

# Impact of 2003 Power Outages on Public Health and Emergency Response

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#### Abbreviations:

EMS = emergency medical services  
EOC = emergency operations center  
HAN = health alert network system

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#### Abstract

**Introduction:** In 2003, a major power outage occurred in the midwest and northeast United States affecting some 50 million people. The power outages affected multiple systems in state and local municipalities and, in turn, affected public health.

**Methods:** Semi-structured interviews were conducted using open-ended questionnaires, with a convenience sample of state- and locally selected subject matter experts from Ohio, Michigan, and New York. Respondents were interviewed in groups representing one of five areas of interest, including: (1) emergency preparedness; (2) hospital and emergency medical services; (3) municipal environmental systems; (4) public health surveillance and epidemiology; and (5) psychosocial and behavioral issues. The reported positive and negative impacts of the power outage on public health, medical services, and emergency preparedness and response were documented. Responses were categorized into common themes and recommendations were formulated.

**Results:** The amount of time that the respondents' locations were without power ranged from <1 hour to 52 hours. Many common themes emerged from the different locations, including communications failures, alternate power source problems, manpower and training issues, and psychosocial concerns. There was minimal morbidity and mortality reported that could be attributed to the event.

**Conclusion:** Power outages negatively impacted multiple municipal infrastructures, and affected medical services, emergency response, and public health efforts. Previous federal funding positively impacted public health and emergency response capabilities. Recommendations were made based upon the common themes identified by the respondents.

Recommendations may assist state and local health departments, medical service providers, and emergency responders in planning for future power outage problems.

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#### Introduction

On 14 and 15 August 2003, a major power outage occurred in the midwest and northeast United States (US), affecting an estimated 50 million people.<sup>1</sup> The power outages affected state and local municipalities, impacting multiple systems that, in turn, may have affected the public health and emergency response. The purposes of this study were to evaluate the impact of the power outage on public health and emergency preparedness and response, as well as the contribution of recent federally funded preparedness efforts. This report summarizes the general findings and provides recommendations that are offered as guidance for state and local health departments and other responders to emergencies caused by power outages.

## Methods

From 22 September through 08 October 2003, with the cooperation of state and local authorities, open-ended questionnaires were administered through semi-structured interviews to a convenience sample of approximately 55 state and local public health and emergency response subject matter experts. These experts were selected by their home state and local authorities, and were from Ohio, Michigan, and New York. Because the questionnaires were administered during a public health response and not as research, institutional review board approval was not required.

Respondents were interviewed in groups representing one of five areas of interest, including: (1) emergency preparedness; (2) hospital and emergency medical services; (3) municipal environmental systems; (4) public health surveillance and epidemiology; and (5) behavioral and psychosocial factors. In each location, the respondents were assigned into groups representing one of these five areas. The interviewers administered a standard questionnaire that had been developed for each of the five areas, and recorded each respondent's comments.

Every survey instrument for each area contained questions relevant to that particular area, and were designed to obtain information about the positive and negative impacts during the power outage, including: (1) What aspects of your agency's response to the power outage worked well?; (2) What aspects of your agency's response to the power outage needed improvement?; (3) As a result of the power outage, what additional preparedness activities did you learn are needed to cope with future events?; (4) How would your efforts have changed if the event had lasted 3–5 days?; and (5) In what way have federal preparedness funds helped your agency or jurisdiction become better prepared than in the past?

A qualitative review of the comments of the respondents from the different localities was performed to identify and summarize common themes and anecdotal information regarding the municipal infrastructure and public health impact, and the responses to the power outages. Identification of common themes facilitated the development of recommendations that should assist state and local emergency and public health personnel in preparing for future power outage response efforts.

## Results

The length of the power outages in the respondent's various locations ranged from <1 hour to 52 hours. Respondents reported several common themes regarding the impact of the power outages during this time frame. In addition, a number of anecdotal reports highlighted critical issues and are noted in each of the five emergency response areas.

### *Municipal Environmental Systems*

Multiple municipal environmental systems, including food protection, public water supply, and wastewater treatment, were affected by the power outages and potentially affected public health. Loss of power from failure or lack of backup generators caused a loss of pressure in affected water distribution systems, which led to the issuance of boil-water advisories. For instance, approximately 1.2 mil-

lion residential and industrial customers in one local jurisdiction had no water or water of uncertain quality. Boil-water advisories affected some 4.3 million people in another local jurisdiction and its surrounding area.

In some cases, because of the lack of explicit recommendations, public confusion existed on which uses of water required boiling, such as cooking or bathing. In addition, boil-water advisories created challenges for the food-service industry that required modifications in their operational procedures, such as discontinuing use of soda dispensers and ice making machines, and the use of bottled water for washing vegetables and hand washing.

