

12-6-2013

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## Recommended Citation

Abir, M., Jan, S., Jubelt, L., Merchant, R.M., Lurie, N. (2014). The impact of a large-scale power outage on hemodialysis center operations. *Prehospital and Disaster Medicine*, 28(6), 543-546.

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# The Impact of a Large-Scale Power Outage on Hemodialysis Center Operations

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**Conflicts of interest:** The authors report no conflicts of interest.

**Keywords:** disaster; hemodialysis; power outage; preparedness

## Abbreviations:

IRB: Internal Review Board  
KCERC: Kidney Community Emergency Response Coalition  
RDRTF: Renal Disaster Relief Task Force

Received: December 9, 2012

Revised: March 17, 2013

Accepted: April 27, 2013

Online publication: August 22, 2013

doi:10.1017/S1049023X13008844

## Abstract

**Introduction:** On June 29, 2012, mid-Atlantic storms resulted in a large-scale power outage affecting up to three million people across multiple (US) states. Hemodialysis centers are dependent on electricity to provide dialysis care to end-stage renal disease patients. The objective of this study was to determine how the power outage impacted operations in a sample of hemodialysis centers in the impacted regions.

**Methods:** The sample consisted of all hemodialysis centers located in the District of Columbia and a total of five counties with the largest power losses in West Virginia, Virginia, and Maryland. A semi-structured interview guide was developed, and the charge nurse or supervisor in each facility was interviewed. The survey questions addressed whether their centers lost power, if so, for how long, where their patients received dialysis, whether their centers had backup generators, and if so, whether they had any problems operating them, and whether their center received patients from other centers if they had power.

**Results:** Calls were placed to 90 dialysis centers in the sampled areas and a 90% response rate was achieved. Overall, hemodialysis operations at approximately 30% (n = 24) of the centers queried were impacted by the power outage. Of the 36 centers that lost power, 31% (n = 11) referred their patients to other dialysis centers, 22% (n = 8) accommodated their patients during a later shift or on a different day; the rest of the centers either experienced brief power outages that did not affect operations or experienced a power outage on days that the center is usually closed. Some centers in the study cohort reported receiving patients from other centers for dialysis 33% (n = 27). Thirty-two percent (n = 26) of the centers queried had backup generators on site. Eleven percent (n = 4) of the centers experiencing power outages reported that backup generators were brought in by their parent companies.

**Conclusions:** Comprehensive emergency planning for dialysis centers should include provisions for having backup generators on site, having plans in place for the timely delivery of a generator during a power outage, or having predesignated backup dialysis centers for patients to receive dialysis during emergencies. Most dialysis centers surveyed in this study were able to sustain continuity of care by implementing such pre-existing emergency plans.

Abir M, Jan S, Jubelt L, Merchant R, Lurie N. The impact of a large-scale power outage on hemodialysis center operations. *Prehosp Disaster Med.* 2013;28(6):543-546.

## Introduction

Chronically ill patients are often vulnerable to disruptions in health care delivery during emergencies, resulting in problems accessing vital medications or treatments.<sup>1</sup> End-stage renal disease patients are especially sensitive to interruptions in dialysis.<sup>2</sup> Emergency preparedness planning by hemodialysis centers, providers, and patients can help decrease interruptions in care and may decrease adverse outcomes in this population during and in the aftermath of such events.<sup>2</sup>

On June 29, 2012, a line of some of the most destructive thunderstorms in the history of North America affected a vast area in the Midwest and Mid-Atlantic regions of the US, resulting in 22 deaths and close to 4.2 million households losing power.<sup>3</sup>

Prior studies have demonstrated the challenges of providing hemodialysis in the aftermath of disasters such as hurricanes<sup>4,5</sup> and earthquakes.<sup>6</sup> For example, Hurricane

