

Norovirus Outbreak at a Wildland Fire Base Camp Ignites Investigation of Restaurant Inspection Policies

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Abstract Norovirus outbreaks occur worldwide and have been associated with congregate settings (e.g., military and recreational camps). Investigation of a norovirus outbreak at a wildland fire base camp identified 49 (27%) illnesses among approximately 180 responders. Epidemiologic evidence implicated a restaurant as the infection source. Eight (89%) of nine wildland fire responder groups who ate at the restaurant had ill members; no groups who ate elsewhere reported ill members. An environmental health specialist restaurant inspection identified lack of managerial knowledge to protect against foodborne disease one year after the restaurant's opening; earlier inspection after opening might have led to earlier intervention. States were surveyed to determine existence of any policy or rule for food establishment inspection after opening and inspection timing. Among 18 states, five had no state rule or policy; nine had a policy in place; and four required postopening inspection by rule. Further research is needed to evaluate postopening inspection efficacy and timing.

Introduction

Noroviruses cause acute gastrointestinal illness characterized by nausea, vomiting, stomach cramps, and diarrhea. Transmission occurs by ingestion of contaminated food or water, directly through the fecal-oral route, or indirectly through contact with contaminated fomites or environmental surfaces. Norovirus transmission can also occur through the ingestion of particles of aerosolized vomit (Centers for Disease Control and Prevention [CDC], 2011a).

Norovirus outbreaks are reported worldwide and have been associated with restaurants and hotels (CDC, 2006; Dippold, Lee, Selman, Monroe, & Henry, 2003; Guzman-Herrador, Heier, Osborg, Nguyen, & Vold, 2011; Smith et al., 2011), college campuses (CDC, 2009), recreational camps (CDC, 2007; Heijne et al., 2009), cruise ships (CDC, 2002b), and professional sports leagues (Desai et al., 2011). Outbreaks have also been reported on military ships, among deployed military units, and among U.S. Air Force Academy cadets par-

ticipating in field training (Bailey et al., 2009; CDC, 2002a; Chapman et al., 2011; McCarthy, Estes, & Hyams, 2000).

In the U.S., noroviruses cause an estimated 21 million illnesses annually (CDC, 2011a). During 2008, norovirus was the most common cause of confirmed single-etiology foodborne disease outbreaks in the U.S., accounting for about 49% of these outbreaks and about 46% of associated illnesses (CDC, 2011b). To reduce the incidence of norovirus and other pathogen-associated foodborne illnesses associated with food establishments, federal, state, and local regulatory and public health agencies have instituted standards, rules, and policies for inspection of such establishments to ensure that facilities meet minimum standards. These standards include facility construction (to aid in ability to maintain sanitary conditions), employee health practices, employee behaviors related to food safety practices, and management knowledge of foodborne illness prevention techniques such as safe food storage and proper cooking of potentially hazardous foods.

Similar to military encampments, wildland fire base camps are established to provide logistical support for operations, including sleeping areas; food, water, and sanitary services; and limited medical care for incident responders. Because many wildland fires are in remote locations, sleeping arrangements are often in designated tent

camping areas. Sanitary facilities consist of mobile shower units and portable toilets; water for drinking and bathing is provided from portable tanks. Meals in camp are provided by contracted mobile catering units. A camp might exist from a limited number of days to weeks, and accommodate less than 100 to more than 1,000 responders, depending on fire size and complexity.

On August 31, 2011, lightning ignited the Black Canyon Fire in Idaho's Salmon-Challis National Forest. An incident command post and associated base camp were established in a nearby rural town (population approximately 300). Firefighting resources began arriving on August 31; a majority arrived on September 1. Until food was available in camp on September 2, firefighting resources ate at local restaurants or ate food brought from home. On September 2, the incident safety officer reported to the Idaho state emergency medical services (EMS) communications center (StateComm) that more than 35 of about 180 responders at the base camp had reported acute gastrointestinal illness. StateComm notified Southeastern Idaho Public Health, which requested epidemiologic assistance from the Idaho Division of Public Health.

We report on the ensuing public health investigation of the second known foodborne outbreak of acute gastrointestinal illness caused by norovirus at a wildland fire base camp. We also report on a subsequent informal survey of states about the presence and required timing of postopening food establishment inspections to advise policy updates currently under consideration in Idaho.

Methods

Outbreak Investigation

A retrospective cohort study by using the wildland fire responder group as the unit of analysis was conducted on September 3 to identify risk factors for illness. A group-level unit of analysis was chosen for both time efficiency and because persons within each resource group (e.g., firefighting hand crew) shared common exposures (low within-group variability) that might have differed among resource groups (high between-group variability). Resource groups with at least one person reporting the presence of vomiting or diarrhea were categorized as ill. After a likely exposure

was identified, food histories were obtained from individual exposed responders.

