ASPR TRACIE Technical Assistance Request

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Request:

To examine and outline the El Niño effects on Domestic weather patterns and the potential related health effects.

Response:

El Niño is a disruption of the ocean-atmosphere system in the Tropical Pacific having important consequences for weather and climate around the globe. It occurs every 2-7 years, and is characterized by a warming of the Pacific Ocean between South America and the Date Line, centered directly on the Equator, and typically extending several degrees of latitude to either side of the equator. The current cycle is expected to continue through to spring 2016 in the Northern Hemisphere, with peak activity in late fall/early winter. Weather patterns are expected to mirror those of the 1997-1998 El Niño. This El Niño is expected to be one of the strongest over the past 50 years. La Niña, which occurs when cooler than usual ocean temperatures occur on the equator between South America and the Date Line, is the opposite of El Niño, and another phase in the El Niño/Southern Oscillation (ENSO) cycle. When La Niña occurs, weather patterns are generally opposite to those of El Niño.

According to the National Oceanic and Atmospheric Administration (NOAA), the chance of El Niño is >95% through winter and just under 50% by late spring (April-June) 2016.

I. El Nino Weather Patterns and Consequences

The various El Niño forecasts are each organized slightly differently, as reflected in the table below.

Geographic Area	Possible Effects-Fall-Spring 2015-2016
Northern Tier of the U.S.	Above-average temperatures and below-median precipitation. From Hawaii, central and western Alaska, parts of the Pacific Northwest and northern Rockies, and for areas near the Great Lakes and Ohio Valley. Reflected in green/yellow/orange in Exhibit 1.
Southern Tier of the U.S.	Below-average temperatures and above-median precipitation. From central and southern California, across Texas, to Florida,

Geographic Area	Possible Effects-Fall-Spring 2015-2016
	and up the East Coast to southern New England, also Southeastern Alaska. Reflected in blue tones in Exhibit 1.
California	In general, high amounts of rain and snow are likely. See below for additional information.
Southwest (southern California, Arizona, southern Nevada, New Mexico, and southern Utah)	50% chance that winter precipitation totals will be in the top 33% of historic values across far southern California, Arizona, and New Mexico. Wetter than normal conditions along the southern third of California eastward across Arizona, southern Nevada and Utah, New Mexico, and into Texas (more rainy days, and more rain per rainy day). Cooler than normal temperatures in the far southeastern portion of the West, especially in southeastern New Mexico.
Central and northern California, northern Nevada, southern Oregon, northern Utah, southern Wyoming, and much of Colorado	The effects of El Nino are ambiguous. No strong association in either direction (toward wet or dry) can be discerned.
Pacific Northwest, Northern Rockies, and Interior Northwest	Above normal temperatures and below normal precipitation. Drought may be prolonged in interior northwest and extended into norther Rockies, with drier than normal conditions.
Great Lakes Region	Less lake-effect snow than usual expected.
Northeast and Mid-Atlantic	Above-average storminess, though it is unclear what form the precipitation will take.
Florida	Explosive thunderstorms and very heavy rainfall.
Southern Alaska	Wetter winter expected.
Hawaiian Islands	Dry winter expected. Drought is more likely during El Niño years, during the October-March period.
Illinois	Falls tend to be wetter and cooler than average. Winters tend to be warmer and drier, with below average snowfall. Springs tend to be drier than average.

Also of note, El Niño increases tropical storm activity in the Pacific, and decreases tropical storm and hurricane activity in the Atlantic, Caribbean Sea, and Gulf of Mexico.

