Impact of a Hurricane Shelter Viral Gastroenteritis Outbreak on a Responding Medical Team

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Conflicts of interest: none

Keywords: cyclonic storms; disaster; disease outbreak; gastroenteritis; infection control

Abbreviations:
CDC: Centers for Disease Control and Prevention
IV: intravenous
PPE: personal protective equipment

Received: January 22, 2015
Revised: April 23, 2015
Accepted: May 9, 2015

doi:10.1017/S1049023X15004872

Online publication: July 1, 2015

Abstract

Introduction: In late October of 2012, Hurricane Sandy struck the northeast United States and shelters were established throughout the impacted region. Numerous cases of infectious viral gastroenteritis occurred in several of these shelters. Such outbreaks are common and have been well described in the past. Early monitoring for, and recognition of, the outbreak allowed for implementation of aggressive infection control measures. However, these measures required intensive medical response team involvement. Little is known about how such outbreaks affect the medical teams responding to the incident.

Hypothesis/Problem: Describe the impact of an infectious viral gastroenteritis outbreak within a single shelter on a responding medical team.

Methods: The number of individuals staying in the single shelter each night (as determined by shelter staff) and the number of patients treated for symptoms of viral gastroenteritis were recorded each day. On return from deployment, members of a single responding medical team were surveyed to determine how many team members became ill during, or immediately following, their deployment.

Results: The shelter population peaked on November 5, 2012 with 811 individuals sleeping in the shelter. The first patients presented to the shelter clinic with symptoms of viral gastroenteritis on November 4, 2012, and the last case was seen on November 21, 2012. A total of 64 patients were treated for nausea, vomiting, or diarrhea over the 17-day period. A post-deployment survey was sent to 66 deployed medical team members and 45 completed the survey. Twelve (26.7%) of the team members who responded to the survey experienced symptoms of probable viral gastroenteritis. Team members reported onset of symptoms during deployment as well as after returning home. Symptoms started on days 4-8, 8-14, on the trip home, and after returning home in four, four, two, and two team members, respectively.

Conclusion: Medical teams providing shelter care during viral gastroenteritis outbreaks are susceptible to contracting the virus while caring for patients. When responding to similar incidents in the future, teams should not only be ready to implement aggressive infectious control measures but also be prepared to care for team members who become ill.

Gaither JB, Page R, Prather C, Paavola F, Garrett AL. Impact of a hurricane shelter viral gastroenteritis outbreak on a responding medical team. *Prehosp Disaster Med.* 2015;30(4):355-358.

Introduction

On the evening of October 29, 2012, Hurricane Sandy struck the northeast United States. This unusual, late season, post-tropical cyclone made landfall northeast of Atlantic City, New Jersey (USA).[1] It was the second most costly storm to hit the United States since 1990.[1] During the impact phase of the storm, many small shelters were established throughout the region. As the affected areas of the northeastern United States recovered from the storm, individuals moved back to their homes or found alternative housing. Throughout this period, smaller shelter populations were combined, such that a few large shelters continued to operate for more than a month after the storm hit. In past incidents, the operation of shelters similar to these has been critical to meeting the needs of displaced populations.

In past incidents, one common cause of illness in large shelters operating after hurricanes has been outbreaks of viral gastroenteritis.[2] One example of a high-profile

https://doi.org/10.1017/S1049023X15004872 Published online by Cambridge University Press

outbreak of viral gastroenteritis occurred following Hurricane Katrina (2005) when a large group of displaced individuals were sheltered in the Houston Astrodome (Houston, Texas USA) and infection rates in the general shelter population were reported to be 4.6 per 1,000 individuals.[2] Such outbreaks are not unique to disaster management and have occurred in many different settings, including: military installations, health care institutions, and food service providers.[3-6] When these outbreaks have occurred in other health care settings, infection rates in patient populations have been as high as 16%.[7] Additionally, in hospital settings, these outbreaks have been associated with increased cost and the need for additional staff and supplies.[8,9]

Noroviruses are the most common cause of infectious viral gastroenteritis outbreaks in the United States and worldwide.[10,11] This group of viruses, similar to influenza, undergo rapid antigenic shift, resulting in decreased immunity to the seasonal circulating strain, within any given population. These viruses are non-enveloped, single stranded ribonucleic acid viruses that are transmitted via the fecal-oral route. Infection can occur when as few as 10-100 viral particles come into contact with an individual's mouth. Routes of exposure may include: consumption of contaminated food or water, contact with contaminated surfaces, or direct exposure of the mouth to aerosolized particles created during vomiting.[12] Infection with the virus can result in nausea, vomiting, diarrhea, and abdominal pain. Although symptoms typically last only two to three days, infection in vulnerable populations has the potential for prolonged morbidity and increased mortality, particularly in the elderly and chronically ill.[8,13]

