

Noroviruses: Q&A

What are noroviruses?

Noroviruses are a group of viruses that cause the “stomach flu,” or gastroenteritis (GAS-tro-en-ter-I-tis), in people. The term norovirus was recently approved as the official name for this group of viruses. Several other names have been used for noroviruses, including:

- Norwalk-like viruses (NLVs)
- caliciviruses (because they belong to the virus family *Caliciviridae*)
- small round structured viruses.

Viruses are very different from bacteria and parasites, some of which can cause illnesses similar to norovirus infection. Viruses are much smaller, are not affected by treatment with antibiotics, and cannot grow outside of a person’s body.

What are the symptoms of illness caused by noroviruses?

The symptoms of norovirus illness usually include nausea, vomiting, diarrhea, and some stomach cramping. Sometimes people additionally have a low-grade fever, chills, headache, muscle aches, and a general sense of tiredness. The illness often begins suddenly, and the infected person may feel very sick. The illness is usually brief, with symptoms lasting only about 1 or 2 days. In general, children experience more vomiting than adults. Most people with norovirus illness have both of these symptoms.

What is the name of the illness caused by noroviruses?

Illness caused by norovirus infection has several names, including:

- stomach flu – this “stomach flu” is *not* related to the flu (or influenza), which is a respiratory illness caused by influenza virus.
- viral gastroenteritis – the most common name for illness caused by norovirus. Gastroenteritis refers to an inflammation of the stomach and intestines.
- acute gastroenteritis
- non-bacterial gastroenteritis
- food poisoning (although there are other causes of food poisoning)
- calicivirus infection

How serious is norovirus disease?

Norovirus disease is usually not serious, although people may feel very sick and vomit many times a day. Most people get better within 1 or 2 days, and they have no long-term health effects related to their illness. However, sometimes people are unable to drink enough liquids to replace the liquids they lost because of vomiting and diarrhea. These persons can become dehydrated and may need special medical attention. This problem with dehydration is usually only seen among the very young, the elderly, and persons with weakened immune systems. There is no evidence to suggest that an infected person can become a long-term carrier of norovirus.

How do people become infected with noroviruses?

Noroviruses are found in the stool or vomit of infected people. People can become infected with the virus in several ways, including:

- eating food (see [food handler fact sheet](#)) or drinking liquids that are contaminated with norovirus;
- touching surfaces or objects contaminated with norovirus, and then placing their hand in their mouth;
- having direct contact with another person who is infected and showing symptoms (for example, when caring for someone with illness, or sharing foods or eating utensils with someone who is ill).

Persons working in day-care centers or nursing homes should pay special attention to children or residents who have norovirus illness. This virus is very contagious and can spread rapidly throughout such environments.

When do symptoms appear?

Symptoms of norovirus illness usually begin about 24 to 48 hours after ingestion of the virus, but they can appear as early as 12 hours after exposure.

Are noroviruses contagious?

Noroviruses are very contagious and can spread easily from person to person. Both stool and vomit are infectious. Particular care should be taken with young children in diapers who may have diarrhea.

How long are people contagious?

People infected with norovirus are contagious from the moment they begin feeling ill to at least 3 days after recovery. Some people may be contagious for as long as 2 weeks after recovery. Therefore, it is particularly important for people to use good handwashing and other hygienic practices after they have recently recovered from norovirus illness.

Who gets norovirus infection?

Anyone can become infected with these viruses. There are many different strains of norovirus, which makes it difficult for a person's body to develop long-lasting immunity. Therefore, norovirus illness can recur throughout a person's lifetime. In addition, because of differences in genetic factors, some people are more likely to become infected and develop more severe illness than others.

What treatment is available for people with norovirus infection?

Currently, there is no antiviral medication that works against norovirus and there is no vaccine to prevent infection. Norovirus infection cannot be treated with antibiotics. This is because antibiotics work to fight bacteria and not viruses.

Norovirus illness is usually brief in healthy individuals. When people are ill with vomiting and diarrhea, they should drink plenty of fluids to prevent dehydration. Dehydration among young children, the elderly, the sick, can be common, and it is the most serious health effect that can result from norovirus infection. By drinking oral rehydration fluids (ORF), juice, or water, people can reduce their chance of becoming dehydrated. Sports drinks do not replace the nutrients and minerals lost during this illness.

Can norovirus infections be prevented?

Yes. You can decrease your chance of coming in contact with noroviruses by following these preventive steps:

- Frequently wash your hands, especially after toilet visits and changing diapers and before eating or preparing food.
- Carefully wash fruits and vegetables, and steam oysters before eating them.
- Thoroughly clean and disinfect contaminated surfaces immediately after an episode of illness by using a bleach-based household cleaner.
- Immediately remove and wash clothing or linens that may be contaminated with virus after an episode of illness (use hot water and soap).
- Flush or discard any vomitus and/or stool in the toilet and make sure that the surrounding area is kept clean.