Also, inadequate backup generators at some wastewater treatment plants resulted in the release of sewage into surface water. Two local jurisdictions ordered beach swimming areas to close to public use because of the sewage release.

Finally, the loss of refrigeration created a health risk from food spoilage in homes and restaurants. In some jurisdictions, the power outage created problems for operating food service facilities. For example, emergency action plans defining the conditions in which food facilities are allowed to operate during a power failure were not well-defined. Some jurisdictions reported that, in the days following the power outage, inspectors found that some foods had reached unsafe temperatures during the power outage.

### *Emergency Operations and Preparedness*

Respondents reported unexpected failures of or inadequacies with some of their emergency communications systems, that affected both emergency responders and the public. For instance, in one state, attempts to contact local authorities directly were unsuccessful until communications were coordinated through the state emergency operations center (EOC). In another instance, the EOC for one local jurisdiction did not have a backup generator.

Respondents reported that federally funded, post-11 September 2001 activities (such as regional collaboration and coordination of responders) and Y2K planning had improved response activities. Staffing plans and training for emergencies, for the most part, contributed to an efficient EOC activation and response. The impact of the power outage on personal staff readiness, ability to get to work, and family care plans often was unexpected. Because of this, one suggested improvement for preparedness and training was to include power outage events during terrorism exercises.

Other suggested areas for improvement were contingency plans for responders' power requirements and prescribed educational information for the public. In addition, suggested improvement in communications equipment included the use of 800 MHz and advisory-type radio systems, the use of T-1 and Integrated Services Digital Network telephone lines, and the use of streaming video and broadband cable. The health alert network system (HAN) was reported useful for emergency preparedness communication.<sup>2</sup> Respondents noted a need for redundant, interoperable, communications systems.

### *Hospital and Emergency Services*

Respondents interviewed about hospital and emergency

medical services (EMS) reported that EMS calls doubled in some local jurisdictions, primarily with questions anticipating medication storage and availability problems, oxygen supplies, and patients on home ventilators. In addition, all cities reported double the volume of emergency-911 telephone calls during the first 24 hours of the power outage. Visits to emergency departments increased as well. For instance, one local jurisdiction reported increased visits to hospital emergency departments from people who needed power for ventilator equipment or oxygen, and victims from motor vehicle crashes caused by nonfunctioning traffic lights. However, respondents reported that the use of an incident management system, such as a hospital emergency incident command system, helped during the response to the power outage.

Respondents also noted issues related to generator age and fuel availability. In some cases, even though generators worked well, not all of the essential systems, such as computers and laboratories, were connected to them. For example, one local jurisdiction did not have an operable hospital computerized tomography scanner during the power outage.

Electronic security systems in hospitals were affected, especially the default for such systems in the event of a power outage, such as either open or locked doors. This issue needs to be addressed. Also, several hospitals in one local jurisdiction reported that reliance on just-in-time inventory methods brought them to the verge of a serious shortage in essential supplies.

A suggested improvement for hospitals was to include representatives from hospitals and long-term care facilities in the state and local EOCs. In addition, hospitals should ensure emergency management agencies have key contact numbers, such as the emergency department and hospital EOC.

#### *Public Health and Surveillance*

Respondents reported that routine public health surveillance was maintained for reportable diseases in most instances. However, there was no reported extended surveillance for health problems related to the emergency, such as heat-related illness or carbon monoxide poisoning. Some respondents reported that the ability to conduct ongoing surveillance and epidemiologic investigations would have been degraded if the outage had lasted longer, primarily due to a transfer of personnel resources to other needed areas, and a shortage of fuel for public health vehicles. Some respondents reported inadequate planning about which agency should be responsible for public health messages.

Activation of the EOCs reportedly enhanced surveillance capabilities through improved communications between public health and other responding agencies. However, the regional public health EOC for one state was in a rented building whose owners ordered evacuation because of the power outage. Also in one state, to reduce power loads on the back-up system, much of the Public Health Department's critical information technology infrastructure was turned off temporarily by building facility staff until appropriate Department staff could contact them to correct the matter.

There was limited morbidity and mortality reported specifically relating to the power outages. One state report-

ed one death from carbon monoxide poisoning caused by the operation of a generator in a home. One of the local jurisdictions received passive surveillance reporting of increased enteric illnesses, although upon further investigation, the illnesses could not be confirmed. Using an active surveillance system, one state identified an increase in sales of anti-diarrheal medications in the days after the power outages, although no actual illnesses were confirmed.

Finally, some respondents reported minimal loss of pharmaceutical products that require refrigeration, such as vaccines, because of available backup generator power or prearranged relocation of pharmaceuticals to a facility with power.