A clinical case was defined as vomiting or diarrhea of any duration on or after September 2 in a person associated with the fire camp. Cases were identified through the fire camp medical unit and anecdotally. The medical unit leader maintained a list of ill persons who had been treated by onsite medical personnel or emergency medical responders or had been transported to local hospitals.

On September 2, an initial walk-through of the camp was performed to observe camp operations, identify meal sources and obvious contamination sources, and ensure that any food items that might have been vehicles of infection remaining from past camp meals were held for analysis.

All hospitals represented on state EMS communications conference calls regarding the outbreak and able to receive ill patients were contacted and asked to collect stool samples from patients who were associated with the fire camp and to forward these samples to the Idaho Bureau of Laboratories. Stool samples were cultured for Shiga toxin-producing *E. coli*, and *Salmonella*, *Shigella*, and *Campylobacter* species. Real-time reverse transcriptase polymerase chain reaction (RT-PCR) was used to detect genogroup GI and GII norovirus. Conventional PCR and sequencing were used for genotyping.

On September 4, an epidemiologist visited Restaurant A to observe operations and determine if any leftover food from September 1 was available. On September 6, a registered environmental health specialist (REHS) conducted an unscheduled routine food establishment inspection of Restaurant A for compliance with the Idaho *Food Code* (Idaho Department of Health and Welfare [IDHW], 2008).

Surveys of State Food Inspection Practices, January–April 2012

We conducted an informal survey of state food protection program managers from states located within the Food and Drug Administration (FDA) Pacific Region (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, and Washington). State managers were contacted by e-mail by the Idaho state food protection program manager and queried about restaurant inspection timing and practices within their states. The Sidebar lists the questions included in the e-mail query. We

Questions About Restaurant Inspections Included in the E-mail Query to State Food Protection Program Managers

- 1) Has your jurisdiction (state) adopted the Food and Drug Administration's Model *Food Code* Section 8-203.10 or similar language specific to pre-operational inspections?
- 2) Does your jurisdiction (state) have any specific language about conducting, after a preoperational inspection, another regular inspection within a defined time after opening or after changing ownership?
 - a) If yes, what is the defined time?
 - b) If yes, is this language included in statute, rule, or policy? (Please state which.)
 - i) If in policy, may local jurisdictions modify the policy?
- 3) After a food establishment opens, what is the inspection frequency in your state or jurisdiction?
 - a) May local jurisdictions modify this frequency?
 - b) Is the frequency related to other factors (e.g., past performance or risk category)?

subsequently requested assistance from FDA regional retail food safety specialists to distribute the query by e-mail to state food protection program managers in all 50 U.S. states and territories. Additional verbal queries focusing on presence and timing of a postopening inspection were made by the Idaho delegate to the remainder of the Body of State Delegates to the Conference for Food Protection (CFP) during the state caucus meetings at CFP biannual meetings in April 2012.

Results

Outbreak Investigation

Table 1 describes the resource groups assigned to the fire on September 1. One firefighting hand crew, one camp crew, three fire truck crews, shower crew, supervisory personnel, and portable toilet contractor all reported at least one ill person among their resource group. Four firefighting hand crews, three fire truck crews, water truck personnel, and cater-

ing crew reported no ill persons among the resource group. Definitive information about dinner location on September 1, 2011, was obtained for 13 (76%) of 17 resource groups who had arrived at the fire camp by September 1. All resource groups categorized as ill reported having members who had eaten dinner at Restaurant A on September 1. Among resource groups who ate at Restaurant A, 89% were categorized as ill (Table 2). Resource groups with no members who had eaten at Restaurant A on September 1 had eaten at other restaurants or had eaten food brought from home. Subsequent food exposures were consistent across all resource groups when the contract caterer began service with breakfast on September 2. Individual food histories of responders who had eaten at Restaurant A were similar because fire managers had arranged for service of a limited menu to responders. No food item was associated with an increased risk for illness.

Forty-nine persons who met the clinical case definition were identified; 46 persons were identified by the fire camp medical unit and three were identified anecdotally. Among persons who met the clinical case definition, 47 (96%) were directly associated with the fire response and two (4%) were emergency medical personnel who had responded to the outbreak. Among 47 persons for whom time of onset was known, five (11%) had onset 24 hours or more after the first reported onset, had no restaurant exposure, and were considered secondary cases. The overall attack proportion among all responders was about 27%.