Exhibit 1. El Nino Precipitation - US Weather Outlook: 2015-2016 Credit: NOAA

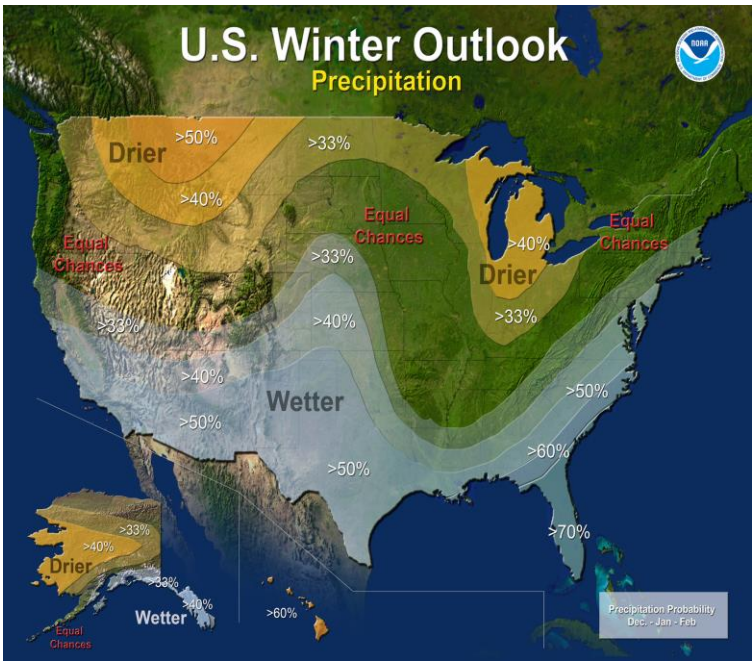


Exhibit 2. El Nino Winter Temperature Outlook for Northern Tier US/ Credit: NOAA Presentation to the Emergency Support Leadership Group on 17 November 2015

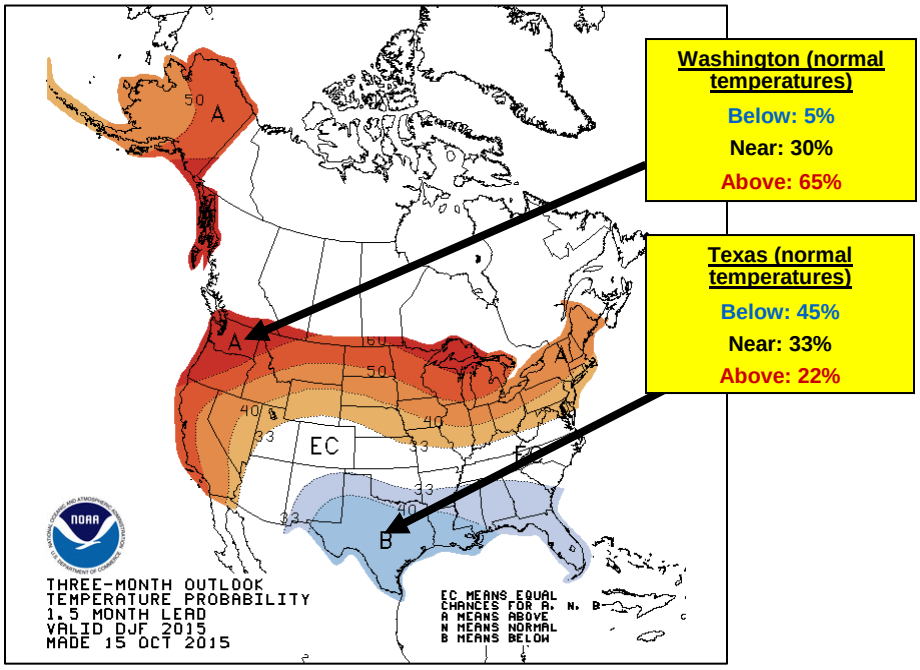


Exhibit 3. El Nino Winter Temperature Outlook for Southern Tier US/ Credit: NOAA Presentation to the Emergency Support Leadership Group on 17 November 2015