#### *Psychosocial and Behavioral Issues*

Some respondents interviewed about behavioral and psychosocial responses reported that they had not spent much time planning for these issues before or during the power outage. Many felt that having mental health experts present in the EOC, not just on-call, would help EOC staff deal with the anxieties and fears of the public, and would have helped to alleviate some of their own stress had the blackout lasted longer.

Respondents believed that pre-scripted messages for the public, such as where to go for assistance and whom to contact for additional information, would be beneficial. Communication failures between field personnel and their own EOC, as well as communication between different EOCs contributed to the stress levels, as did the lack of training for emergencies involving prolonged power outages and multiple systems failures.

Finally, most respondents reported that the only special-needs population included in disaster plans was the elderly, and that other populations, such as children and persons with disabilities, should be included in future plans.

#### **Discussion**

Most reported power outages occur in conjunction with natural events such as hurricanes, ice storms, and earthquakes.<sup>3-6</sup> However, the power outages in August 2003 did not occur with a natural event, so researchers could study and understand the effects power outages alone have on the community. The US population has become accustomed to readily available electrical energy at all times, and its loss, especially for prolonged periods, could impair public health and emergency response. The lessons learned from such a single event can better prepare responders for multiple emergencies resulting from natural events or terrorism.

The most common themes include:

1. Power outages negatively impacted the infrastructure, communications and emergency response, and public health surveillance and response.
2. Communication was limited, largely because of failures of digital telephones and electronically powered phone devices, and in some cases, impaired response efforts, suggesting a need for improvement of communications within and between agencies.
3. Minimal morbidity and mortality was attributed specifically to the power outages, but respondents reported that the situation might have worsened if the outages had lasted longer.

4. Respondents reported lack of preparations and resources for coping with public anxiety and behavioral issues.
5. Additional training in power outage emergencies would have improved responder efforts.
6. Activation of state and local emergency operations (coordinated control) centers contributed positively to public health response efforts.

Federal funds were credited with helping to establish relationships, positions, and communications that facilitated problem resolution during the power outages.

Carbon monoxide poisoning resulting from inappropriate placement of generators or heaters is an important health consequence of power outages.<sup>3,4</sup> Other causes of morbidity and mortality during power outages include cold exposure,<sup>3</sup> heat-related illness,<sup>5</sup> and fire.<sup>6</sup>

Research is needed to assess post-emergency morbidity and mortality, to evaluate potential lives saved using active surveillance for emergency-related events, and to evaluate the use of pre-scripted public health messages for specific events.

This report infers a positive impact of recent [US] federal funding on emergency response efforts.<sup>7</sup> Federal funds were reported to have been used to create and fund public health positions such as epidemiologists, to implement syndromic surveillance systems, to provide for communications systems such as the Health Alert Network (HAN), and to help increase networking among health partners. At all interview locations, previous federally funded disaster-planning activities were credited with helping to establish professional and personal relationships between public health and other emergency-response professionals, which facilitated problem resolution during the power outages.

This report also suggests that one area in need of improvement is the assessment of the behavioral and psychosocial impact of emergencies.<sup>8,9</sup> Responding to emergencies is an inherently stressful and challenging activity. Personnel staffing the EOC and other emergency responders along with people in the affected communities, often can find themselves under considerable pressure in chaotic situations, which are associated with a broad range of behavioral and psychosocial effects. Even emergencies, such as the power outages in 2003, that are relatively short in duration and do not result in many injuries or deaths, still can be highly stressful, due to damage to infrastructures and extensive disruption of social and occupational routines. It is important to note that these factors were identified only through the inclusion of behavioral and psychosocial questions into the current assessment. Integrating behavioral and psychosocial factors into future public health assessments should improve the efficiency and effectiveness of planning efforts and service delivery by emergency response personnel that should enhance the quality of life among the public in the aftermath of catastrophic events.

#### *Limitations*

Limitations of this study include possible selection and information bias, and that findings and recommendations in this study may not be generalizable to other areas. The participants were selected by their own state and local jurisdictions. The fact that participants were interviewed in

groups may have influenced their individual responses. These findings may not represent all of the impacts of a power outage, but they document the experiences in some major state and local jurisdictions.

#### *Recommendations*

The following are general recommendations (including references related to the area of interest) based upon the findings of this study and are offered as guidance for state and local health departments, hospital and prehospital emergency medical service providers, and other responders to emergencies caused by power outages.