Past outbreaks of viral gastroenteritis have been managed successfully by implementing aggressive monitoring systems and infection control measures.[14] Early monitoring of Hurricane Sandy shelter populations identified norovirus as the cause of viral gastroenteritis in several shelters. As a result, aggressive infection control measures, recommended by the Centers for Disease Control and Prevention (CDC; Atlanta, Georgia USA) and demonstrated to be effective in containing prior outbreaks, were implemented. These infection control measures included:[15]

1. Isolation of individuals with symptoms of viral gastroenteris,[14] including provision of separate sleeping, toilet, and bathing facilities, and provision of separate dinning services;
2. Isolation of individuals for 48-72 hours following the resolution of symptoms; and
3. Aggressive sanitation measures, including cleaning surfaces with bleach[16] and hand washing with soap and water, for all individuals in the shelter, when possible.[3]

Implementation of these aggressive infection control measures requires intensive medical team involvement in the care of ill individuals.[7] The medical care provided in response to this potential norovirus outbreak included traditional medical care, such as patient assessment (obtaining a medical history, physical exam, vital signs, and more), administration of home medications, placing an intravenous (IV) catheter, administration of IV fluids, IV anti-emetics, oral anti-diarrheal therapy, as well as others. Additionally, medical team personnel were responsible for isolating patients and providing support for activities of daily living while patients were in isolation, including setting up the isolation area, providing meals, and ensuring proper sanitation while in isolation.

The effects of viral gastroenteritis outbreaks have been described previously in a variety of patient populations. Outbreaks have occurred during normal health care operations in long-term nursing care facilities,[13] in hospital units,[7,9] as well as following disasters such as Hurricane Katrina where a single shelter treated more than 1,000 patients in 11 days with symptoms consistent with norovirus.[2,14] Limited data also suggest that under normal operations, such outbreaks may affect health care providers to an even greater extent than the shelter or hospital populations. This was best described in a hospital outbreak of norovirus at John Hopkins (Baltimore, Maryland USA), where 90 patients (5.3%-16.7% of the patient population) became infected and 265 (38%) health care workers became infected.[7] However, little is known about how such an outbreak affects the medical teams responding to a disaster such as Hurricane Sandy, or the effect of these outbreaks on the ability of the medical team staff to deliver the expected assistance to the community.

Methods

In November of 2012, a disaster medical team was deployed to a large shelter operating in New York State (USA). Throughout the shelter operational period, basic data regarding the shelter population were obtained from the shelter staff who estimated shelter occupancy daily for the purpose of operational planning.

Throughout the clinic operational period, the number of patients treated for symptoms of viral gastroenteritis, defined as patients with abdominal pain, nausea, vomiting, or diarrhea, were recorded each day. This included both individuals temporarily housed in the temporary shelter as well as members of the medical response team who became ill. Clinic staff maintained a simple log of the number of patients being treated for presumed viral gastroenteritis and reported that number to public health officials as part of public health monitoring efforts. Initially, stool samples were collected from a representative sample of patients with diarrhea, nausea, and vomiting. These initial samples returned positive for norovirus, and subsequently, patients presenting to the medical clinic with nausea, vomiting, or diarrhea were presumed to have norovirus infection. At no time were patient identifiers or other patient encounter information evaluated/reviewed for the purpose of this study.

For a period of 12 days, the responding medical team members provided care for patients, and later for team members, with symptoms of viral gastroenteritis. Care provided included the administration of IV fluids such as normal saline or lactated ringers, IV or oral odansetron, as well as oral loperamide, and the use of disposable personal protective equipment (PPE): gowns, masks, and gloves. Provision of this care rapidly depleted the team's supply of PPE but did not affect the number of supplies available to treat any individual requesting evaluation of a medical complaint.

The responding team consisted of 66 team members responsible for medical care, mission support, and command functions. On return from deployment, team members were surveyed using an online survey tool (Survey Monkey; Palo Alto, California USA) to determine how many team members became ill during, or immediately following, their deployment. A member of the research team, with experience in survey design, developed the survey tool used in this report. Following development of the survey tool, each question and response options were revised until the full research group reached conscientious on the best wording and response options for each question. Unfortunately, given the short time frame in which this tool was developed, the need to ensure team member anonymity, and no available or previously published validated surveys on this topic, it was not possible to validate this survey tool prior to distribution of the survey or after review of the survey results. Team members were asked two questions, as illustrated in Figure 1.

https://doi.org/10.1017/S1049023X15004872 Published online by Cambridge University Press

1) Did you experience the following symptoms during or after deployment: abdominal pain, nausea, vomiting, or diarrhea?

