stations, and mobile feeding and community outreach centers. They found 17,979 risk factors, with significant differences across survivors in eight counties. They also found survivors with high risk in areas apart from those with the greatest physical damage.


This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

Just after Hurricane Katrina, the Centers for Disease Control and Prevention collaborated with the Louisiana Department of Health and Hospitals to establish an injury and illness surveillance system in functioning hospitals and medical clinics. The surveillance system recorded more than 7,500 nonfatal injuries in the month after the storm, with the leading "mechanisms of injury" being fall and cut/stab/pierce. Residents were more likely than relief workers to be injured.

**Tornadoes**


This MMWR describes 13 cases (5 of which were fatal) of cutaneous mucormycosis identified after the 2011 Tornado in Joplin, Missouri. It reminds clinicians to consider fungal infections in individuals presenting with necrotizing soft-tissue infections following tornadoes, and to begin treatment as soon as possible in suspected cases.


The authors review the clinical courses of 24 patients who suffered cranial, spinal, and peripheral nerve injuries due to the tornadoes that touched down in Alabama in 2011, and the medical responses of the pediatric neurosurgical team they were part of.


The authors examined the demographics of the 247 decedents from the tornado outbreak in Alabama on April 27, 2011 and found that females and older adults were at highest risk for tornado-related deaths. The authors stressed the importance of local community shelters (and messaging to inform residents of shelter locations); encouragement of word-of-mouth warnings; and personal and family preparedness planning (with a focus on helping vulnerable population members take shelter).


On May 3, 1999, powerful tornadoes, including a category F5 tornado, swept through Oklahoma, resulting in 40 deaths and hundreds of injuries. The authors examined all
tornado-related deaths, hospital admissions, and emergency department visits to identify important risk factors.


This 90-minute webinar discusses lessons learned from the Joplin, Missouri, tornado about legal hospital emergency response issues.


The author describes pneumonia cases admitted to Freeman Health System in Joplin, Missouri from May 2009 to May 2012. She found a higher incidence of pneumonia cases, particularly those caused by uncommon microbes, in the group of cases that lived or worked in the tornado zone in the year following the Joplin tornado. She concludes that respiratory infections many increase following tornadoes, and should be treated with broad-spectrum antibiotics, not currently standard practice for community-acquired pneumonia.


The authors write that disaster-related wounds contaminated with soil or vegetative matter should be monitored for mucormycosis. They provide an overview of treatment strategies and encourage emergency physicians to “maintain a high index of suspicion for cutaneous mucormycosis infections when deep injuries” present.


The authors review data on 13 patients who developed necrotizing cutaneous mucormycosis, a rare fungal infection, in addition to other injuries sustained form an F-5 tornado. The authors share risk factors, treatment strategies, and other relevant information that can help healthcare providers work with tornado survivors.


The authors analyzed tornado-related injuries seen at hospitals and risk factors for tornado injury, and screened for post-traumatic stress following a statewide tornado-emergency in Alabama in April 2011. The majority of injuries were not life-threatening; the most severe injuries affected the head and chest regions.

This report describes response and recovery operations by several hospitals during the 2011 natural disasters in Missouri. It summarizes lessons learned, with a focus on the Joplin tornado.


The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.


This article describes the planning one health center undertook to secure its data so that it could be accessed after a disaster, and discusses why healthcare information technology must be a priority focus for planning. The authors advocate for increased federal funding and clear guidelines from federal planning partners in support of physical security, data back-up, and redundancy planning, as well as staff training to support these technology needs.


This one-hour webinar covers the provision of pre-hospital care; the patterns of injury seen after hurricanes and tornadoes, including appropriate initial management; appropriate emergency risk communication messages; and the importance of data collection to improve messaging and response efforts.

**Tsunamis**


The authors describe the effects of the 2004 tsunami on medical facilities and systems in 10 countries.

This article describes the health response to the 2004 tsunami that caused nearly 225,000 deaths in eight countries on two continents. Information on rapid response, conducting health and needs assessments, and public health surveillance is included.

Centers for Disease Control and Prevention. (2013). Tsunami-Related Information for Clinicians. This webpage includes general information on the health effects of tsunamis, resources on handling human remains, and links to disaster mental health resources.

*Geiger, A., Kawauchi, K. and Bellamy, S. (2015). Innovative Disaster Responses Model Approaches from Japan's 3/11 Disaster. Japan Center for International Exchange. The authors present four examples of initiatives that helped communities recover from Japan's earthquake/tsunami "3/11 Disaster." They stress the important role of healthcare providers in ensuring access to care and reducing stressors in survivors.

*Li, X.H., Hou S.K., Zheng J.C. et al. (2012). Post-Disaster Medical Rescue Strategy in Tropical Regions. World Journal of Emergency Medicine. 3(1): 23–28. The authors analyzed the medical response to earthquakes and tsunamis in tropical regions and found that shock, infection, and heat stroke were frequently encountered by survivors.