1. Consider a systematic assessment of emergency response to relatively short events, including the integration of public health and municipal environmental infrastructure, to identify gaps, and to improve preparedness for a wide variety of natural and human-made events and disasters, including terrorism.<sup>10</sup>
2. Plan for multiple-systems failures in a multistate power outage and similar events in communities that usually rely on aid from nearby communities.
3. Review and discuss with interagency partners, current research and recommendations regarding interoperable and redundant communications.<sup>11</sup>
4. Review and test appropriate locations for functioning back-up generators, as well as the critical systems attached to the generators that are needed for proper operations. This information should be verified on a recurring basis as facility and/or technology improvements are made.
5. Prepare pre-scripted public health messages and educational information related to the specific emergency to assist state and local authorities in warning communities of the most common morbidity- and mortality-associated outcomes related to that emergency.<sup>12-14</sup>
6. Initiate active surveillance for morbidity and mortality associated with the specific event, such as carbon monoxide poisoning and heat- or cold-related illness with regard to power outages, to assist responders in identifying a potential increase in mortality and morbidity, allowing for a more proactive public health response.<sup>15-17</sup>
7. Include behavioral and psychosocial issues in emergency preparedness planning. Steps taken to improve functioning and reduce stress in EOC and with other first responders will lead to better and more efficient responses to emergencies in the future.<sup>8,9</sup>

#### **Conclusions**

The power outage of 2003 facilitated the identification of numerous issues associated with catastrophic events in general and power failures in particular. From semi-structured interviews conducted following the outage, numerous recommendations for improved preparedness are proposed.

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## References

1. North American Electric Reliability Council, United States-Canada Power System Outage Task Force. *Interim Report: Causes of the August 14 Blackout in the United States and Canada*. Available at <http://www.iwar.org.uk/cip/resources/blackout-03>. Accessed April 2004.
2. Center for Disease Control and Prevention: *Health Alert Network*. Available at <http://www.phppo.cdc.gov/han/>. Accessed April 2004.
3. Center for Disease Control and Prevention: Community needs assessment and morbidity surveillance following an ice storm—Maine, January 1998. *MMWR* 1998;47(17):351–354.
4. Daley WR, Smith A, Paz-Argandona E, et al: An outbreak of carbon monoxide poisoning after a major ice storm in Maine. *J Emerg Med* 2000; 18(1):87–93.
5. Center for Disease Control and Prevention: Heat-related mortality—United States, 1997. *MMWR* 1998;47(23):473–476.
6. Center for Disease Control and Prevention: Deaths associated with hurricane Georges—Puerto Rico, September 1998. *MMWR* 1998;47(42): 897–898.
7. Center for Disease Control and Prevention: Terrorism preparedness in state health departments—United States, 2001–2003. *MMWR* 2003;52(43): 1051–1053.
8. Hall M, Norwood A, Ursano R, Fullerton C: The psychological impacts of bioterrorism. *Biosecurity and Bioterrorism* 2003;1:139–144.
9. Stith Butler A, Panzer AM, Goldfrank LR (eds): *Preparing For The Psychological Consequences of Terrorism: A Public Health Strategy*. Committee on Responding to the Psychological Consequences of Terrorism, Board on Neuroscience and Behavioral Health, Institute of Medicine, Washington, DC: National Academies Press, 2003.
10. Federal Emergency Management Agency: *Education and Training*. Available at [http://www.fema.gov/tab\\_education.shtm](http://www.fema.gov/tab_education.shtm). Accessed April 2004.
11. Office of Domestic Preparedness: *Developing Multi-agency Interoperability Communication Systems: User's Handbook*. Available at [www.ojp.usdoj.gov/odp/docs/acu\\_trp1000.pdf](http://www.ojp.usdoj.gov/odp/docs/acu_trp1000.pdf). Accessed April 2004.
12. National Weather Service: *Emergency Alert System*. Available at [www.nws.noaa.gov/os/nws\\_eas.htm](http://www.nws.noaa.gov/os/nws_eas.htm). Accessed April 2004.
13. Food Safety: *Consumer Advice*. Available at <http://www.foodsafety.gov/~fsg/fsgdisas.html>. Accessed April 2004.
14. Food Safety and Inspection Service: *Keeping Food Safe During An Emergency*. Available at <http://www.fsis.usda.gov/OA/pubs/pofeature.htm>. Accessed April 2004.
15. National Center for Environmental Health: *Carbon Monoxide Poisoning*. Available at <http://www.cdc.gov/nceh/airpollution/carbonmonoxide/default.htm>. Accessed April 2004.
16. National Center for Environmental Health: *Extreme Heat*. Available at <http://www.cdc.gov/nceh/hsb/extremeheat/default.htm>. Accessed April 2004.
17. National Center for Environmental Health: *Extreme Cold*. Available at <http://www.cdc.gov/nceh/hsb/extremecold/faq.htm>. Accessed April 2004.