2) When did your symptoms start?
   a. Day 0-4
   b. Day 4-8
   c. Day 8-14
   d. While returning from deployment
   e. After returning from deployment

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Figure 1. Survey Questions.

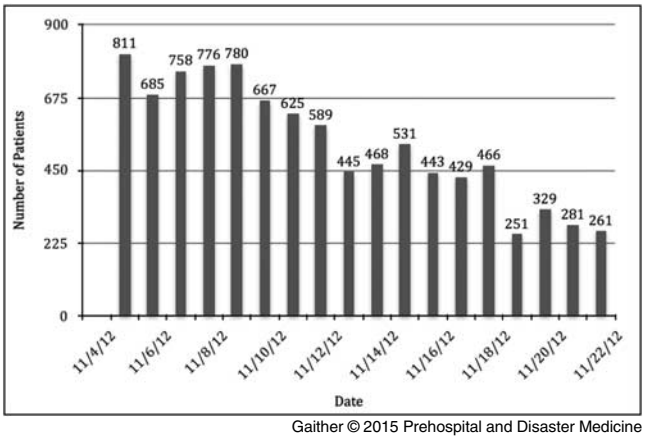

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Figure 2. Number of Individuals Staying in a Large Shelter Following Landfall of Hurricane Sandy.

Survey data obtained using the online survey tool did not allow association between the email address to which the survey was sent and the responses to the survey. This study was determined to be a non-human subjects research project by the University of Arizona (Tucson, Arizona USA) institutional review board.

Data analysis was performed using a Microsoft Excel data sheet (Microsoft Corporation; Redmond, Washington USA) and simple descriptive statistics were used to describe the relationships above.

Results

Hurricane Sandy made landfall on October 29, 2012. At the time of landfall, multiple small and large shelters were open to provided services for displaced individuals and families. As smaller shelters closed, those left without housing moved to one of the larger shelters where a medical response team was operating a shelter medical clinic. On post-landfall day 7, the population of this large shelter peaked with 811 individuals sleeping in the shelter. From this point, the population requiring the services steadily decreased as illustrated in Figure 2. The shelter clinic was closed on post-landfall day 31(November 26, 2012). The first patients presented to the shelter clinic with symptoms of viral gastroenteritis on post-landfall day 8; between day 8 and day 31, a total of 64 patients were treated for nausea, vomiting, or diarrhea. Over the course of the outbreak, there were two peaks in the numbers of patients being treated, as illustrated in Figure 3. The medical response team surveyed in this report started to care for patients after the outbreak of gastroenteritis in the shelter, and at the time of deployment, no members of the team were known to have been ill.

The post-deployment survey was sent to all deployed medical team members. A total of 66 team members were surveyed, as illustrated in Figure 3. Forty-five team members (68.2%) completed the survey and 12/45 (26.7%) of those who responded to

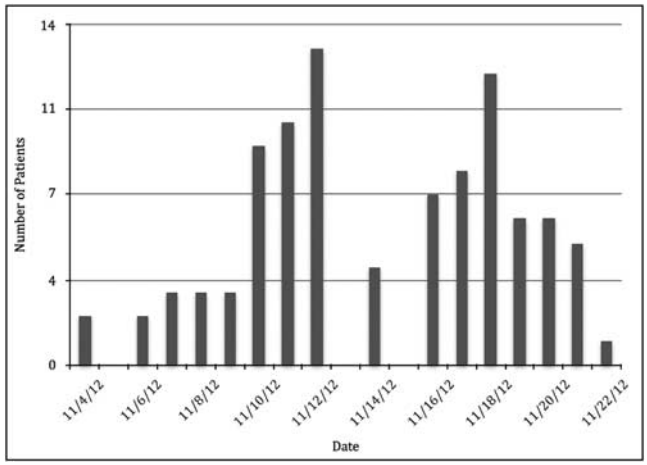

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Figure 3. Number of Patients Presenting to a Medical Clinic with Symptoms of Nausea, Vomiting, or Diarrhea.

the survey experienced symptoms consistent with viral gastroenteritis. Symptom onset occurred throughout team deployment, with four members becoming ill on deployment days 4-8, four additional members on deployment days 8-14, two on the trip home, and another two after returning home.

Following the collection of responses and review of the data, the margin of error for this survey was calculated using a 95% confidence interval and the observed response rate of 68.2%. Using standard margin of error calculations, the margin of error for this survey was found to be +/- 13.9%. Alternatively stated, it was found that 26.9% of team members experienced symptoms of viral gastroenteritis with a 95% CI of 40.3%-13.1%.