Persons who are infected with norovirus should not prepare food while they have symptoms and for 3 days after they recover from their illness ([see food handler information sheet](#)). Food that may have been contaminated by an ill person should be disposed of properly.

Noroviruses and Food Handlers

What are noroviruses?

Noroviruses are members of a group of viruses called caliciviruses also known previously as “Norwalk-like viruses.” Infection with norovirus affects the stomach and intestines, causing an illness called gastroenteritis, or “stomach flu.” This “stomach flu” is *not* related to the flu (or influenza), which is a respiratory illness caused by influenza virus. In addition, noroviruses are not related to bacteria and parasites that can cause gastrointestinal illnesses. Norovirus is not a “new” virus, but interest in it is growing as more is learned about how frequently noroviruses cause illness in people (see – [“Why is norovirus infection important for food handlers?”](#)).

What are the symptoms of infection with norovirus?

Norovirus infection causes gastroenteritis, which is an inflammation of the stomach and the small and large intestines. The symptoms of gastroenteritis are nausea, vomiting, and/or diarrhea accompanied by abdominal cramps. Some people also complain of headache, fever/chills, and muscle aches. Symptoms are usually brief and last only 1 or 2 days. However, during that brief period, people can feel very ill and vomit, often violently and without warning, many times a day. Symptoms usually begin 24 to 48 hours after ingestion of the virus, but can appear as early as 12 hours after exposure (see – [“How is norovirus spread?”](#)). There is no evidence that sick persons can become long-term carriers of the virus, but the virus can be in the stool and vomit of infected persons, from the day they start to feel ill to as long as 2 weeks after they feel better.

Other infectious and non-infectious agents can cause symptoms similar to those of norovirus gastroenteritis; people who have these symptoms and have questions about the cause of their illness should consult a physician.

How serious is norovirus gastroenteritis?

Norovirus gastroenteritis is usually not a serious illness, and other than drinking liquids to prevent dehydration, there is no specific treatment. Most people recover completely within 1 to 2 days, with no long-term complications of norovirus illness. However, persons who are unable to drink enough liquids to replace those lost with vomiting and/or diarrhea may become dehydrated and require special medical attention. These people include young children, the elderly, and persons of any age unable to care for themselves.

How is norovirus spread?

Noroviruses are found in the stool or vomit of infected people. People can become infected with the virus in several ways, including:

- eating food ([see food handler fact sheet](#)) or drinking liquids that are contaminated with norovirus;
- touching surfaces or objects contaminated with norovirus, and then placing their hand in their mouth;
- having direct contact with another person who is infected and showing symptoms (for example, when caring for someone with illness, or sharing foods or eating utensils with someone who is ill).

Food and drinks can very easily become contaminated with norovirus because the virus is so small and because it probably takes fewer than 100 norovirus particles to make a person sick. Food can be contaminated either by direct contact with contaminated hands or work surfaces that are contaminated with stool or vomit, or by tiny droplets from nearby vomit that can travel through air to land on food. Although the virus cannot multiply outside of human bodies, once on food or in water, it can cause illness.

Some foods can be contaminated with norovirus *before* being delivered to a restaurant or store. Several outbreaks have been caused by the consumption of oysters harvested from contaminated waters. Other produce such as salads and frozen fruit may also be contaminated at source.

Why is norovirus infection important for food handlers?

People working with food who are sick with norovirus gastroenteritis are a particular risk to others, because they handle the food and drink many other people will consume. Since the virus is so small, a sick food handler can easily – without meaning to – contaminate the food he or she is handling. Many of those eating the contaminated food may become ill, causing an outbreak.

Outbreaks of norovirus gastroenteritis have taken place in restaurants, cruise ships, nursing homes, hospitals, schools, banquet halls, summer camps, and family dinners – in other words, places where often people have consumed water and/or food prepared or handled by others. It is estimated that as many as half of all food-related outbreaks of illness may be caused by norovirus. In many of these cases, sick food handlers were thought to be implicated.

What can I do to prevent norovirus gastroenteritis?

Many local and state health departments require that food handlers and preparers with gastroenteritis *not* work until 2 or 3 days after they feel better. In addition, because the virus continues to be present in the stool for as long as 2 to 3 weeks after the person feels better, strict hand washing after using the bathroom and before handling food items is important in preventing the spread of this virus. Food handlers who were recently sick can be given different duties in the restaurant so that they do not have to handle food (for example, working the cash register or hostessing).