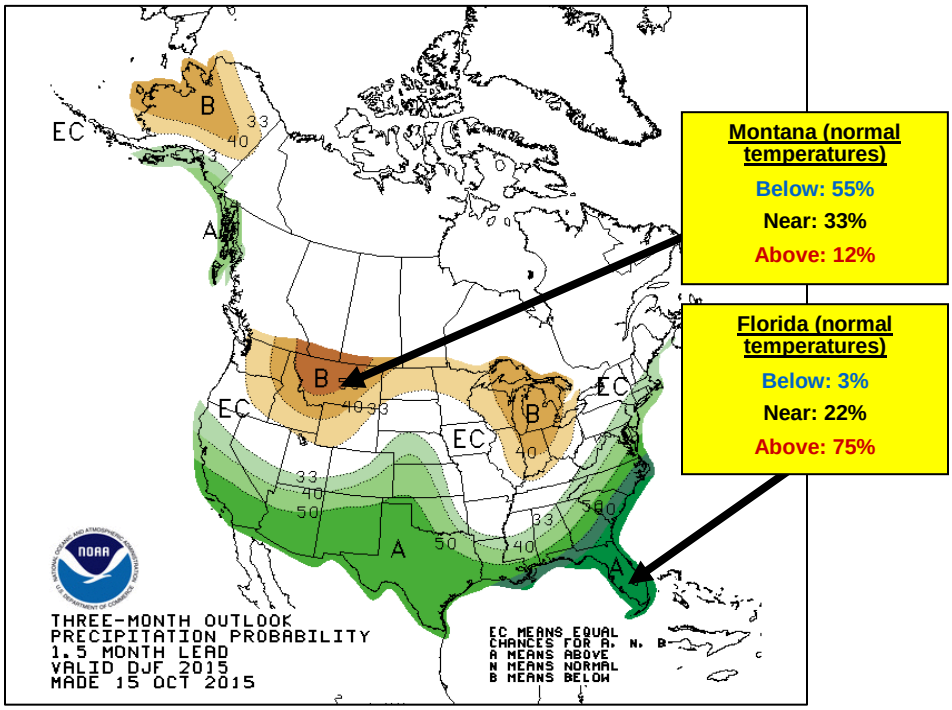
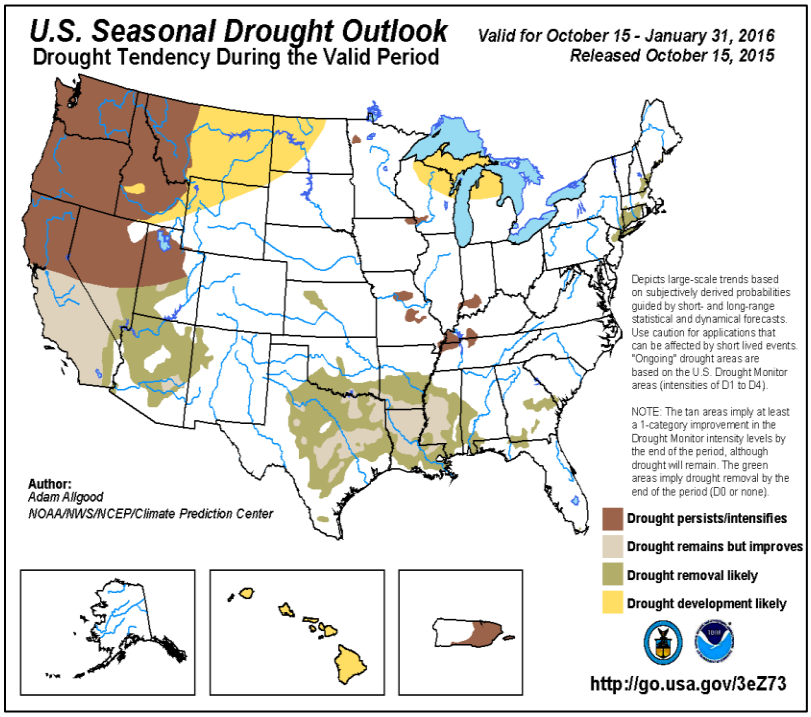


Exhibit 4. Nov-Jan Drought Outlook/ Credit: NOAA Presentation to the Emergency Support Leadership Group on 17 November 2015



II. Potential Health Effects

The global health effects of El Niño are well-documented, though there is little data on its effects on human health in the United States. This is likely because El Niño generally affects other parts of the world more significantly, and because its effects on human health in resource-poor areas are more pronounced. To determine the potential health effects El Niño may have in the United States, available information from prior El Niño years and general information on how weather and topographical phenomena may affect health were reviewed.