Discussion

Norovirus is a common cause of viral gastroenteritis in shelter populations following natural disasters. Outbreaks may cause increased morbidity and mortality, emotional trauma, and increased costs, among other issues. Although not reported previously, these outbreaks also appear to have a significant impact on responding medical teams. Given that this responding medical team initiated patient care at the shelter after the start of the outbreak of viral gastroenteritis and none of the responding team members were known to have been sick during the initial days of deployment, it is most likely that contact with individuals at the shelter caused team members to become ill. In this study, it appears that a significant percent of responding medical personnel may have developed symptoms of viral gastroenteritis during or immediately following their deployment. This finding has not been reported previously. The rough estimate of viral gastroenteritis transmission found in this survey does fall below that seen in other health care settings where up to 35% of health care providers had become ill after treating patients with viral gastroenteritis.

The immediate impact of norovirus infections and the associated illness in team members was a decrease in the capability of the team to provide medical assistance and the creation of an additional health care demand. Although in this incident the increased demand did not cause a change in the level of care delivered, a shortage of medical supplies, or a shortage of PPE, the potential clearly exists. Future planners may consider allocation of additional supplies and PPE specifically to address treatment and prevention of the transmission of common communicable diseases.

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Responding medical teams also should consider that they might be called upon to both provide health care and facilitate the isolation of patients and fellow team members during an outbreak. During this response, the isolation of all individuals with symptoms of viral gastroenteritis not only required additional medical supplies, but also required additional space, security, washing facilities, and medical providers. In the future, responding medical teams should plan for disease outbreaks in shelter populations and also should consider how they might isolate and treat medical providers that become ill while providing treatment.

In addition to the immediate impact at the site of operations, illness was common after return from deployment; this may have resulted in a delayed return to work following deployment or in the transmission of illness to family members upon return home. Although viral gastroenteritis is common, self-limiting, and unlikely to cause any long-term health complications, responders should be aware of the potential to become ill, and to make others ill, after they return home. Indeed, several team members reported that individuals they contacted on return from deployment also became ill.

Illness among health care providers may have effects beyond the immediate health care team; a security team directly supported the deployed medical assistance team. Additionally, the medical assistance team worked closely with shelter staff as well as a large incident support team from a number of local, state, and federal agencies, all providing assistance for displaced individuals. It is clear that several members of the security team, as well as multiple shelter staff and other supporting professionals, became ill. Although these individuals were not members of the deployed medical team and were not included in the team survey, they did require medical attention, time off duty, and isolation.

Limitations

This study has several limitations that should be considered before broad application of the results. Only estimates of shelter populations and the number of clinic visits for gastroenteritis were obtained; data on how many shelter occupants actually had viral gastroenteritis were not available. One factor that may have resulted in a significant underestimate of the prevalence of norovirus in the shelter population was the hesitance of some individuals to seek medical care because of minor symptoms or fear of being placed in isolation. One major factor that may have resulted in an overestimate of the number of patients with gastroenteritis is the necessity to assume that any patient with nausea, vomiting, or diarrhea had norovirus, as diagnostic testing was not feasible for all patients. Multiple other disease processes may have caused similar symptoms, resulting in an overestimate of disease prevalence.

As with other studies that use survey data, this study was limited by failure of all responders to complete the survey. This survey response rate of 68% was low, but did exceed response rates commonly reported for other health care surveys: from 1996-2005 mean response rates for health care surveys published in medical journals was 56% with only 16% of surveys reporting response rates over 75%.[17] However, it is possible that these results have a significant response bias. It is possible that responders did not complete the survey because they did not have symptoms or because they felt uncomfortable disclosing their symptoms despite anonymous reporting.

This survey methodology was also limited by distribution of the survey to medical response team members who served on a single response team over a 2-week operational period. The methods of this study did not allow inclusion of team members from other medical response teams, American Red Cross (Washington, DC USA) shelter staff, or security personnel providing close mission support services, many of whom were also known to have become ill. Many of the area shelters were operated by the American Red Cross, or other shelter volunteers, who provided food distribution services, medical screening evaluations, and other shelter services. Some of these responders were also known to have become ill; however, due to this study design, it is not possible to quantify or further describe the effects of this outbreak among these responders due to lack of contact information for the responding Red Cross members following deployment.

Conclusion

Outbreaks of viral gastroenteritis among shelter populations after natural disasters have the potential to impact responding medical teams. In this study, a single medical team responding to a shelter in which a viral gastroenteritis outbreak had occurred experienced a 26.7% (95% CI, 40.3%-13.1%) infection rate among the responding team members.

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