People who are sick with norovirus illness can often vomit violently, without warning, and the vomit is infectious; therefore, any surfaces near the vomit should be promptly cleaned and disinfected with bleach solution and then rinsed. Furthermore, food items that may have become contaminated with norovirus should be thrown out. Linens (including clothes, towels, tablecloths, napkins) soiled to any extent with vomit or stool should be promptly washed at high temperature. Oysters should be obtained from reputable sources and appropriate documentation kept. Washing raw vegetables thoroughly before eating and appropriate disposal of sewage and soiled diapers also help to reduce the spread of norovirus and prevent illness. In small home-based catering businesses or family owned or operated restaurants, sick children and infants in diapers should be excluded from food preparation areas.

How is norovirus gastroenteritis diagnosed?

In special cases, when there is an outbreak of gastroenteritis there is a need to identify norovirus as the cause of the illness. In these cases, norovirus can often be found in stool samples of infected persons by using special tests. Sometimes blood tests looking for antibodies against norovirus are also performed, when the stool tests are inconclusive or were not done. Food handlers will often be asked for a stool sample or even a blood sample to help investigate the cause of an outbreak.

Can a person have norovirus gastroenteritis more than once?

Yes, a person can be infected with norovirus more than once in their lifetime. This is because there are many different noroviruses, and being infected with one type does not prevent infection from another type later. For this reason, it is difficult to develop a vaccine against norovirus.

Noroviruses

Noroviruses (genus *Norovirus*, family *Caliciviridae*) are a group of related, single-stranded RNA, nonenveloped viruses that cause acute gastroenteritis in humans. Norovirus was recently approved as the official genus name for the group of viruses provisionally described as “Norwalk-like viruses” (NLV). This group of viruses has also referred to as caliciviruses (because of their virus family name) and as small round structured viruses, or SRSVs (because of their morphologic features). Another genus of the calicivirus family that can cause gastroenteritis in humans is *Sapovirus*, formerly described as “Sapporo-like virus” (SLV) and sometimes referred to as classic or typical calicivirus.

Noroviruses are named after the original strain “Norwalk virus,” which caused an outbreak of gastroenteritis in a school in Norwalk, Ohio, in 1968. Currently, there are at least four norovirus genogroups (GI, GII, GIII and GIV), which in turn are divided into at least 20 genetic clusters.

Clinical Presentation

The incubation period for norovirus-associated gastroenteritis in humans is usually between 24 and 48 hours (median in outbreaks 33 to 36 hours), but cases can occur within 12 hours of exposure. Norovirus infection usually presents as acute-onset vomiting, watery non-bloody diarrhea with abdominal cramps, and nausea. Low-grade fever also occasionally occurs, and vomiting is more common in children. Dehydration is the most common complication, especially among the young and elderly, and may require medical attention. Symptoms usually last 24 to 60 hours. Recovery is usually complete and there is no evidence of any serious long-term sequelae. Studies with volunteers given stool filtrates have shown that asymptomatic infection may occur in as many as 30% of infections, although the role of asymptomatic infection in norovirus transmission is not well understood.

Virus Transmission

Noroviruses are transmitted primarily through the fecal-oral route, either by consumption of fecally contaminated food or water or by direct person-to-person spread. Environmental and fomite contamination may also act as a source of infection. Good evidence exists for transmission due to aerosolization of vomitus that presumably results in droplets contaminating surfaces or entering the oral mucosa and being swallowed. No evidence suggests that infection occurs through the respiratory system.

Noroviruses are highly contagious, and it is thought that an inoculum of as few as 10 viral particles may be sufficient to infect an individual. During outbreaks of norovirus gastroenteritis, several modes of transmission have been documented; for example, initial foodborne transmission in a restaurant, followed by secondary person-to-person transmission to household contacts. Although presymptomatic viral shedding may occur, shedding usually begins with onset of symptoms and may continue for 2 weeks after

recovery. It is unclear to what extent viral shedding over 72 hours after recovery signifies continued infectivity.

Immunity to Norovirus

Mechanisms of immunity to norovirus are unclear. It appears that immunity may be strain-specific and lasts only a few months; therefore, given the genetic variability of noroviruses, individuals are likely to be repeatedly infected throughout their lifetimes. This may explain the high attack rates in all ages reported in outbreaks. Recent evidence also suggests that susceptibility to infection may be genetically determined, with people of O blood group being at greatest risk for severe infection.

Disease burden of Norovirus Gastroenteritis

CDC estimates that 23 million cases of acute gastroenteritis are due to norovirus infection, and it is now thought that at least 50% of all foodborne outbreaks of gastroenteritis can be attributed to noroviruses.