	Experienced Power Outage n = 36 Centers No. (%)	Power Maintained n = 45 Centers No. (%)
Power outage		
12 hours or less	13 (36)	Not applicable
13-24 hours	9 (25)	Not applicable
>24 hours	12 (33)	Not applicable
Unknown	2 (6)	Not applicable
Sent patients to other units for dialysis	11 (31)	Not applicable
Received patients from other centers	8 (22)	19 (42)
Backup generator on site		
Yes	10 (28)	16 (36)
No	25 (69)	28 (62)
Unknown	1 (3)	1 (2)

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**Table 1.** Power Status of Hemodialysis Centers Affected by the 2012 Mid-Atlantic Storms

Katrina caused structural destruction, flooding, loss of power and water, and problems with transportation; an estimated 44% of hemodialysis patients missed one or more dialysis sessions, compared to a 5%-9% miss rate during non-disaster periods.<sup>7</sup>

Several studies have examined the impact of power outages, including the 2003 power outage in the northeastern United States and Canada, on health more generally.<sup>8</sup> These studies documented an increase in accidental deaths and injuries,<sup>9,10</sup> food poisoning,<sup>11</sup> hospitalizations for respiratory disease,<sup>12</sup> hypothermia,<sup>9</sup> and non-accidental disease-related mortality<sup>8</sup> during blackouts.

Previous large-scale blackouts, including the power outage in New York City in 1965, led to a New York State mandate that required all hospitals and long-term care facilities to have backup generators.<sup>13,14</sup> A 2009 assessment of hospitals in New York State indicated that all hospitals had backup generators.<sup>15</sup> In addition to hospitals and long-term care facilities, hemodialysis centers are reliant on electricity and clean water to provide the needed services to their patients. Several states have passed legislation requiring that all dialysis centers have backup generators in order to ensure continuity of care for their patients during power outages.<sup>16,17</sup> However, many states have been reluctant to enact such legislation, and there is no federal requirement that they have backup power.

In this study, a sample of dialysis centers affected by the June 2012 mid-Atlantic storms were surveyed to determine how their operations were affected.

## Methods

The study sample consisted of all hemodialysis centers located in all of the District of Columbia and in the five counties with the greatest numbers of reported power outages across West Virginia, Virginia, and Maryland. The charge nurse or supervisor in each facility was interviewed via telephone.

A semi-structured interview guide was developed based on literature review and on the clinical experience of one of the

authors (MA) in caring for patients presenting to the emergency department for dialysis after the storm. The survey questions addressed whether their centers lost power, if so, for how long, where their patients received dialysis, whether their centers had backup generators, and if so, whether they had any problems operating them, and whether their center received any patients from other dialysis centers if they had power.

Four authors (MA, SC, RM, SJ) independently reviewed the interview notes and identified central emerging themes.

The RAND Corporation's Internal Review Board (IRB) deemed that the study protocol did not involve human subjects, hence did not require IRB review.

## Results

Calls were placed to all 90 dialysis centers in the sampled areas; the response rate was 90%. Three centers declined to participate, five either did not answer the phone or did not return calls, and one was a home dialysis service.

The results of the study are summarized in Table 1. Overall, approximately 30% (n = 24) of all the dialysis centers queried were impacted by the power outage, as defined by those that had to have patients return for dialysis during a different shift or on a different day, those that had to send their patients to different dialysis centers, those that had to have backup generators brought in, and those that had problems operationalizing their on-site backup generators.

Of the 36 centers that lost power 36% (n = 13) experienced a power loss of 12 hours or less, 25% (n = 9) experienced a power loss of 13-24 hours, 33% (n = 12) experienced a power loss for greater than 24 hours, and six percent (n = 2) experienced a power loss for an unknown length of time.

