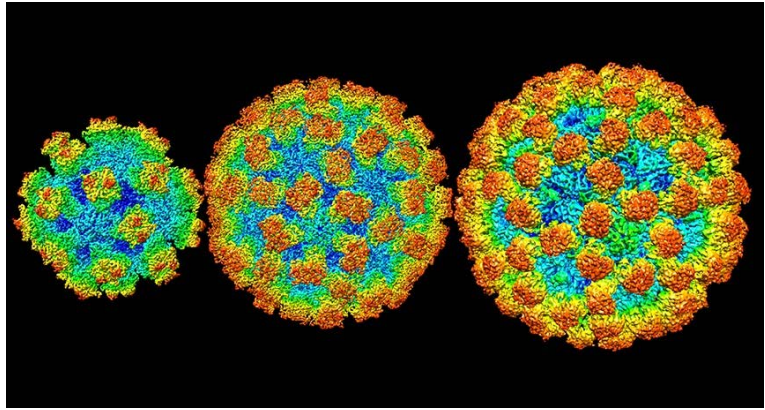


Avoiding and Managing Norovirus on a Grand Canyon River Trip



By Marc Hunt

Norovirus (Norwalk Virus) is a particularly harsh gastrointestinal infection that is very highly contagious. A Norovirus outbreak on a Grand Canyon river trip can be debilitating, and several members of the trip can suffer it simultaneously. Waves of norovirus outbreaks among river trips in the Grand Canyon, while not annual, occur with enough frequency and intensity that it is worth taking precautions to avoid occurrences and to be ready when they do happen.

Norovirus infection causes inflammation in the linings of the stomach and intestines, and is often characterized by nausea, vomiting, watery diarrhea, achiness, headache, light fever, and/or abdominal pain. A person usually develops symptoms 24 to 48 hours after being exposed to noro. Most who contract it make a recovery within two to three days, though they remain carriers for an additional five days after symptoms subside.

Background Factoids

- Norovirus transmission is primarily fecal-oral. After infection, the virus multiplies in human small intestine and is released when the infected person vomits, poops, farts, or leaks anally. And a sick patient does those things a lot, and sometimes spontaneously.
- Vomit of an infected person is also especially rich with the virus, and the virus can easily go aerosol when a person vomits. In one case where an infected person vomited in a restaurant, 52 of the 126 people eating in the restaurant became infected, despite a quick cleanup by staff, with the new victims taking the virus on through inhalation.
- Research shows that it requires ingestion of as few as twenty copies of the virus to become fully infected.
- Research shows that one gram of feces or vomit of an infected person can carry up to 2 billion copies of the virus.
- A carrier continues to carry and anally discharge the virus in high quantities for up to five days after symptoms wane.
- About one in five infected carriers do not exhibit symptoms but shed the virus in similar quantities.