Excessive Rainfall, Flooding, and Landslides

- Flooding and/or landslides could cause structural damage, power outages, and present generally hazardous conditions in health care facilities that would impact critical care delivery capabilities and require the evacuation of some, or all affected patients.
- An increase in dermatological infections generally follows flooding. Contact with contaminated water can also cause wound infections, conjunctivitis, and ear, nose and throat infections.
- Incidence of water-borne diseases may increase, leading to diarrhea and dehydration, particularly when drinking water facilities are affected by contamination and/or loss of power. Leptospirosis infections are possible following contact of mucous membranes with water, damp soil/vegetation, or mud contaminated with rodent urine.
- Higher incidence of vector-borne diseases may result from increases in standing water sources where mosquitoes breed, as well as expanded habitats.
- Landslides may cause increases in traumatic injuries and wounds that require cleaning and debridement.
- Loss of livelihood, such as through crop failure, could result in increases in mental and behavioral health concerns and worsening of chronic health conditions due to lack of insurance/financial hardship and stress.
- Loss of homes could result in increases in mental and behavioral health concerns and worsening of chronic health conditions due to stress and lack of access to regular medical care either through displacement, or financial hardship.
- Workers who routinely handle corpses may have a risk of contracting tuberculosis, bloodborne viruses (such as Hepatitis B/C and HIV), and gastrointestinal infections (such as rotavirus diarrhea, salmonellosis, E. coli, hepatitis A, shigellosis and cholera).

Drought

- Water quantity and quality may be compromised by drought conditions, which could result in increased illness.
- Lack of water or water conservation efforts may affect healthcare facilities' ability to function and deliver care.
- Increases in injuries resulting from recreational activities that rely on adequate water levels may be seen.

- Dry conditions may lead to wildfires and dust storms. Both could lead to increases in respiratory ailments, like bronchitis and pneumonia, as well as worsening of chronic lung diseases. In addition, the most intense global pollution from fires occurred during droughts caused by El Nino.
- Loss of livelihood, such as through crop failure, could result in increases in mental and behavioral health concerns and worsening of chronic health conditions due to lack of insurance/financial hardship and stress.
- Loss of homes could result in increases in mental and behavioral health concerns and worsening of chronic health conditions due to stress and lack of access to regular medical care either through displacement, or financial hardship.

Severe Thunderstorms

- Power outages are possible with severe thunderstorms, and could disrupt many health care facility functions/equipment, such as lighting, medical records, ventilators, disinfection equipment, and food services. Evacuations may be required for some, or all affected patients.
- Power outages could lead to more trips and falls, increasing traumatic and neurological injuries that require care.
- Incidence of food-borne illness could increase during power outages, particularly if they are widespread and prolonged.
- Tornadoes are possible with severe thunderstorms, and could lead to increases in traumatic injuries, peripheral nerve injuries, soft tissue infections, and pneumonia cases. Infections may be caused by atypical microbes. Post-traumatic stress is also possible. Chronic health conditions may also worsen due to stress and lack of access to regular medical care either through displacement, or financial hardship.

Above Average Temperatures/Below Average Temperatures

- Temperature deviations could change the seasonality of diseases, including the flu, and vector-borne diseases.

III. Federal El Niño Preparedness Action Plan

On 24 November 2015, The National Security Council's workgroup focused on increasing preparedness of communities facing the impacts of flood in anticipation of El Niño rains, released the El Niño Preparedness Action Plan (not for public release). The working group included representatives from FEMA, USGS, NOAA, NWS, USDA, USACE, and DOI. The following actions are included in the plan:

1. Broadcast the latest forecasting data to the field- The most up-to-date El Niño forecast information shall be made widely available and communicated to state, local, tribal, and territorial governments as well as to the general public.
2. Prepare through practice and training- Joint exercises and pre-event training with state, local, tribal and territorial governments in high-risk areas will expedite and improve the effectiveness of flood response and preparedness efforts.

3. Ensure prompt action at the state and local level- Conduct community outreach and provide current resource information to target communities as well as individuals most susceptible to flood.
4. Continue all mitigation efforts- Continue mitigation such as seeding, debris clearance, and other efforts.

Appendix A: Research Results

El Niño-Specific Resources

EcoHealth 101: Environmental Change and Our Health. (n.d.). How Can El Niño Affect Human Health? Accessed October 26, 2015.