Of the 36 centers that lost power, 31% (n = 11) referred their patients to other dialysis centers, 22% (n = 8) accommodated their patients during a later shift or on a different day, and the rest of the centers either experienced brief power outages that did

not affect operations or experienced a power outage on days that the center is usually closed. Twenty-two percent ( $n = 8$ ) of the centers that experienced a power outage received patients from other centers after their power was restored, and 42% ( $n = 19$ ) of the centers that maintained power received patients from other centers. Some dialysis centers in the study cohort reported receiving patients from other centers for dialysis (33%,  $n = 27$ ); approximately four percent ( $n = 3$ ) of centers reported receiving such requests but were unable to accommodate patients due to inadequate space or staffing. One center indicated that it had staff from other centers come into their facility on a third shift to dialyze their own patients.

Of the centers that experienced a power outage 28% ( $n = 10$ ) had generators on site. Thirty-six percent ( $n = 16$ ) of the centers that maintained power had generators on site. Of the centers that had generators on site, only one center reported that its staff was unable to operate the generator on the day of the power outage. Eleven percent ( $n = 4$ ) of the centers that experienced a power outage reported that backup generators were brought in by their parent companies, and 17% ( $n = 6$ ) reported that they could have accessed one if needed. Of note, the four centers that had a backup generator brought in each experienced at least one day of delay before the generator arrived.

Additionally, some centers volunteered that they had difficulty contacting patients by phone to refer them to other centers due to the power outage. Respondents also indicated that although they arranged for their patients to be dialyzed at alternate sites, some patients inquired about why they could not present to nearby emergency departments to receive dialysis, citing the distance from their homes to the alternate centers and problems with transportation as barriers to receiving dialysis at those locations.

## Discussion

Dialysis facilities were queried in a sample of areas affected by the 2012 mid-Atlantic storm to determine the challenges a natural disaster presents to dialysis center operations. Thirty percent of the dialysis centers queried reported that care at their centers was impacted by the storm. Although respondents at these impacted dialysis centers used common-sense coping mechanisms to ensure their patients were dialyzed, some challenges experienced by the different dialysis centers were identified.

Many centers had previous agreements with partner facilities to dialyze their patients in the event of an emergency. However, some patients did not present for their rescheduled dialysis visits, some centers could not contact their patients by phone to refer them to the alternate centers, and some patients complained about the backup centers being too far away to access. A few centers in this study reported requests to accommodate patients from centers with power outages, but they were unable to accommodate them due to space or staffing shortages. One center reported that it had the staff and patients from another facility come in during a third shift for dialysis.

The results of this study indicate that even centers with backup generators may have problems operating these units, highlighting the importance of regular maintenance of, and staff familiarity with, backup generators. For centers that rely on generators being brought in as needed during power outages, having plans in place ensuring that these units are delivered in a timely manner is critical. For dialysis centers that have agreements with partner facilities to have their patients dialyzed at that center in case of emergencies, ensuring that the receiving

facility has the staffing and space needed to accommodate an increase in patient load is important.

The study findings, including the challenges and coping strategies reported, highlight the importance of emergency planning for dialysis facilities and their patients. A number of existing resources may help inform benchmarks for emergency planning for hemodialysis centers and patients with chronic renal insufficiency. The Renal Disaster Relief Task Force (RDRTF) of the International Society of Nephrology provides dialysis services in the aftermath of disasters.<sup>18</sup> Additionally, the RDRTF has conducted post-disaster analysis of acute care, hospital-based care, and chronic care, and has made recommendations to improve disaster preparedness and response as it pertains to dialysis providers and patients.<sup>19</sup> A review of recommendations from this task force can help inform and improve disaster planning for patients and dialysis centers. The Kidney Community Emergency Response Coalition (KCERC), with representation from all aspects of the dialysis community and federal partners in the United States, has developed a disaster plan focused on the needs of dialysis patients in the aftermath of disaster at both local and national levels.<sup>20</sup> The resources and programs developed by this coalition can be informative in improving emergency planning for dialysis patients and facilities.