Among the 232 outbreaks of norovirus illness reported to CDC from July 1997 to June 2000, 57% were foodborne, 16% were due to person-to-person spread, and 3% were waterborne; in 23% of outbreaks, the cause of transmission was not determined. In this study, common settings for outbreaks include restaurants and catered meals (36%), nursing homes (23%), schools (13%), and vacation settings or cruise ships (10%).

Most foodborne outbreaks of norovirus illness are likely to arise through direct contamination of food by a food handler immediately before its consumption. Outbreaks have frequently been associated with consumption of cold foods, including various salads, sandwiches, and bakery products. Liquid items (e.g., salad dressing or cake icing) that allow virus to mix evenly are often implicated as a cause of outbreaks. Food can also be contaminated at its source, and oysters from contaminated waters have been associated with widespread outbreaks of gastroenteritis. Other foods, including raspberries and salads, have been contaminated before widespread distribution and subsequently caused extensive outbreaks.

Waterborne outbreaks of norovirus disease in community settings have often been caused by sewage contamination of wells and recreational water.

Diagnosis of Norovirus

Human. In the last 10 years, diagnosis of norovirus illness in outbreaks has improved with the increasing use of reverse transcriptase polymerase chain reaction (RT-PCR). Currently, 27 state public health laboratories have the capability to test for noroviruses by RT-PCR. RT-PCR can be used to test stool and emesis samples, as well as to detect the presence of noroviruses on environmental swabs in special studies. Identification of the virus can be best made from stool specimens taken within 48 to 72 hours after onset of symptoms, although good results can be obtained by using RT-PCR on samples taken as long as 5 days after symptom onset. Virus can sometimes be found in stool samples taken as late as 2 weeks after recovery.

Older methods for diagnosis include direct and immune electron microscopy of fecal specimens, and detection of a fourfold increase of specific antibodies in acute- and convalescent-phase blood samples. An enzyme-linked immunosorbent assay for detection of virus in stools is under development.

Sequencing of noroviruses found in clinical samples has helped in conducting epidemiologic investigations by linking cases to each other and to a common source and by differentiating outbreaks that were mistakenly connected. Sequences can be entered into CaliciNet, a database used to store the different sequences of norovirus that cause disease throughout the United States, thereby allowing rapid assessment of the relationships between strains.

In addition to microbiological techniques, several epidemiologic criteria have been proposed for use in determining whether an outbreak of gastroenteritis is of viral origin. Kaplan's criteria for this purpose are as follows: 1) a mean (or median) illness duration of 12 to 60 hours, 2) a mean (or median) incubation period of 24 to 48 hours, 3) more than 50% of people with vomiting and 4) no bacterial agent previously found." Although quite specific, these criteria are not very sensitive, and therefore the possibility of a viral etiology should not be discarded if the criteria are not met.

Environmental. Assays to detect virus in food need to be adapted for each food substance; these have been only rarely used, with the exception of assays to detect virus in shellfish. Water can be tested for noroviruses by using RT-PCR to detect virus when large volumes of water are processed through specially designed filters.

Management of Norovirus Infection

No specific therapy exists for viral gastroenteritis. Symptomatic therapy consists of replacing fluid losses and correcting electrolyte disturbances through oral and intravenous fluid administration.

Prevention

Prevention of foodborne norovirus disease is based on the provision of safe food and water. Noroviruses are relatively resistant to environmental challenge: they are able to survive freezing, temperatures as high as 60°C, and have even been associated with illness after being steamed in shellfish. Moreover, noroviruses can survive in up to 10 ppm chlorine, well in excess of levels routinely present in public water systems. Despite these features, it is likely that relatively simple measures, such as correct handling of cold foods, frequent handwashing, and paid sick leave, may substantially reduce foodborne transmission of noroviruses.

Surveillance of Norovirus Infection in the United States

CDC currently does not conduct active surveillance to monitor outbreaks of gastroenteritis caused by noroviruses. Outbreaks are reported to CDC's Viral Gastroenteritis Section, Respiratory and Enteric Viruses Branch, Division of Viral and Rickettsial Diseases, National Center for Infectious Diseases (NCID) when states send

specimens for testing or sequencing, or outbreaks are reported directly by states to the database maintained by the Foodborne Diarrheal Diseases Branch, Division of Bacterial and Mycotic Diseases, NCID.

Recently, a system called CaliciNet has been developed on the basis of the PulseNet model. CaliciNet is a database of norovirus sequences identified from outbreaks of norovirus that can then help to determine links between outbreaks. For further details please email calicinet@cdc.gov