This webpage includes information on how excessive rainfall and drought caused by El Niño can affect human health.

Engelthaler, D.M., Mosley, D.G., Cheek, J.E. et al. (1999). Climatic and Environmental Patterns Associated with Hantavirus Pulmonary Syndrome, Four Corners Region, United States. Emerging Infectious Diseases. 5(1).

The authors discuss an outbreak of hantavirus cases in the Four Corners region of the U.S. from 1993-1995 following the 1992-1993 El Niño, which brought high amounts of rain, followed by drought conditions.

Intergovernmental Panel on Climate Change. (n.d.) Effects of El Niño Phenomenon on Health. Accessed October 23, 2015.

This report chapter discusses the effects of El Niño on human health in South America, based on historical data from prior El Niño years.

International Research Institute for Climate and Society, Earth Institute, Columbia University. (2014). Emerging El Niño Conditions: Notes for the Global Health Community.

This report describes health effects of past El Niño events and possible health impacts of El Niño in general. It also includes recommendations for action that health professionals should take to prepare for possible health effects of El Niño.

Kovats, R.S., Bouma, M.J., Hajat, S. et al. (2003). El Niño and Health. Published online May 20, 2003.

The authors discuss how the El Niño Southern Oscillation (ENSO) affects human health globally, citing evidence for how it increases malaria and cholera. They note that seasonal climate forecasts could help with targeting of resources for disease control and disaster preparedness.

Macmath, J. (2015). U.S. El Niño Forecast: California, East to Bear Brunt of Impacts This Winter. Accuweather.com.

This article discusses the anticipated impacts of El Niño on the U.S. this winter.

National Oceanic and Atmospheric Administration (NOAA). (n.d.) NOAA's El Nino Portal. Accessed October 23, 2015.

This website provides links to forecasts, observations, impacts, and other El Niño-related information. The "Current Diagnostic Discussion" and "Weekly Update" links provide summary information and are updated monthly and weekly, respectively. State-specific temperature and precipitation assessments are also available.

National Oceanic and Atmospheric Administration (NOAA). (n.d.) New Look at 1918/1919 El Niño Suggests Link to Flu Pandemic. Accessed October 23, 2015.

This article discusses how a re-analysis of data for the 1918-1919 El Niño links it to a severe drought in India at the time. Study authors suggest that the population in India was compromised because the drought led to famine and a lack of potable water, and that this, in turn, made them more susceptible to the flu pandemic affecting the world at that time.

National Oceanic and Atmospheric Administration (NOAA). (n.d.) Frequently Asked Questions about El Niño and La Niña. Accessed October 23, 2015.

This webpage contains frequently asked questions and answers about El Niño and La Niña.

State Climatologist Office for Illinois. (2015). El Niño and La Niña in Illinois.

This webpage discusses the anticipated effects of El Niño and La Niña on Illinois.

U.S. Geological Survey. (n.d.) Effects of El Niño on Streamflow, Lake Level, and Landslide Potential (Southwestern U.S.). Accessed October 23, 2015.

This webpage discusses the potential effects of El Niño on the southwestern U.S.

Western Regional Climate Center. (2015). El Niño Impacts and Outlook: Western Region.

This webpage provides a weather outlook for winter 2015-2016 for the western region of the U.S.

Western Regional Climate Center. (n.d.) El Niño, La Nina, and the Western U.S., Alaska and Hawaii: Frequently Asked Questions. Accessed October 23, 2015.

This webpage contains frequently asked questions and answers regarding how El Niño and La Niña affect the western U.S., Alaska, and Hawaii.

General Weather/Weather Effects Resources

Apisarnthanarak, A., Mundy, L., Khawcharoenporn, T., et al. (2013). Hospital Infection Prevention and Control Issues Relevant to Extensive Floods. Infection Control and Hospital Epidemiology. 34(2): 200-206. (Must login to JSTOR to retrieve full article).

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.

Bandino, J.P., Hang, A., and Norton, S.A. (2015). The Infectious and Noninfectious Dermatological Consequences of Flooding: A Field Manual for the Responding Provider. American Journal of Clinical Dermatology. 16(5): 399-424.

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.

