



TRACIE

HEALTHCARE EMERGENCY PREPAREDNESS
INFORMATION GATEWAY

Utility Failures
Topic Collection
2/6/2017

Topic Collection: Utility Failures

Losing power or potable water after a critical incident can have serious and significant effects on both healthcare facilities and patients. Either situation could lead to facility evacuation, as the utilities are significantly interdependent within healthcare facilities. (Access the [ASPR TRACIE Healthcare Facility Evacuation/Sheltering Topic Collection](#) for more information on this topic.) The resources in this Topic Collection include lessons learned from recent disasters, case studies, and toolkits designed to help healthcare planners prepare to respond to, continue functioning during, and recover from post-disaster utility failures.

Planners may also wish to access several other related ASPR TRACIE Topic Collections. The [Access and Functional Needs](#) Topic Collection highlights recent case studies, lessons learned, tools, and promising practices for working with individuals with disabilities and others with access and functional needs. For information on planning for and treating patients with kidney disease during and after a disaster, access the [Dialysis Center](#) Topic Collection. The [Continuity of Operations \(COOP\) Failure Plan](#) Topic Collection also contains helpful resources.

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](#)

[Education and Training](#)

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[Plans, Tools, and Templates](#)

[Agencies and Organizations](#)

Must Reads

Anderson, G. and Bell, M. (2012). [Lights Out: Impact of the August 2003 Power Outage on Mortality in New York, NY. *Epidemiology*. 23\(2\): 189-193](#)

The authors examined the effect of a large U.S. blackout (2003, New York) on mortality. They found a 122% increase in accidental deaths and a 25% increase in non-accidental deaths.

California Emergency Medical Services Authority. (n.d.). [Incident Planning Guide: Utility Failure](#). (Accessed 1/17/2017.)

This document includes a series of questions to guide hospitals in planning for utility failures associated with systems such as power, water, heating, ventilation, air conditioning, medical air, vacuum, or medical gases.

California Hospital Association. (n.d.). [Loss of Utilities/Services](#).

This webpage includes links to many resources related to healthcare facilities preparing for and responding to utility outages. There are links to presentations, tools categorized by utility system, best practices, and lessons learned.

Centers for Disease Control and Prevention. (2014). [Power Outages](#).

This webpage includes links to general informational resources related to power outages and resources specific to worker safety and healthcare facilities.

Centers for Disease Control and Prevention and American Water Works Association. (2012). [Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities](#).

This comprehensive document provides a four-step process for the development of a hospital emergency water supply plan and includes tips for assembling the right planning team, performing a water use audit, analyzing alternatives, and developing and exercising the plan.

Healthcare & Public Health Sector Coordinating Councils. (n.d.). [Planning for Power Outages: A Guide for Hospitals and Healthcare Facilities](#). (Accessed 1/18/2017.)

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

Klinger, C., Landeg, O., and Murray, V. (2014). [Power Outages, Extreme Events and Health: A Systematic Review of the Literature from 2011-2012](#).

The authors identified 20 articles that examined the effects of power outages on health. Table 5 highlights the impacts by category (e.g., hospital, healthcare, community, and public health infrastructure).

Minghella, L. (2013). [Be Prepared: Lessons from an Extended Outage of a Hospital's EHR System](#).

The author shares her experience losing access to her facility's electronic health record system for ten days following a power outage.

Stoto, M., Pilch-Loeb, R., Savoia, E. (2015). [The Public Health System Response to the 2014 West Virginia Water Crisis](#).

The authors analyzed the public health system's response to the spill of close to 10,000 gallons of a chemical cleaning agent into West Virginia's Elk River, a public water supply to nine counties in the state. They focused specifically on internal and external (risk) communication with the public.

Stymiest, D. (2016). [Best Practices for Hospital Power System Reliability](#). Health Facilities Management

The author lists best practices for healthcare facility planners to consider regarding preventing, preparing for, and responding to power outages.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2014). [Working Without Technology: How Hospitals and Healthcare Organizations Can Manage Communication Failure](#).

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

Education and Training

Federal Emergency Management Agency. (2016). [IS-815: ABCs of Temporary Emergency Power](#).

This course can help emergency planners and responders understand the requirements associated with providing temporary generator power to facilities.

Virginia Department of Public Health. (2013). [Don't Sweat It: Preparing for Disasters in Nursing Homes and Assisted Living Facilities](#).

This video was developed to be an educational tool for staff training on emergency preparedness specific to long-term care facilities. The scenario follows staff as they deal with a major storm that causes a week-long power outage. The video covers topics including preparedness, sheltering in place, and evacuation.