- Studies show that an infected carrier who is not isolated and continues to circulate in public infects about 14 others on average.
- Once a person has cycled through an infection, they are likely immune to that particular strain of noro for a few months.
- The virus can survive on dry hard surfaces and fabrics for days; and for weeks or months in static wet environments (an important point to recall as you read further).
- An infected person can and probably does have billions of the virus on the external surfaces of skin around his/her butt and legs. One study indicated that the average swimmer who does not bathe before entering a pool indicated an average of 10 grams of fecal material on their bodies and in the fabric of their underwear, pants, and/or swimsuit. People on GC trips often go days without laundering their clothing. They can go days without thorough bathing with soap. So an infected person on a GC trip can remain continuously infectious as a transmitting agent.
- Alcohol and hand sanitizers are ineffective on norovirus due to its viral structure. Chlorine bleach works (though not bleach substitutes). In order to kill the virus with bleach, it requires about ten tablespoons of per gallon of water to reach sufficient concentration to be effective. This is a much higher concentration than dishwashing systems in trip kitchens use. If there is no outbreak on your trip, there is no need to use such a heavy concentration for general cleaning or dishwashing. And of course, treating with a bleach solution is not recommended on a human's skin nor through ingestion.
- Thorough washing with soap can be effective in removing the virus by simply cleansing and flushing the virus from skin, clothing, and other surfaces. This is a first-line response.
- Norovirus does not spontaneously arise. For instance, it will not be found in food that is going bad in a cooler, nor in an in-use groover (or even a municipal sewage treatment plant for that matter) unless it was introduced into one of those places by a host.
- Norovirus does not replicate itself or multiply outside the intestines. Except in continuously static (non-moving) moist environments, it has a relatively short life cycle of only a few days. In other words, it is not likely to lurk continuously in many places.
- It is very unlikely that the Colorado River is the source of noro outbreaks in the Canyon. With a billion or so gallons flowing by each day, any load of norovirus that finds its way into the water will be quickly dispersed into concentrations well below the infection threshold and ultimately flushed downstream. Water in even the deepest and calmest eddies exchanges into the main flow numerous times per day, so any viral loading in the river is unlikely to lurk for long.
- There is some evidence of occasional infection in other mammals, but the primary way it arrives in a locale (like the Grand Canyon) is through introduction by an infected human. There are about 20 million cases of noro in the US each year. The statistical odds that a human carrier of the virus, including asymptomatic or post-symptomatic ones, finds his or her way onto an occasional Grand Canyon trip are actually pretty good. Not on every trip, not on many trips, just one every now and then.

Avoiding Introduction of Norovirus into Your River Group

Again, a participant on any trip - including your trip - might arrive already infected and contagious. Check with all participants as the trip begins to learn whether anyone is currently or has recently (in the previous few days) experienced gastroenteritis. Research shows that a substantial proportion (perhaps 25% or more) of g/i illnesses are noro. If you have a potential carrier in your midst, or if someone on your trip falls ill with gastroenteritis, you should institute the precautions and the quarantining of that person outlined further below.

Unless the virus has arrived with a carrier who is part of your group, your challenge would be to avoid picking it up along the way, for example, from surfaces contaminated by carriers that came before your group or from the calm-water in side streams that might have recently become contaminated by a carrier (more on that in a minute).

The virus is acquired via inhalation in the case of someone vomiting, by ingesting food handled by someone who is infected, by human-to-human contact, by contact with surfaces or other media harboring the virus.

Washing hands is the well-known first line of defense in avoiding gastrointestinal illness on the river. Honor that. But realize that hand-washing alone will not be nearly enough of a defense if noro finds its way into your group.

Make sure everyone on the trip knows that they should alert the trip leader and others if anyone begins to feel sick. It can be a big mistake to wait too late...

If you hear of gastrointestinal sickness on other trips, take extra caution. Make sure and ask the NPS ranger at the put-in if there are reported outbreaks. Once you get on the river, if there is an outbreak in other parties, you may hear about it from others.

If folks on other trips are getting sick:

- Avoid sharing camps or lunch spots with other trips.
- Be careful at Phantom Ranch contacting surfaces in general, especially in public restrooms.
- Stay well clear of another person vomiting. Avoid the temptation to approach them and offer comfort / support.
- Be very careful if you encounter a place where it appears another person has vomited or pooped.

Calm Water in Certain Side Creeks as a Possible Medium for Transmission

Once the virus has found its way into the Canyon, there is a high frequency of transmission of the virus between trips, and the reasons remain somewhat a mystery. One theory is that the pools in several very-slow-draining side creeks that are popular short hikes from the river could harbor high concentrations of the virus once infected by a human carrier.