*Nagamatsu, S., Maekawa, T., Ujike Y., et al. (2011). The Earthquake and Tsunami--Observations by Japanese Physicians Since the 11 March Catastrophe. Critical Care. 15(3):167. The authors discuss how lessons learned from the 1995 Hanshin earthquake and effective use of the Internet for communication and coordination assisted with the response to the 2011 earthquake and tsunami. They also describe and compare the injuries and causes of death for the two events.


Mitigation

American Meteorological Society. (2014). A Prescription for the 21st Century: Improving Resilience to High-Impact Weather for Healthcare Facilities and Services. This report shares workshop findings on increasing and improving the resilience of healthcare facilities and services to high-impact weather events. The workshop grouped
their findings into three main categories: hardening structures, making incremental adaptations, and implementing innovative practices.


This design guide can inform and help design professionals, hospital administrators, and facility managers employ sound mitigation measures that will decrease the vulnerability of hospitals to disruptions from natural hazard events (e.g., earthquakes, high wind events, floods).


This vulnerability assessment highlights structural, non-structural, and functional elements that must be considered to ensure that a health facility can withstand and remain operational in emergencies.


The materials from this workshop can help hospital administrators and facility managers identify opportunities to implement seismic mitigation in their facilities.


The authors use models to measure the resilience of different medical building types to excessive heat. They found that masonry and Nightingale wards (a large room without subdivisions) fared better than rooms in light-weight modular buildings.


This 106-page document provides information about three potential levels of protection for hospitals and health facilities from adverse events such as disasters, or performance objectives: life safety, investment protection, and functional protection.


This guidance document includes two hospital-specific case studies that illustrate the successful use of floodwalls.

The presenter focuses on four main areas: the impact of an unexpected natural disaster on healthcare services; how the nation responded to help the Joplin community; how to incorporate lessons learned into planning; and how to design enhancements that can protect against future incidents.


This document discusses how to safeguard health facilities from natural disasters, how to retrofit existing facilities, and plan and train for emergencies.

Plans, Tools, and Templates

Earthquakes

Children's Hospital and Research Center Oakland. (n.d.) Children's Hospital Earthquake Response Guide. (Accessed 10/20/2015.)

The goal of this plan is to maintain hospital operations for at least four days after a major earthquake and to ensure that care continues for patients, visitors, and survivors of the earthquake. This plan can be adapted to meet the needs of hospital emergency response professionals and healthcare preparedness planners.


This webpage provides a summary of the hospital's earthquake plan and can help assist other hospitals as they update or develop their own earthquake plan.

Excessive Cold


This checklist can help healthcare facility staff plan for and respond to major snowstorms (i.e., 12 or more inches of accumulation).


These checklists can help residents prepare for winter weather. Checklists for communication, heating, food and safety, and car supplies are included.

This toolkit can help local health authorities develop public messaging before and during periods of extreme cold weather. It includes key messages, sample press releases, factsheets, links to key resources, and sample social media messages for Twitter and Facebook.


This document outlines the hospital's plan for “an anticipated or an actual snow storm, the severity or duration, or any combination in which it is necessary.” It includes information on personnel practices, nurse staffing, and the transportation command center.

Excessive Heat


This plan was developed by the Arizona Department of Health Services to address and help limit the adverse public health effects from excessive heat. It identifies conditions or events that would trigger activation of the emergency response plan, and provides a framework for coordinating efforts with other agencies that provide services to at-risk populations. The plan also includes a list of prevention and educational resources that can help mitigate heat-health adverse effects and deaths.


This guide provides local health officials and public information officers with information on health impacts of extreme heat events, decision-support tools, and useful resources for prevention of heat-related illnesses. This document also supports the Arizona Department of Health Services Heat Emergency Response Plan.


This extreme heat response plan can be downloaded and tailored by a local jurisdiction. It was provided to ASPR TRACIE by a state representative who requested identifying information be redacted prior to sharing with the field.


The authors review heat wave plans from 18 cities and list recommendations for overcoming challenges (e.g., targeted outreach geared towards the socially isolated, begin prevention efforts before high temperatures arrive, and collect and use data to determine the effectiveness of interventions).

The materials on this webpage include a toolkit, web tools, and press release and other templates that can help community leaders develop communication plans for extreme heat events.


This website is geared towards people with diabetes and includes tips for planning ahead for hot weather and emergency situations.


These checklists can help mental health service providers identify consumers and vulnerable residents at highest risk for heat-related illnesses.


These checklists can help healthcare and other service providers identify vulnerable residents at highest risk for heat-related illnesses.

East Central (GA) Regional Hospital. Heat Plan.

This document outlines the East Central Regional Hospital's plans for extreme heat situations. It includes response actions by title (e.g., Safety Manager, Nurse Director) and recovery actions. The plan also includes a list of preventive measures, symptoms and treatment, and a weather index chart that lists steps to follow by temperature level.