Among 48 patients for whom sex was known, 41 (85%) were men; among 15 patients for whom age was known, the age range was 20–58 years. Among 24 patients for whom signs and symptoms were known, six (25%) reported vomiting; five (21%) reported diarrhea; 13 (54%) reported both vomiting and diarrhea; 12 (50%) reported nausea; three (13%) reported muscle aches; four (17%) reported chills; and six (29%) reported headache. Mild fever (<100.5°) was reported by seven (78%) of nine patients treated at any hospital. The incubation period was calculated from 7:00 p.m., the midpoint of dinner service on September 1, yielding a median incubation period of 31 hours (range: 21–55 hours; *n* = 42) (Figure 1). The estimated mean duration of illness was 32 hours (range: 13–44 hours; *n* = 42),

TABLE 1

Personnel Assigned to the Black Canyon Fire (Idaho) by Group—September 1, 2011

Group	# of Groups	# of Personnel Per Group
Supervisory personnel	1	~35
Firefighting hand crew	5	20–22
Camp crew	1	9
Fire truck	6	3–5
Water truck	3	1
Portable toilet contractor	1	1
Caterer	1	~10
Shower	1	3

TABLE 2

Distribution of Resource Groups by Dinner Location and Gastrointestinal Illness Status—Idaho, September 1, 2011

Exposure	Ill Resource Groups (#)	Well Resource Groups (#)	Total (#)	Risk Among Exposed (%)
Ate at Restaurant A	8	1	9	89
Ate elsewhere	0	4	4	0
Total	8	5	13	–

calculated from the reported time of onset to midday September 4, when all ill firefighters had returned to work.

No obvious sources of contamination were identified during the initial camp survey, at which time meals were being provided to fire camp personnel by a contract caterer hired by using a mobile food service contract through the National Interagency Fire Center (NIFC).

Stool samples from two patients were submitted to the Idaho Bureau of Laboratories for analysis. Stool samples were negative for Shiga toxin-producing *E. coli*, and *Salmonella*, *Shigella*, and *Campylobacter* species. Norovirus genogroup GII was detected in samples from both patients.

The camp had designated areas for camping, eating, and bathing. Portable toilets were located near camping and common areas and were equipped with portable hand-washing stations. Additional hand-washing stations were located at the food service line entrance. An NIFC-contracted, truck-mounted mobile shower was available for camp personnel. The national shower contract specifies both method and frequency of

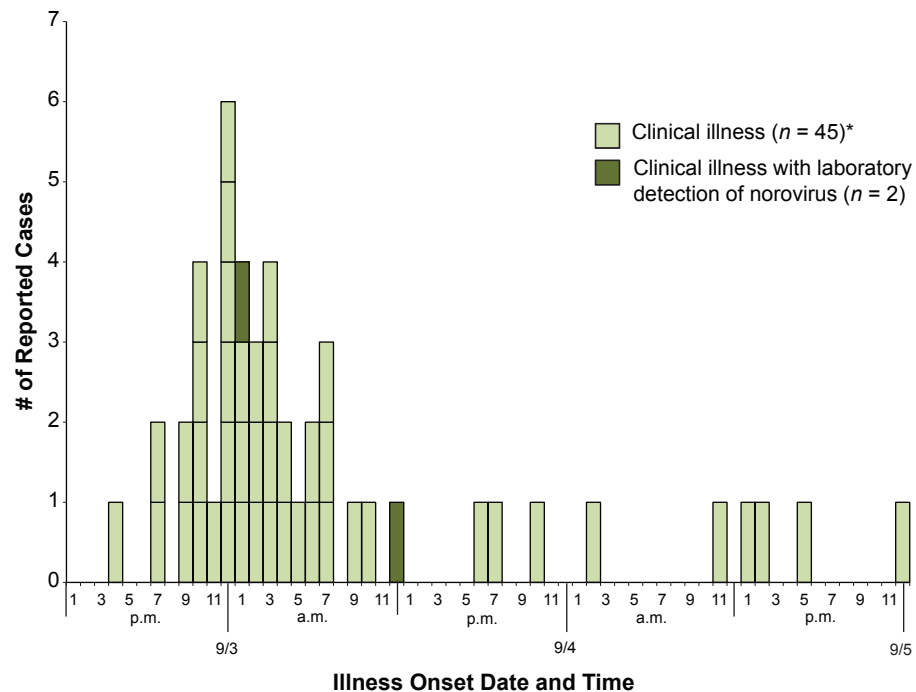
sanitization (National Interagency Fire Center [NIFC], 2014).

