

Norovirus Infections

Summary

Noroviruses are the leading cause of acute gastroenteritis which is sometimes referred to as “stomach flu” or “winter vomiting disease”. Individual norovirus infections are not reportable to the New Mexico Department of Health. However, outbreaks of norovirus are frequently reported to the Epidemiology and Response Division (ERD); therefore, information about norovirus is included in this manual. Suspected outbreaks should be reported to ERD at 505-827-0006. Noroviruses are highly contagious, with as few as 100 virus particles thought to be sufficient to cause infection. These viruses can remain viable and infective on surfaces for up to two weeks. Although the illness is generally short-lived and self-limiting, hospitalizations and deaths have occurred, especially among nursing home residents. Outbreaks of norovirus illness can be due to a food or water vehicle, but more commonly the virus is transmitted person to person.

Agent

Noroviruses (genus *Norovirus*, family *Caliciviridae*) are a group of related, single-stranded RNA, non-enveloped viruses that cause acute gastroenteritis in humans and were previously described as “Norwalk-like viruses” (NLV).

Transmission

Reservoir:

Humans are the only known reservoir.

Mode of transmission:

Noroviruses are found in the stool or vomitus of infected people or on contaminated surfaces not properly cleaned and disinfected. People can become infected with the virus through:

- Eating food, drinking liquids or using utensils contaminated with norovirus.
- Touching surfaces or objects contaminated with norovirus, and then touching the face/mouth/mucous membranes.
- Direct contact with the feces or vomitus of a person who is infected and showing signs or symptoms (e.g., while caring for someone who is sick).
- Inadvertent ingestion of airborne aerosolized virus particles that may occur with patient vomiting.
- Ingesting recreational water that is contaminated and lacks sufficient chlorination.

Persons at increased risk of spreading disease include:

- Food handlers.
- Persons providing direct patient care in hospitals or long term care facility (LTCF).
- Residents and visitors of LTCFs.
- Residents of homeless shelters.
- Children and staff in daycare centers and schools.
- Other closed populations (e.g., cruise ship staff and passengers).

Period of communicability:

Although presymptomatic viral shedding may occur, shedding in either stool or vomitus usually begins with onset of symptoms and may continue for two weeks after recovery. Ill persons are most contagious with the greatest amount of viral shedding during the illness and for 72 hours after symptoms end. Long-term shedding is seen but it is unclear how infective the shed virus is above 72 hours after symptoms end.

Clinical manifestations

Incubation period:

Generally 24 to 48 hours after ingestion of the virus; however, symptoms can appear as early as 12 hours after exposure.

Illness:

Illness is characterized by acute onset of vomiting, watery, non-bloody diarrhea with abdominal cramps, and nausea. Some persons may experience only vomiting or diarrhea. In addition, myalgia, malaise, and headache are commonly reported. Low-grade fever is present in about half of cases. Symptoms usually last 24 to 60 hours. Dehydration is the most common complication of illness and may require intravenous replacement fluids. Studies suggest that up to 30% of infections may be asymptomatic. Mechanisms of immunity to norovirus are unclear. Immunity may be strain-specific and persist for only a few months, but with the genetic variability of noroviruses, individuals may be repeatedly infected throughout their lifetimes.

Laboratory Diagnosis

Diagnosis of norovirus infection relies on the detection of viral RNA in the stools or vomitus of affected persons, by use of reverse transcription-polymerase chain reaction (RT-PCR) assays. In New Mexico, testing is available at the Scientific Laboratory Division (SLD) and must be approved by the Epidemiology and Response Division (ERD). Identification of the virus can best be made from stool or vomitus specimens taken within 48 to 72 hours after onset of signs and symptoms, although good results can be obtained by using RT-PCR on samples taken as long as seven days after symptom onset. See Appendix A for more information regarding collection of samples.

SLD does not yet perform norovirus testing for environmental samples.

Treatment

There are no antiviral medications or vaccines to treat or protect against noroviruses, respectively. 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 replacement of fluid and correction of electrolyte disturbances through oral and intravenous fluid administration.

Surveillance

The Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE) have not developed case definitions for a norovirus infection and they are not reportable at the national or New Mexico state level. However, New Mexico

Administrative Code requires that suspicion or confirmation of any outbreak, including norovirus, must be reported to ERD at 505-827-0006.

