

An outbreak of gastroenteritis among rafters on the Middle Fork of the Salmon River occurred during the summer and autumn of 2013. Eastern Idaho Public Health District investigated the outbreak with support from Central District Health Department, the United States Forest Service, and the Idaho Dept. of Health and Welfare. We distributed a link to an online questionnaire to Middle Fork rafting permit holders and asked them to forward the link to members of their rafting parties. We requested stool samples from ill persons for pathogen testing. We also took water samples for *E. coli* and norovirus testing and swabbed environmental surfaces for norovirus testing.

Our investigation indicates that this outbreak did not have a single cause or source. Both giardia and norovirus were detected among ill rafters. Several factors most likely contributed to the spread of illness. It was not surprising to find cases of giardia from this outbreak as giardia is a parasite commonly found in surface waters. Outdoor activities involving natural surface water usually place a person at some risk. Rafting white water may increase this risk since individuals are exposed to possibly swallowing water that is splashed into one's face and mouth while going through the rapids. An occasional swim during calmer parts of the river may also place a person at risk, as would drinking untreated surface water. Norovirus is not naturally found in surface waters unless the water has been contaminated by human feces or vomit. Norovirus is highly transmissible from person to person. According to the Centers for Disease Control and Prevention, 100 billion viral copies can be found in 1 gram of feces during peak shedding times (2–5 days after infection) and an infectious dose can be as low as 18 viral particles. Virus can be detected in the stool for an average of 4 weeks following infection. Also, 30% of norovirus infections are asymptomatic and an asymptomatic person can shed virus although at lower titers. Combining this with the lack of available clean water to wash hands, sanitation conditions while rafting and camping in the wilderness, and reports to the health departments of rafting trips that had multiple people in their group ill with different onset times while either on the river or shortly after returning home, one can easily make the connection of human to human transmission as a route of transmission.

Our analysis of responses to the online questionnaire found that drinking filtered water from the river was a statistically significant risk factor for illness. The association was stronger when we examined cases having a short duration of illness, characteristic of norovirus infection. Norovirus has a particle size of 27 – 38 nanometers (nm). When researching water filters / purifiers online at outdoor recreation stores, the typical filter / purifier removes particles down to about 0.1 to 0.2 micron (μ). To remove norovirus, a water filter would need to remove particles down to 0.027 μ . If additional treatment to inactivate norovirus was not done, this could possibly explain why the association between drinking

filtered water from the river was so much higher for our illness of short duration than for our group representing giardia. Norovirus would pass through the filter and giardia would not since giardia (specifically *Giardia lamblia*) is of greater size (10 – 15 μ) than norovirus. We also found Whitie Cox Hot Springs as a significant risk factor for short duration of illness. It is possible that a person shedding norovirus could contaminate the hot spring and in turn infect other people using the hot spring.

The United States Forest Service (USFS) tested water from Boundary Creek Campground (launch site) spigots and swabbed surfaces of Boundary Creek Campground spigots and outhouses. Water samples were negative for coliform bacteria, including *E. coli*. Norovirus genogroup II was detected in swabs of the surfaces of spigots and outhouses, supporting the theory of transmission of disease through contact with contaminated environmental surfaces. Norovirus can survive on surfaces for weeks to months depending on environmental conditions. Even though analysis of questionnaire responses did not find use of a spigot or toilet at Boundary Creek a statistically significant risk factor, the presence of the virus on these commonly touched surfaces cannot dismiss the possibility that some transmission of the virus occurred in this manner. *E. coli* was detected in surface water used for drinking, indicating the presence of contamination that could potentially be a source of norovirus or giardia.

Three norovirus isolates recovered from stool were genotyped. Norovirus genotype G1_8 was identified. The presence of not one but two different noroviruses detected in this outbreak is interesting. The human stool samples were submitted several weeks before the environmental samples, which were collected toward the end of the outbreak investigation. This raises the question, were both genogroups circulating at the same time or did one genogroup continue the outbreak where the other left off?

Recommendations

Ill people should consider postponing going on a river trip for 72 hours to 2 weeks after symptoms go away, depending on the cause of diarrhea. Pathogenic organisms can be shed in your stool and expose other even after diarrhea stops.

Hand hygiene is a must to prevent and control norovirus transmission. Frequent hand washing with soap and water is a recommended prevention measure to stop the transmission of norovirus, but the availability of clean water while in the wilderness is very limited. When hand washing cannot be performed, hand sanitizer containing 70% ethanol should be used. Hand hygiene should be performed after using the toilet or after experiencing a vomiting episode, and before and after touching the spigots.

It should also be done before preparing and consuming food and drinks. Ill people should be excluded from handling food during their illness and for 48 – 72 hours after symptoms resolve.

Frequent disinfection of environmental surfaces with an approved disinfectant for norovirus may prevent exposures to contaminated surfaces that are often touched. Disinfect surfaces not typically identified as possible risk factors, like outdoor spigot handles, oars, raft surfaces, life jackets, and groovers. Sodium hypochlorite (chlorine bleach) or another product registered by the Environmental Protection Agency (EPA) as effective against norovirus

(http://www.epa.gov/oppad001/list_g_norovirus.pdf) is recommended for norovirus disinfection.

Quarternary ammonium compounds are less effective and should not be used for norovirus disinfection.

Some rafters reported evidence of prior illness at their designated campsites. Sand or dirt contaminated with vomitus was seen. To prevent contamination of shoes, tents, and sleeping bags, avoid areas with evidence of prior illness. Also, ill rafters should try (if time permits) to vomit outside the campground borders, but not into the river or creeks. Ill rafters should try to vomit in plastic zip lock bags if available and dispose with the rest of the garbage. If possible, try to keep sick people on the same boat and have them set up their tents in the same area of the campground. For the remainder of the trip, try to keep the same equipment with the people who were sick. Serve food to sick people last and away from people who are not sick.

Filtering alone will not remove particles as small as norovirus from water. It is recommended to first filter water and then boil or chemically treat the water. Replacing filters in a timely manner according to manufacturer's recommendations is strongly advised. The three-container (or four-container) system for cleaning and sanitizing dishes should be followed. Pamphlets and hand-outs on these issues were prepared and sent to USFS to give to rafters, and are currently found at the following URLs: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5432535.pdf, <http://www.healthandwelfare.idaho.gov/Health/FoodProtection/English/tabid/769/Default.aspx>, and <http://healthandwelfare.idaho.gov/Health/DiseasesConditions/Waterbornellness/tabid/113/Default.aspx>.

Next Steps

A second online survey focusing on water treatment methods and asking additional questions related to sanitation and our educational materials was developed and a link sent by e-mail to respondents to the first questionnaire who agreed to be contacted again with additional questions. We anticipate that results from this survey will help us refine our prevention outreach. Please contact Ken

Anderson or Mike Taylor at Eastern Idaho Public Health District at 208-533-3152 if you have any questions.

Thank you for your cooperation.