Guidance

* California Hospital Association. (n.d.). [Loss of Utilities/Services](#). (Accessed 2/3/2017.)

This webpage includes links to many resources related to healthcare facilities preparing for and responding to utility outages. There are links to presentations, tools categorized by utility system, best practices, and lessons learned.

Centers for Disease Control and Prevention. (2014). [Clinical Guidance for Carbon Monoxide \(CO\) Poisoning After a Disaster](#).

This guidance can help healthcare providers determine whether patients are suffering from carbon monoxide poisoning (more likely to be an issue after a power outage, when residents are using generators).

Centers for Disease Control and Prevention. (2014). [Impact of Power Outages on Vaccine Storage](#).

This resource provides tips on maintaining the integrity of vaccine supplies during a power outage.

Centers for Disease Control and Prevention. (2014). [Power Outages](#).

This webpage includes links to general informational resources related to power outages and resources specific to worker safety and healthcare facilities.

Greater New York Hospital Association. (2015). [Power Disruptions](#).

The Greater New York Hospital Association shares links to documents that can help healthcare facilities plan for disruptions to electrical and other power systems.

Stymiest, D. (2015). [How to Plan for Water Outages](#). Health Facilities Management.

The author lists best practices for healthcare facility planners to consider regarding preventing, preparing for, and responding to water outages.

Stymiest, D. (2016). [Best Practices for Hospital Power System Reliability](#). Health Facilities Management

The author lists best practices for healthcare facility planners to consider regarding preventing, preparing for, and responding to power outages.

Transportation and Infrastructure Committee, U.S. House of Representatives. (2016). [Blackout! Are We Prepared to Manage the Aftermath of a Cyber-Attack or Other Failure of the Electrical Grid?](#)

This two-hour hearing of the Subcommittee on Economic Development, Public Buildings, and Emergency Management features experts in prolonged, widespread power outages discussing vulnerabilities, preparedness, and response.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2014). [Working Without Technology: How Hospitals and Healthcare Organizations Can Manage Communication Failure](#).

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

U.S. Food and Drug Administration. (2014). [Disposal of Contaminated Devices](#).

This resource provides tips on checking medical devices for contamination and disposing of contaminated products in order to help pharmacies return to business as soon as possible following flooding or loss of power.

U.S. Food and Drug Administration. (2015). [Medical Devices Requiring Refrigeration](#).

Tips for storing common medical devices and other products during and after a power outage are listed on this webpage.

Williams, M. (2016). [Healthy Energy: Creating Outage-Resilient Hospital Facilities](#). Healthcare Facilities Today.

In this blog post, the author explains the "Energy Network of Things" concept and how it can contribute to a healthcare facility's resilience in a power outage.

Lessons Learned

Abir, M., Jan, S., Jubelt, L., et al. (2013). [The Impact of a Large-Scale Power Outage on Hemodialysis Center Operations](#). (Abstract only.) Prehospital Disaster Medicine. 28(6):543-546.

The authors surveyed 90 dialysis centers in the areas adversely impacted by the June 29, 2012 mid-Atlantic storms that resulted in a large-scale power outage affecting up to three million people in multiple states. The objective of the study was to determine how power outage impacted operations in a sample of hemodialysis facilities in the impacted area. The study identified a number of best practices regarding back up power emergency planning and actions taken to ensure continuity of care for their vulnerable populations.

Anderson, G. and Bell, M. (2012). [Lights Out: Impact of the August 2003 Power Outage on Mortality in New York, NY](#). Epidemiology. 23(2): 189-193.

The authors examined the effect of a large U.S. blackout (2003, New York) on mortality. They found a 122% increase in accidental deaths, a 25% increase in non-accidental deaths, but their estimates of mortality risk exceeded actual reported mortality.

Barkemeyer, B. (2006). [Practicing Neonatology in a Blackout: The University Hospital NICU in the Midst of Hurricane Katrina: Caring for Children Without Power or Water](#). Pediatrics. 117(Suppl. 4):S369 -S374.

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.

* California Hospital Association. (n.d.). [Loss of Utilities/Services](#).

This webpage includes links to many resources related to healthcare facilities preparing for and responding to utility outages. There are links to presentations, tools categorized by utility system, best practices, and lessons learned.

Femino, M., Young, S., and Smith, V. (2013). [Hospital-Based Emergency Preparedness: Evacuation of the Neonatal Intensive Care Unit-The Smallest and Most Vulnerable Population](#). *Pediatric Emergency Care*. 29(1):107-13.

The authors describe a full-scale neonatal intensive care unit evacuation exercise and emphasize the importance of constant, clear communication.

Fink, S. (2013). *Five Days at Memorial: Life and Death in a Storm-Ravaged Hospital*. (Book available for purchase.)