Centers for Disease Control and Prevention. (2012). Drought and Health.

This webpage discusses the health effects of drought.

Centers for Disease Control and Prevention. (2011). Notes from the Field: Fatal Fungal Soft-Tissue Infections After a Tornado --- Joplin, Missouri, 2011. Morbidity and Mortality Weekly Report. 60(29);992.

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.

Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Agency, and American Water Works Association. (2010). When every drop counts: protecting public health during drought conditions— a guide for public health professionals. U.S. Department of Health and Human Services.

This document provides an overview of drought-and water-related information and principals, as well as drought-related public health effects. It also includes drought preparation and response considerations for public health professionals.

Chern J.J., Miller, J.H., Tubbs, R,S. et al. (2011). Massive Pediatric Neurosurgical Injuries and Lessons Learned Following a Tornado Disaster in Alabama. Journal of Neurosurgery. Pediatrics. 8(6):588-92.

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.

Finlay, S.E., Moffat, A., Gazzard, R. et al. (2012). Health Impacts of Wildfires. PLOS Currents Disasters. Nov 2;4:e4f959951cce2c.

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.

Forshee-Hakala, B.A. (2015). Pneumonia Cases Following an EF-5 Tornado. American Journal of Infection Control. 43(7):682-5.

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.

Grassly, N. and Fraser, C. (2006). Seasonal Infectious Disease Epidemiology. Proceedings of Biological Science. 273(1600): 2541–2550.

The authors discuss the causes and consequences of seasonality of infectious diseases, including how poorly understood and complex the mechanisms of seasonality are.

Hauser, A. (2014). Why Flu Season Strikes in Winter. The Weather Channel.

This article discusses theories as to why flu season occurs during the winter. The top theory is that cooler air and lower humidity promote transmission of the virus, and the warmer, humid air cause the virus to fall to the ground.

McMichael, A.J. (2015). Extreme Weather Events and Infectious Disease Outbreaks. (Abstract only.) Virulence. 6(6):539-43.

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.

National Resources Defense Council. (2013). Where There's Fire, There's Smoke: Wildfire Smoke Affects Communities Distant from Deadly Flames.

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.

Niederkrotenthaler, T., Parker, E.M., Ovalle, F. et al. (2013). Injuries and Post-Traumatic Stress Following Historic Tornados: Alabama, April 2011. PloS One. 8(12): e83038.

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.

Pereira, B., Morales W., Cardoso, R. et al. (2013). Lessons Learned From a Landslide Catastrophe in Rio de Janeiro, Brazil. (Abstract only.) American Journal of Disaster Medicine. 8(4):253-8.

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.

Redlener, I., Reilly, M. (2012). Lessons from Sandy — Preparing Health Systems for Future Disasters. National Center for Disaster Preparedness, Mailman School of Public Health, Columbia University, New York.

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

Rosen, Y. and Yakubov, N. (2013). Hurricane Sandy: Lessons Learned from the Severely Damaged Coney Island Hospital. (First page only.) Pre-hospital and Disaster Medicine. 28(6):643.

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.

Shin, P. and Jacobs, F. (2012). An HIT Solution for Clinical Care and Disaster Planning: How One Health Center in Joplin, MO Survived a Tornado and Avoided a Health Information Disaster. Online Journal of Public Health Informatics. 4(1).

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.

Shroades, R. (2007). Flood Preparedness: Once Bitten, Twice Ready. Facility Maintenance Decisions.

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.

Stanke, C., Kerac, M., Prudhomme, C. et al. (2013). Health Effects of Drought: A Systematic Review of the Evidence. PLos Currents. Published online June 5, 2013.

The authors conducted a literature review to determine the health effects of drought, many of which are indirect. They note the complexity of drought's effect on health, as it is difficult to assign a beginning and end to periods of drought, and discuss the main categories of findings from their research.

Sugerman, D., Armstrong, J. (2013). Prevention and Treatment of Injuries Following Hurricanes and Tornadoes. Centers for Disease Control and Prevention.

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.

World Health Organization. (n.d.) Flooding and Communicable Diseases Fact Sheet. Accessed October 27, 2015.

This fact sheet discusses the effects of flooding on communicable disease transmission.