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Original Investigation

Dialysis Care and Death Following Hurricane Sandy

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Background: Hurricane Sandy affected access to critical health care infrastructure. Patients with end-stage renal disease (ESRD) historically have experienced problems accessing care and adverse outcomes during disasters.

Study Design: Retrospective cohort study with 2 comparison groups.

Setting & Participants: Using Centers for Medicare & Medicaid Services claims data, we assessed the frequency of early dialysis, emergency department (ED) visits, hospitalizations, and 30-day mortality for patients with ESRD in Sandy-affected areas (study group) and 2 comparison groups: (1) patients with ESRD living in states unaffected by Sandy during the same period and (2) patients with ESRD living in the Sandy-affected region a year prior to the hurricane (October 1, 2011, through October 30, 2011).

Factor: Regional variation in dialysis care patterns and mortality for patients with ESRD in New York City and the State of New Jersey.

Measurements: Frequency of early dialysis, ED visits, hospitalizations, and 30-day mortality.

Results: Of 13,264 study patients, 59% received early dialysis in 70% of the New York City and New Jersey dialysis facilities. The ED visit rate was 4.1% for the study group compared with 2.6% and 1.7%, respectively, for comparison groups 1 and 2 (both $P < 0.001$). The hospitalization rate for the study group also was significantly higher than that in either comparison group (4.5% vs 3.2% and 3.8%, respectively; $P < 0.001$ and $P < 0.003$). 23% of study group patients who visited the ED received dialysis in the ED compared with 9.3% and 6.3% in comparison groups 1 and 2, respectively (both $P < 0.001$). The 30-day mortality rate for the study group was slightly higher than that for either comparison group (1.83% vs 1.47% and 1.60%, respectively; $P < 0.001$ and $P = 0.1$).

Limitations: Lack of facility level damage and disaster-induced power outage severity data.

Conclusions: Nearly half the study group patients received early dialysis prior to Sandy's landfall. Post-storm increases in ED visits, hospitalizations, and 30-day mortality were found in the study group, but not in the comparison groups.

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When Hurricane Sandy made landfall in the United States on Monday, October 29, 2012, it affected 17 million individuals across numerous states, led to at least 162 deaths, and caused widespread destruction to thousands of homes and critical health care, transit, energy, water, and communication infrastructure.[1-3] Sandy was the second deadliest storm in US history and, similar to Hurricane Katrina, had the potential to disproportionately affect chronically ill populations by limiting access to critical life-maintaining health care services.[4-8] One group of particular concern was patients with end-stage renal disease (ESRD) because many of them are reliant on regular dialysis services and have historically experienced increased morbidity related to disaster-induced disruptions in their dialysis schedules.[4,5,7,9]

Disaster preparedness practices for patients with ESRD have improved significantly since Hurricane Katrina. For example, many dialysis facilities have backup generators and have implemented practices to expand access to short-term dialysis care in times of crisis.[10] The Kidney Community Emergency Response (KCER) Program now assists ESRD networks to be better prepared and supports response by facilitating the identification and transportation of patients needing dialysis in emergencies.[6] Whether improved

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preparedness practices have improved dialysis-related care and adverse outcomes has been difficult to assess. The decentralized nature of dialysis care, broad variability and timeliness of renal registry data, and small survey samples have limited population-based research on dialysis care and outcomes related to disasters.[5,6,9,11,12]

We used claims data from the Centers for Medicare & Medicaid Services (CMS) Datalink Project to characterize patterns of care and mortality of patients with ESRD who live and receive dialysis in the areas that were most affected by Sandy. Understanding how patients with ESRD receive care during disasters is critical to informing preparedness actions and mitigating adverse outcomes for this vulnerable population.

METHODS

Data Source and Study Population

We used Medicare Parts A and B fee-for-service claims from October 1, 2012, through November 30, 2012, to identify patients with ESRD who received facility-based dialysis in the State of New Jersey and in the 5 New York City boroughs (Brooklyn, Manhattan, Queens, Staten Island, and the Bronx)—the areas most affected by Sandy.

We included patients in our study group if they were ESRD Medicare beneficiaries receiving dialysis and enrolled in Medicare Parts A and B in October 2012, as determined by the Enrollment Database; alive as of October 28; and had a claim for at least one maintenance dialysis treatment between October 1 and October 28, as identified through Medicare Part B Outpatient fee-for-service claims with Type of Bill "72x." We excluded patients receiving at-home hemodialysis or peritoneal dialysis.