Past disasters, including hurricanes Katrina and Rita, have been informative regarding the need for and various methods of emergency preparedness for hemodialysis centers and patients with chronic renal insufficiency. Unlike the 2012 mid-Atlantic storms, the aftermath of these hurricanes was not only marked by the loss of utility, but by structural destruction, flooding, and problems with transportation.<sup>21</sup> The current study sheds light on aspects of emergency preparedness pertinent to scenarios where dialysis centers experience a power loss in the absence of significant structural damage or barriers to patient transportation to centers for dialysis.

Strategies for emergency preparedness for dialysis patients have previously been described using an all-hazards approach to help reduce or prevent adverse effects on this population, including patient and provider education, developing and reviewing personal disaster plans with patients, and public service announcements during and in the aftermath of disasters.<sup>19</sup> While dialysis centers are required to devise and implement emergency plans for patients and their facilities as per the US Medicare Conditions for Coverage,<sup>22</sup> backup power is not an explicit requirement.

A recent study evaluating the effect of the 2003 large-scale power outage on health care systems in New York City concluded that disaster planning could greatly benefit from non-acute health care facilities having backup generators.<sup>23</sup> Some states, including New Jersey and Maine, have legislation in place requiring dialysis centers to have backup generators on site.<sup>16,17</sup> Other states have approached emergency planning requirements for dialysis centers differently. In 2011, Maryland passed legislation requiring dialysis centers to have emergency plans that include continuity of operations procedures that would ensure patient access to dialysis services.<sup>24</sup> This law, however, does not mandate dialysis centers have generators on site. In the aftermath of Hurricanes Rita, Ike and Gustav, Texas passed legislation with a tiered requirement that mandates centers to have either onsite generators or contracts for portable generators, unless they have an agreement with another facility within a 100-mile radius to provide emergency contingency care to their patients.<sup>25</sup>

This study also sheds light on the challenges and needs for data collection during or in the immediate aftermath of emergencies. Fortunately, an Internal Review Board (IRB) was able to review the protocol for this study and make a determination within 48 hours, but this is often not the case, even with simple protocols such as this. Similarly, this study was conducted with no external funding; had funding been needed, the time required to find, apply and receive an award likely would have been beyond a reasonable recall period for the staff interviewed, compromising the quality of the information obtained.

### Limitations

This study has several limitations. First, calls to the dialysis centers were made two to three weeks after most centers experienced a power outage, hence responses were subject to recall bias. However, there are currently no systems in place to collect data rapidly from various health care organizations in the immediate aftermath of disasters. Second, there may have been some variability in knowledge of the individuals to whom the questions were directed across dialysis centers, although in every case the unit supervisor was sought in order to conduct the study. Third, the study survey interview guide was not validated prior to the study. Fourth, some of the data collected was volunteered by some of the facilities and not formally collected as part of the study, hence may not be representative of the experience of the surveyed centers on the whole. Finally, this study did not determine whether power-related issues at dialysis facilities had any effect on patient outcome. Although ideal, adding such level of detail for a time-sensitive study such as this may have presented significant challenges to the

completion of the study. Further studies may be directed at evaluating outcomes related to such patients.

### Conclusion

Most dialysis centers surveyed in this study were able to sustain continuity of care by implementing pre-existing emergency plans, highlighting the importance of comprehensive emergency planning for dialysis centers. These results may inform dialysis center preparedness and response in the setting of future power outages. Dialysis facility owners, as well as policy makers, should consider taking a proactive stance to dialysis preparedness in order to ensure that dialysis plans are not interrupted and patient outcomes are not adversely affected. This planning should include provisions for having backup generators on site, having plans in place for the timely delivery of a generator during a power outage, or having predesignated backup dialysis centers for patients that both the center leadership and patients are informed about. Considering the paucity of literature addressing best practices regarding dialysis center preparedness, this and future studies can help inform states considering implementing related policy.

### Disclaimer

The views expressed in this paper are those of the authors and do not necessarily reflect those of the Medical Faculty Associates of the George Washington University, the RAND Corporation, the University of Pennsylvania, or the US Department of Health and Human Services.

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