The author details the consequences of Hurricane Katrina on Memorial Hospital in New Orleans. This book—a critical “call to action”—offers learning about the consequences of utilities failures and the importance of incident management, communication, and healthcare coalition connections between hospitals, community emergency medical systems, and emergency management during such incidents and why crisis care processes must be integrated into the incident command system.

Greenwald, P., Rutherford, A., Green, R. et.al. (2004). [Emergency Department Visits for Home Medical Device Failure During the 2003 North American Blackout](#). *Academic Emergency Medicine*. 11(7):786-789.

The authors assessed the characteristics of community-based medical device dependent individuals that rapidly sought assistance in the emergency department during the Northeast Blackout of 2003. The study sought to characterize the population and identify specific emergency planning scenarios and resources that could inform planning and response activities in any future emergencies or disasters.

Johnson-Arbor, K., Quental, A., and Li, D. (2014). [A Comparison of Carbon Monoxide Exposures after Snowstorms and Power Outages](#). *American Journal of Preventive Medicine*. 46(5): 481-486

The authors reviewed all carbon monoxide cases reported to the Connecticut Poison Control to better understand the difference between exposure after a snowstorm and exposure after a "power loss storm." They found most exposure took place within the first day after a snowstorm and two to three days after the power outage storm.

Kearns, R., Wigal, M., Fernandez, A., et al. (2014). [The 2012 Derecho: Emergency Medical Services and Hospital Response](#). *Prehospital and Disaster Medicine*. 29(5): 542-545.

This article describes the use of Emergency Medical Services (EMS) and hospital resources in West Virginia in response to the 2012 derecho that resulted in substantial power outages.

Klein, K., Rosenthal, M., and Klausner, H. (2005). [Blackout 2003: Preparedness and Lessons Learned from the Perspectives of Four Hospitals](#).

The authors reviewed after-action reports from four hospitals that experienced loss of power (and in two cities, water supply). They found that many issues landing or keeping patients in the hospital were social/resource rather than medical, which is consistent with more recent disasters (e.g., Hurricane Sandy).

Klinger, C., Landeg, O., and Murray, V. (2014). [Power Outages, Extreme Events and Health: a Systematic Review of the Literature from 2011-2012](#).

The authors identified 20 articles that examined the effects of power outages on health. Table 5 highlights the impacts by category (e.g., hospital, healthcare, community, and public health infrastructure).

Markham, P., Gianato, J., Hoyer, J. (2015). [After Action Review: Emergency Response to January 9, 2014 Freedom Industries Chemical Leak](#).

Several local health departments participated in a review of the response to the 2014 4-methylcyclohexane spill into the Elk River in West Virginia. Interagency communications and public risk communications were listed as challenges, and participants shared that, for example, flushing recommendations were not practical for hospitals (they suggested that in future incidents, hospitals be treated as separate from the business community).

Minghella, L. (2013). [Be Prepared: Lessons from an Extended Outage of a Hospital's EHR System](#).

The author shares her experience losing access to her facility's electronic health record system for ten days following a power outage.

Muscatiello, N., Babcock, G., Jones, R., et al. (2010). [Hospital Emergency Department Visits for Carbon Monoxide Poisoning Following an October 2006 Snowstorm in Western New York](#). *Journal of Environmental Health*. 72(6): 43-48.

The authors conducted telephone interviews with a subset of people who were diagnosed with carbon monoxide poisoning after winter storm-related power outages in 2006.

Present, D., Clair, J., Belyaev, S., et al. (2005). [Effects of the August 2003 Blackout on the New York City Healthcare Delivery System: A Lesson for Disaster Preparedness](#). *Critical Care Medicine*. 33(1): S96-S101.

The authors reviewed citywide emergency medical calls for service, emergency department visits, and hospital admissions after the 2003 power failure in New York City. They found unexpected increases in calls for service from respiratory device failures in community-based patients and note the need for better disaster preparedness planning for facilities and homebound patients.

Stoto, M., Piltch-Loeb, R., Savoia, E. (2015). [The Public Health System Response to the 2014 West Virginia Water Crisis](#).

The authors analyzed the public health system's response to the spill of close to 10,000 gallons of a chemical cleaning agent into West Virginia's Elk River, a public water supply to nine counties in the state. They focused specifically on internal and external (risk) communication with the public.

Tonn, G., Guikema, S., Ferreira, C., and Quiring, S. (2016). [Hurricane Isaac: A Longitudinal Analysis of Storm Characteristics and Power Outage Risk](#). *Risk Analysis*. 36(10): 1936-1947.