All food served to fire camp personnel at Restaurant A the evening of September 1 had been consumed on that day. Hamburgers had been hand formed from meat purchased the same day from a local supplier. French fries had been hand cut from fresh potatoes. Ketchup and mustard were available on the table in the multiserving containers in which they were purchased. All meals were served on disposable plates. On September 4, the epidemiologist observed two young children in the food preparation and eating areas. In addition, fire personnel who had eaten at Restaurant A on September 1 and were interviewed to obtain food histories reported that on September 1 young children had been present in the food preparation area, and that one young child was being carried by the Restaurant A server when serving food. One firefighter reported observing a restaurant server arrive from outside and go directly to work without hand washing.

Deficiencies noted by the REHS when conducting the unscheduled routine food estab-

FIGURE 1

Epidemic Curve (n = 47)*, Norovirus Outbreak in a Fire Camp—Idaho, September, 2011



*Two clinical illnesses not listed because onset date was unknown.

TABLE 3

Timing of Postopening Food Establishment Inspection by State Rule or Policy

Days to Routine Inspection After Opening (at State Level)	Rule or Policy	# of States (N = 18)	Comments
30 days	Rule	2	
45 days	Rule	1	
60 days	Rule	1	
30 days	Policy	7	Can vary by local health department
Variable	Policy	1	Depends on preopening inspection results
None	Policy	1	Preopening and regular inspection may be completed at the same time
No requirement	None	5	Decision might be delegated to local health department

lishment inspection as a result of the outbreak included lack of knowledge about safe food handling practices such as bare hand contact with ready-to-eat foods and improper

sanitization of food contact surfaces, impeded access to hand-washing facilities, and incorrect food item storage to prevent cross contamination. In response to the query to the

Restaurant A manager as to whether any of the children observed in the food preparation areas on multiple occasions had been ill recently, statements were made that one child had an episode of vomiting on August 31; no stool sample was obtained. Restaurant A was reinspected one week later to ensure that deficiencies noted at the routine inspection following the outbreak had been remedied.

Survey of State Food Inspection Practices

Eight states responded to one of two e-mail queries and 10 states responded in person at the 2012 CFP. States that responded represented geographic areas of the U.S. from Alaska to Florida. Four states require a post-opening inspection by rule at 30, 45, or 60 days after opening. Seven states have a policy that a postopening inspection should be completed in less than 30 days; however, this can be at the discretion of the local health department. One state reported that three of eight responding local health departments perform a full inspection 30 days after the preopening inspection; four place the establishment into the regular rotation on the basis of risk category derived from establishment characteristics that might contribute to foodborne illness; and one department returns 7–14 days after the preopening inspection. One state reported a policy whereby the timing of any postopening inspection depends on findings at the preopening inspection. One state reported that the preopening and regular inspection could be completed at the same time. Five states had no requirement at the state level, but inspection frequency regulation and timing might be delegated to the local health department (Table 3).

Discussion

Epidemiologic investigation of a norovirus outbreak among responders to a wildland fire base camp implicated a restaurant as the source. A contributing cause might have been a child ill with vomiting on August 31, who might have contaminated environmental surfaces or food at the restaurant. A second contributing cause might have been the general lack of knowledge of managerial roles and responsibilities to protect against foodborne disease outbreaks and associated risk factor behaviors demonstrated by restaurant management during the routine

inspection conducted as a result of the epidemiologic investigation.

A reopening inspection focusing on facility characteristics was conducted prior to Restaurant A opening in accordance with Idaho regulations, but no routine inspection was conducted shortly after establishment opening. If more frequent inspections had occurred, managerial and behavioral risk factors that contribute to foodborne illness might have been noted and corrected earlier, thus avoiding a major contributing cause of this outbreak.

One method advocated to improve foodborne illness knowledge and improve food safety behavior is to have an education or certification requirement for food service managers or food handlers. The 2009 FDA *Food Code* (Food and Drug Administration [FDA], 2009) and the Idaho *Food Code* (IDHW, 2008) require demonstration of knowledge; certification by an accredited program is one way to meet the requirement. Evidence varies, however, as to effectiveness of this strategy. A limited number of studies have reported that having a trained and certified food manager is associated with reducing or improving control of certain inspection violations or risk factors (Cates et al., 2009; FDA, 2010; Kassa, Silverman, & Baroudi, 2010).