We defined 2 comparison groups to help us better understand whether patterns of care for the study group were associated with Sandy versus other factors, such as regional and seasonal variability. Comparison group 1 comprised patients with ESRD receiving care during the same week but living in areas unaffected by Sandy. This group included patients with ESRD in all states except New York, New Jersey, Connecticut, Delaware, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, Pennsylvania, Rhode Island, Virginia, Vermont, West Virginia, and the District of Columbia. Comparison group 2 included patients with ESRD receiving care in the same New Jersey and New York City areas during the comparable week (October 31, 2011, through November 6, 2011) a year prior to Sandy.

ESRD treatment facilities were identified using Medicare's Dialysis Facility Compare and Certification and Survey Provider Enhanced Reporting data sets. We considered facilities open on a specific date if they submitted at least one claim with a treatment date of service for that date.

Utilization and Outcome Measures

We identified visits to dialysis facilities, emergency department (ED) visits, hospitalizations, and patient deaths 30 days after Sandy. Hospitalizations included those that originated in the ED or were direct admissions. ED visits included visits for patients who were treated in the ED and subsequently discharged.

To determine whether patients received early dialysis, we compared patient treatment patterns from the week prior to the storm (October 21, 2012, to October 27, 2012) to the week of the storm (October 28, 2012, to November 3, 2012). Patients were categorized based on their prior week treatment pattern as receiving dialysis on a Monday, Wednesday, and Friday (MWF) or Tuesday, Thursday, and Saturday (TThS) schedule. We considered patients to have received early dialysis if they were in the MWF group and received dialysis on Saturday, October 27, or Sunday, October 28, 2012, or were in the TThS group and received dialysis on Sunday, October 28, or Monday, October 29, 2012. We excluded patients who did not have a detectable MWF or TThS dialysis schedule the week prior to the storm (1,948 of 15,212), resulting in a final sample size for the early dialysis analysis of 13,264 (Fig S1, available as online supplementary material). For comparison group 2, we only examined care received on Sunday because most facilities are not open on Sunday and we could not ascertain whether a Monday treatment was for routine care or early dialysis in 2011.

We calculated weekly rates of ED visits and hospitalizations from Sunday, October 7, through Saturday, November 17, for patients in the study and comparison groups. A patient was included in the weekly numerator if they were admitted to the hospital or visited the ED and were counted only once regardless of length of stay. A patient was not counted in the denominator if they spent the entire week in the hospital (Fig S1). We also reviewed ED and hospital discharge diagnoses to determine whether the visits likely were dialysis related (eg, fluid and electrolyte disorders and volume overload) or secondary disaster-related conditions (eg, trauma).

Finally, we counted the number of deaths in the 30 days from Sandy's landfall onward (October 29, 2012, through November 27, 2012) for the study group and comparison group 1 and during the comparable period in 2011 (October 31, 2011, through November 29, 2011) for comparison group 2 (Fig S1).

Analysis

We used frequency counts to compare receipt of early dialysis, ED visits, and hospitalizations in the weeks before, during, and after Sandy. We also calculated 30-day mortality after Sandy, using the number of patients with ESRD in the relevant location and time period as the denominator. We used χ^2 tests to compare ED visits, hospitalizations, and 30-day mortality for patients in the study group with those in the 2 comparison groups. All analyses were conducted using SAS, version 9.2 (SAS Institute Inc).

RESULTS

Patient and Facility Characteristics

Table 1 lists demographic information for all Medicare fee-for-service ESRD patients receiving care in the study and comparison group areas. During Sandy, 15,212 study patients were seen in 221 dialysis facilities in the affected study area. Patients in comparison group 1 less often were older, nonwhite, and dual-eligible for Medicare and Medicaid; patients in comparison group 2 were demographically similar to the study group.

Of 221 facilities caring for the study group, 70% provided early dialysis on the Sunday preceding Sandy compared with 0.04% of facilities caring for comparison group 1 and 0.03% caring for comparison group 2. In the study area, 36 facilities were closed on Monday (October 29, 2012) and 120 were closed on Tuesday (October 30, 2012), with all except 12 facilities resuming some level of service by Wednesday (October 31, 2012). In comparison, no facilities were