North Canyon and Silver Grotto

The dry season for Grand Canyon area is springtime extending into summer. Flow rates in certain side creeks diminish to nearly nothing and can stay that way for weeks. Significant flushing often does not occur until the monsoon period sets in starting usually in July but as late as September. Once a pool becomes contaminated with noro, given the very slow rate of exchange of water and the relatively warm temperature of the water, it could remain a very rich source of spread of the virus for weeks. Several dozen visitors can visit a given side-creek per day = hundreds per week. With the hot weather, these pools are irresistibly inviting. Think of them as being like a popular hotel swimming pool or hot tub with no filtration or chlorination. Many users go for total immersion in some pools. So all it would take is one infected carrier visiting a pool, introducing a few billion copies of the virus into that pool thus contaminating it for weeks. The carrier could be a trip passenger whose symptoms disappeared before they arrived at Lee's Ferry or even exhibited no symptoms at all. And once a pool has billions of the virus thoroughly dispersed in it, a subsequent visitor need only have twenty or so enter his/her system via mouth or nose to become infected. Or a visitor who swims or wades there could have his/her skin and clothing become contaminated for later sharing onto other surfaces in a raft or at camp.

(There is an interesting parallel here to the problem with infamous outbreaks of noro on cruise ships where infected carriers sometimes arrive and unwittingly trigger outbreaks by swimming in one of the crowded on-deck pools.)

So the suggestion is this: Even if there is no news of outbreaks on other trips, when visiting side creeks, avoid contact with very slow-moving water. Especially no swimming, or immersion. And for those that do contact water in these creeks, a through rinsing in the Colorado is a good idea before getting back on a raft. Here are some popular creeks that often have the still-water pools:

<u>Name</u>	<u>River Mile</u>
North Canyon	21
Silver Grotto	29
Saddle Canyon	47
Blacktail Canyon	121
Tuck-Up Canyon	165

Creeks with good constant flow (Elves Chasm, Deer Creek, Tapeats, Matkat, etc.) or have recently been flushed after rainfall would be much less risky and probably just fine to wade and swim in.

Oh, and if there is a person in your group that is suspected of being infected or an active carrier, please ensure that he/she does not go into any side streams.

Okay, so What if a Trip Member Does Get Sick?

- Anyone who is about to vomit or have diarrhea should get far away from camp, from others, and from equipment, camp items, etc. It might even help if they take their pfd, shirt, etc., off first. If someone is in a raft and they are becoming nauseous, the raft should pull over and allow the person to go ashore (not at a campsite or lunch spot, please) till they are no longer nauseous, even if that takes a bit of time. The goal is to avoid possible contamination by a person as they puke or poop.
- If a person is suspected of having noro, he/she should absolutely not be allowed to use the group groover or day groover for at least one week. If time allows, a dedicated “sick” groover should be established. Perhaps one that is already partially filled and converted for sick-use since total groover capacity on the trip could be a concern. This probably means use without a proper seat. It also means a very strong protocol for sealing and very thoroughly washing and disinfecting the sick-groover before reloading it into a raft.
- If someone vomits or has an episode of diarrhea, once nausea subsides, that person should bathe thoroughly with soap in the river, and their clothing should be thoroughly washed with soap. The bucket should be thoroughly cleaned afterward, including with a sufficiently strong Clorox solution (rate of ten tbsps. per gallon). When rinsing with bleach solution, it is always best to let items soak for at least two minutes. Any residual tie-dye fashion in a person’s clothing would be a bonus...
- Realize that a person who shows symptoms is likely to be discharging hundreds of billions of the virus anally every day for the next week. Literally a walking infection agent in your midst. That is going to mean keeping the sick-groover going and establishing a floating/travelling quarantine for that person.
- Important as it is to avoid transmission, the patient will need proper attention and support. There is no known cure. As with most other viruses, antibiotics have no effect. Antiemetics and antidiarrheal drugs might be helpful in severe cases to ease symptoms. The good news is that patients generally recover in a couple days, so it’s usually a matter of riding out the storm and keeping others safe. The primary aim in treatment is to ensure that the patient remains hydrated (which can be a challenge even for otherwise healthy folks in the Canyon). Make sure and provide fluids frequently and generously, and encourage the patient to take them as he/she is able. Norovirus can lead to severe dehydration, a medical emergency, and that could be a cause for quick helicopter evacuation.