One study conducted by the Environmental Health Specialists Network reported that the presence of a certified kitchen manager was associated with a reduced likelihood that the restaurant was associated with an outbreak (Hedberg et al., 2006). Training is not necessarily linked with consistent behavioral change as evidenced by one study where, in a group of food handlers with a high proportion who had received food hygiene training, approximately half admitted to not always adhering to food safety behaviors (Clayton, Griffith, Price, & Peters, 2010). Evidence of the effectiveness of routine inspection to reduce foodborne illness is limited, and some studies provide evidence that no difference exists in outcomes, either in violations or illness outbreaks on the basis of inspection frequency or scores (Mullen, Cowden, Cowden, & Wong, 2002; Newbold, McKeary, Hart, & Hall, 2008). Another study, however, indicated a substantial association between lower routine inspection score and likelihood of foodborne outbreak (Irwin, Ballard, Grendon, & Kobayashi, 1989). No research is

available that has specifically investigated the association of foodborne disease outbreaks with routine inspection within a defined time after a restaurant opens for business or changes ownership. Our surveys of state-level food safety regulators identified that although the requirement for and timing of postopening food establishment inspections varies by jurisdiction, an inspection during this time is considered sufficiently important that 13 (72%) of 18 states that chose to respond to our surveys have a rule or policy at the state level.

Although an outside restaurant was implicated as the illness source in this outbreak, food service provided in camp represents another possible avenue for the introduction of foodborne illness that must be evaluated in an outbreak investigation. Meals are often provided in camp by mobile food service units (MFSU) that are staged near where fires might occur for prompt dispatch. These units operate under a national contract that outlines requirements for equipment and certification of staff (NIFC, 2013). Each MFSU manager and supervisory cook must have a completion certificate for food service management, handling, and sanitation training. MFSU managers are responsible for training employees in safe food handling practices. Each MFSU is required to have a copy of the latest FDA *Food Code* available and is contractually obligated to meet those standards.

Toilet and shower facilities are other shared areas where contamination with norovirus could contribute to transmission among wildland fire responders and should also be evaluated during an outbreak. Toilet and shower facilities are portable units provided under contract. Portable toilets are contracted locally; sanitization frequency is at the discretion of incident staff. Sanitization frequency was increased from once per day to 2–3 times per day after the outbreak was identified. Shower facilities are provided under a national contract that details frequency and sanitization method. Hand-washing sinks are situated near portable toilets, showers, and food service areas to encourage appropriate hand hygiene.

Both the mobile shower contract and the MFSU contract provide for notification of local health authorities of the time, location, and type of services that are being performed. In the event of an illness outbreak among

responders at a base camp, a local environmental health specialist (EHS) might need to inspect camp facilities. The EHS should be aware that these service providers have a contractual obligation to meet applicable federal, state, and local laws and regulations and should work in partnership with incident managers to inspect these facilities to the same standard as other establishments within their jurisdiction.

Despite responder vulnerability to infectious disease transmission because of the closely shared quarters and challenging conditions for good hygiene, this is only the second norovirus outbreak reported at a wildland fire base camp. In response to the first reported norovirus outbreak in a wildland fire base camp during 2009, the National Wildfire Coordinating Group (NWCG) published the *Infectious Diseases Guidelines for Wildland Fire Incident Management Teams* to help fire managers minimize risk to responders and to manage identified outbreaks more effectively (NWCG, 2010). These guidelines include recommendations for notifying and cooperating with public health authorities and were followed during this outbreak to reduce risk of norovirus transmission in camp. This likely contributed to the low number of secondary cases associated with this outbreak.

The findings in our study are subject to at least three limitations. First, a limited proportion of the persons who ate at Restaurant A were interviewed, reducing our ability to identify a specific food item. Second, stool samples were obtained from only two ill persons; other organisms might have been present. Finally, less than 40% of state food protection managers responded to our inquiry, possibly limiting the generalizability of our findings.

Conclusion

Poor restaurant practices contributed to an outbreak of norovirus among wildland firefighters. A postopening restaurant inspection might have identified and corrected deficiencies that contributed to the outbreak. Among states responding to our query, about 75% indicated that although not an FDA *Food Code* component, postopening restaurant inspection was included in a rule or policy. State food safety regulators might consider proposing that the CFP recommend language about a postopening inspection for inclusion in future FDA *Food Code* revisions to aid in

the adoption of this practice by state and local government. Further research is needed to evaluate efficacy and most effective timing for this inspection.

The NWCG infectious disease guidelines provide a useful tool for fire managers for mitigating norovirus outbreak consequences in a wildland fire base camp setting. Public health authorities responding to infectious disease outbreaks at wildland fire operations could consider reviewing the guidelines to gain famil-

ilarity with NWCG expectations for fire incident command's response to outbreaks. 🐞

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