The authors collected and analyzed hourly power data outage for Louisiana and examined the correlations between outages and storm conditions (wind, rainfall, and storm surge). In the case of Hurricane Isaac, the authors found that wind speed, precipitation, and previous outages had a stronger relationship with outages (storm surge had a weaker relationship, even in areas where storm surge was significant).

Vugrin, E.D., Verzi, S.J., Finley, P.D., et al. (2015). [Modeling Evacuation of a Hospital without Electric Power](#). *Prehospital and Disaster Medicine*. 30(3):279-87.

The authors of this report describe a modeling case study of the 2001 evacuation of the Memorial Hermann Hospital in Houston, Texas. They used a model designed to track cascading events following loss of infrastructure services and to identify the staff, resources, and operational adaptations required to sustain patient care and/or conduct an evacuation.

Plans, Tools, and Templates

California Emergency Medical Services Authority. (n.d.). [Incident Planning Guide: Utility Failure](#). (Accessed 1/17/2017.)

This document includes a series of questions to guide hospitals in planning for utility failures associated with systems such as power, water, heating, ventilation, air conditioning, medical air, vacuum, or medical gases.

* California Hospital Association. (n.d.). [Loss of Utilities/Services](#).

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Centers for Disease Control and Prevention and American Water Works Association. (2012). [Emergency Disaster Plan Template](#).

This document provides a four step process for the development of a hospital emergency water supply plan and includes tips for assembling the right planning team, performing a water use audit, analyzing alternatives, and developing and exercising the plan.

Centers for Disease Control and Prevention and American Water Works Association. (2012). [Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities](#).

This document provides a four step process for the development of a hospital emergency water supply plan and includes tips for assembling the right planning team, performing a water use audit, analyzing alternatives, and developing and exercising the plan.

Children's Hospital and Research Center Oakland. (n.d.). [Loss of Electrical Power Incident Response Guide](#). (Accessed 1/18/2017.)

This response guide includes steps healthcare facility staff can take to maintain emergency power systems, patient care and safety, operations and clinical services, and other functions during a power outage. It can be customized by emergency planners from other healthcare facilities.

Healthcare & Public Health Sector Coordinating Councils. (n.d.). [Planning for Power Outages: A Guide for Hospitals and Healthcare Facilities](#). (Accessed 1/18/2017.)

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

Spectrum Health. (n.d.). [96 Hour Operations Impact Chart](#). (Accessed 2/6/2017.)

This chart can help healthcare facility staff plan responses for various types of outages (e.g., gas, electric, water). The second table indicates estimated time frames for activating agreements and rebooting systems.

Spectrum Health. (n.d.). [Risk Ranking Emergency Outlets](#). (Accessed 2/6/2017.)

This Excel spreadsheet can help medical facility planners prioritize and calculate a "risk rank" for electrical outlets during an outage.

Stymiest, D. (2008). [Taking Care of Business – How Hospital Electrical Shutdowns Can Facilitate Emergency Management](#).

The author shares a comprehensive approach to managing hospital electrical power shutdowns in light of the increasing complexity of hospital infrastructures and operational constraints. He illustrates how using an electrical "shutdown" as a pre-planned and scheduled exercise can help train staff; sample shutdown resources are included in the appendices.

U.S. Army Corps of Engineers. (n.d.). [The Emergency Power Facility Assessment Tool](#). (Accessed 1/18/2017; users must register for free and create profile.)

Healthcare and other critical infrastructure organizations can enter and store the information regarding their respective critical public facility generator requirements (along with required connection materials) into this online tool. The data is stored in a protected database and can help expedite delivery and installation of generators at prioritized and approved facilities during emergencies or disasters where commercial power is unavailable. This web site also offers facilities a permanent storage location and the ability to update the information as facility requirements change.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2015). [HHS emPOWER Map](#).

The map features de-identified population data, down to the zip code level, for Medicare beneficiaries that rely upon certain life maintaining electricity-dependent medical and assistive equipment. It also features real-time National Oceanic and Atmospheric Administration severe weather tracking capabilities to help community partners identify areas that may be impacted by severe weather and thus at risk for prolonged power outages. Together, this data assists community partners, such as hospitals, EMS, emergency managers, electric companies, and civic organizations, to better anticipate, plan for, and rapidly assist electricity-dependent populations within their communities.

Agencies and Organizations

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

California Hospital Association. [Loss of Utilities/Services](#).

Centers for Disease Control and Prevention. [Power Outages](#).

U.S. Department of Health and Human Services, Office of the Assistant Secretary of Preparedness and Response. [HHS emPOWER Map](#).

This ASPR TRACIE Topic Collection was comprehensively reviewed in January 2017 by the following subject matter experts (listed alphabetically):

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