This toolkit can help health communicators charged with developing or updating heat-health communication strategies, and features strategies for reaching specific audiences.


The authors looked at 292,666 cardiovascular and 562,738 respiratory disease Emergency Department (ED) visits over an eight-year period in Toronto. They found that: diabetics exposed to extreme heat had more ED visits vs. non-diabetics; respiratory disease ED visits during hot weather were higher for individuals with comorbid respiratory diseases.
and cancer; exposure to extreme cold temperatures over a 2-week period increased cardiovascular disease ED visits for individuals with comorbid cardiovascular diseases, and kidney diseases.


This toolkit can help local health authorities develop public messaging before and during periods of extreme heat. It includes key messages, talking points, sample press releases, fact sheets, sample social media messages for Twitter and Facebook, and links to related information in English and Spanish.


This checklist can help healthcare facility staff plan for and respond to extreme heat events.

Fires/Wildfires


This webpage can help users prepare for a wildfire, take proper actions during a wildfire, and prevent injury and address physical and emotional health after a wildfire.


This 46-page document was created to address the vulnerability of hospitals to fires. It is intended that all possible steps should be taken to minimize the hazard of fires in hospitals and the need for evacuation. The guide is applicable to existing hospitals that can be retrofitted to improve safety against fires, as well as proposed new-build facilities.


This webpage provides up-to-date information on wildfires across the country. Users can search by state or incident name. Photographs, announcements, and news articles are also included.


This webpage includes information and links to factsheets and other resources that can help users learn about current wildfires, smoke conditions, and how to reduce the health effects of wildfire smoke.
Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2015). Crisis and Emergency Risk Communication Toolkit for Wildfire Smoke. This toolkit can help local health authorities develop public messaging during a severe wildfire smoke event. It includes key messages, talking points, sample press releases, sample social media messages for Twitter and Facebook, and links to related information.

U.S. Department of Health and Human Services, Disaster Information Management Research Center. (2015). Fires and Wildfires. This webpage provides links to fire and health-related information and other relevant resources. Information is geared towards health professionals and the general public.

Weston, B., Lappe, M., and Hick, J. (2014). Heat Checklist. Hennepin County Medical Center. This checklist can help healthcare facility staff plan for and respond to extreme heat events.

Floods and Landslides

Louisiana State University Health Sciences Center. (2012). External Flood Prevention Plan. Campus Wide/Hospital Safety Manual. This plan was designed to help prevent floodwaters from entering the ground floor of the medical school and hospital and can be used by medical facility planners faced with similar challenges.


Oregon Health Authority, Public Health Division Health Security, Preparedness, and Response Program. (2015). Risk Communication Toolkit for Flooding. This toolkit can help local health authorities develop public messaging before, during, and after a flood event. It includes information relevant to the actual event and the recovery period: key messages, talking points, sample press releases, factsheets, links to key resources, and sample social media messages for Twitter and Facebook.

World Health Organization, Regional Office for Europe. (2014). Floods and Health: Fact Sheets for Health Professionals.
These fact sheets are geared towards health professionals and describe steps to take during a flood, in the absence of a flood health preparedness and response plan. The sheets cover a variety of strategies including: vaccination during flood events, food safety, water and hygiene in healthcare facilities during and after flood events, and post-flood disinfection strategies.

**Hurricanes**

Jackson Health System. (2012). [Hurricane Response Plan](#).

This healthcare facility hurricane plan can serve as a model for others. It includes sections on scope and planning assumptions, hazard analysis (which can be tailored to a specific jurisdiction), concept of operations (from preparation to recovery), accommodations, employee plans, information on making claims for reimbursement for disaster-related damage, and hospital incident command system.

Monroe Regional Medical Center. (2012). [Hurricane Preparedness Plan](#).

This plan includes sections on pre-hurricane planning, procedures to follow during a hurricane, and recovery. It also includes appendices on a variety of topics, including a list of shelters in the area, items to bring if working during and after a storm, and visitor policy.


These short podcasts were developed to help emergency responders and recovery workers prepare for hurricane-related hazards (e.g., mold, debris, and electrical hazards).


This plan was written to help state hospitals prepare for, respond to, and recover from hurricanes. The plan focuses on sheltering in place and related needs. The plan also includes templates that can be tailored by healthcare facilities.

**Tornadoes**


This webpage lists the steps that will be taken by the hospital in the event of a tornado warning. Steps are listed by the person responsible for taking them.
Tsunamis


This document provides a general plan of action and basic framework for dealing with the unique hazards resulting from tsunamis and can be adapted for use by healthcare emergency planners.

Agencies and Organizations

Note: The agencies and organizations listed in this section have a page, program, or specific research dedicated to this topic area.

Centers for Disease Control and Prevention. Extreme Heat.


Federal Emergency Management Agency.

National Oceanic and Atmospheric Administration.

National Weather Service.

U.S. Department of Health and Human Services, Disaster Information Management Research Center. Fires and Wildfires.


United States Geologic Survey (USGS).

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