- Barring severe dehydration, norovirus illness is rarely bad enough to require hospitalization, and the cases that do often are seen in young children and the elderly. Norovirus should generally not be a cause for helicopter evacuation on a Canyon trip given the likely brevity of the case.

So what does a floating/travelling quarantine look like?

- Again, establish a “sick groover” away from camp for use by the afflicted, and clean/sanitize it with bleach solution each time it is to be reloaded in a raft. Because the intensive sharing of contact surfaces within a trip, it is about avoiding surface-contact transmission as well as person-person transmission. So measures in addition to the normal hand-washing and toilet protocols are called for.
- Remember, the norovirus is extremely contagious and virulent, and it is persistent on surfaces and in fabrics.
- The infected person needs to wear nylon splash pants at all times when on a raft or venturing into the main part of camp or lunch site. (i.e., to contain any small accidental anal discharges)
- That pair of nylon pants should be washed with soap and rinsed well each time the infected person takes them off.
- The infected person should avoid contacting many places on a raft. That means alone in a designated bow compartment in a certain raft day after day, without other group gear in that compartment. The main tubes and decks around that compartment should then be washed with soap and rinsed upon arrival at camp.
- The infected person should be isolated to a corner of camp, socially distant from all others by say, at least 25 feet.
- A spouse or partner of the patient might feel compelled to stay with and comfort him or her. This would be a mistake unless the partner/spouse has had the same illness very recently (thus immune).
- The infected person should not visit the kitchen or main area of camp.
- The dry-bag, sleeping bag, clothing, lounge chair, etc. of the infected person should be managed with as much isolation and disinfection as is reasonably possible. After an infected person packs up, the outside surface of their dry bag should be washed with soap and rinsed well. Their lounge chair should be cleaned. Dipping items in the river can be helpful, though not as effective as using soap and/or bleach.
- An infected person’s dry bag, lounge chair, tent, and day-use bag/box should go in the same compartment of the raft they are riding in.
- Immediately after an infected person has an “accident”, and otherwise on a daily basis, that infected person’s clothing should be washed with soap and thoroughly rinsed.
- I suspect it feels a little awkward to consider washing and rinsing infected stuff into the river. But it beats rinsing it into camp or trying to transport contaminated waste and clothing out with the trip. Remember, billions of gallons are flowing past in the river, and the virus will dissipate so broadly that there is nearly no chance of it infecting anyone else.
- Anyone assisting an infected person should wear rubber gloves. After the assistance, the rubber gloves should be washed and bleached or disposed of.
- Avoid including contaminated items (e.g., a paper towel used to clean up after a person vomits) in the main garbage. Do not bring possibly-contaminated items into the main part of camp or into other rafts.

Norovirus outbreaks do not occur every year in the Grand Canyon and certainly not on many trips. It is best not to become too paranoid about an outbreak on your trip as chances are statistically low that you will have one. But it's best to be ready just in case.

A good approach might be to rigorously maintain personal hygiene – especially frequent hand-washing. Check with all participants as the trip begins as to any current or recent illness. Once underway, make sure anyone feeling ill speaks up. And stay out of the water on the side streams with very low flows.

Consider printing or electronically storing this article and taking it along on your next trip. Happy tripping and thanks for reading!

Informative references:

Wikipedia Article on Norovirus - <https://en.wikipedia.org/wiki/Norovirus>

Centers for Disease Control (CDC) Web Page on Norovirus - <https://www.cdc.gov/hai/organisms/norovirus.html>

Author Marc Hunt is not a medical professional. He was motivated to assemble the above discussion after a memorable Canyon trip he was on had fourteen of the sixteen participants fall sick with Norovirus. To write this, Marc researched various articles and publications by the National Park Service, CDC, and other sources as well as having interviews with a few doctors including an epidemiologist, various professional guides, outfitters, and private users. As such, this is simply an effort to suggest and share good strategies. It is not intended as an exhaustively researched and confirmed study by medical professionals or researchers.