What Constitutes an Outbreak?

Since diarrhea may be fairly common among residents of a long term care facility, determining when there is an outbreak may be subjective. In general, an outbreak of gastroenteritis in a LTCF is defined as the presence of more diarrhea or vomiting than would be anticipated normally in the facility, or in a particular ward/unit, for that time frame of concern.

Clinical Case Definition:

The following definition is recommended for a suspected norovirus outbreak in a LTCF:

Vomiting and/or diarrhea (three or more loose stools per individual in a 24-hour period) in a resident or staff member with sudden onset of symptoms since (specified date) and whose symptoms have no other apparent cause.

An outbreak of norovirus may be categorized as either “suspected” or “confirmed”:

Suspected norovirus outbreak – The signs and symptoms of the illness closely resemble those of norovirus but stool or vomitus samples were not collected and tested or clinical specimens were collected and yielded either negative or inconclusive results.

Confirmed norovirus outbreak – The signs and symptoms of the illness are consistent with norovirus, and laboratory testing yielded positive results for norovirus in specimens collected from at least two ill persons.

Control Measures

1 Case Management

Individual norovirus cases are not reportable and, therefore, would not be individually investigated. However, each case within a suspected outbreak will require review or an interview.

1.1 Isolation:

In general, persons with suspected norovirus infection should be managed with standard precautions with careful attention to hand hygiene practices (see section below). However, contact precautions (as described in (http://www.cdc.gov/ncidod/dhqp/gl_isolation_contact.html) should be implemented when caring for diapered or incontinent persons, during outbreaks in a facility, and when there is the possibility of splashes that might lead to contamination of clothing.

1.2 Prophylaxis: Not applicable.

2. Contact Management

2.1 Isolation:

Exclude ill staff in specific positions (e.g., food handlers, child care personnel and health care personnel with direct patient care duties) until 48-72 (preferably 72) hours after signs/symptoms resolve.

Cohort ill patients and/or residents in institutional settings such as long-term care facilities and hospitals until 24-48 (preferably 48) hours after signs and symptoms fully resolve.

2.2 Prophylaxis: Not applicable

3. Prevention

3.1 Hand Hygiene:

Appropriate hand hygiene has been identified by CDC as the “single most important method to prevent norovirus infection”. Washing hands with running water and plain or antiseptic soap for at least 20 seconds is the most effective and preferred method. Use of alcohol based gels to cleanse hands has not been shown to be consistently effective.

3.2 Environmental Cleaning:

Disinfecting potentially contaminated surfaces is recommended to prevent exposure and further spread of norovirus. The most effective disinfectant is a chlorine bleach solution made from diluting household bleach in 1:10 dilution by mixing one cup bleach in nine cups water. Health care settings should use products that are EPA-registered and labeled for use in such settings.

Management of Norovirus in a Nursing Home or Institutional-Associated Outbreak

- Conduct a site visit assessment with appropriate team member(s) to collect further information. Staff should use checklist (Appendix B) to guide their assessment of the facility.
- Conduct surveillance at the facility. Use a line listing to keep track of potential cases. Include:
 - Number of ill residents
 - Number of ill staff (include job function/location and residents with whom they work)
 - Onset dates (and times if possible) of signs/symptoms
 - Signs and symptoms
 - Duration of illness
 - Physical distribution of illness in the facility
 - Hospitalizations/deaths
- Collect samples for laboratory testing as necessary from people who are/have been ill, if this has not already been done. Try to obtain five specimens (or as many possible) from an outbreak in a nursing home or other institution.
- Provide education to facility staff about clinical presentation, disease transmission, and prevention and control measures.
- Coordinate investigation with the New Mexico Environment Health Food Program to inspect the food facility to determine whether any food handling staff was ill in the days before the residents' illness onset dates. This may indicate that a food source may have started the outbreak in the facility. Assure that food handler interviews are conducted in standardized and complete fashion.
- Contact the Division of Health Improvement (DHI) when the investigation is conducted in a facility licensed by DHI to report the gastrointestinal illness outbreak. Explicitly tell them that we are not requesting any onsite investigation on their part unless we have determined it is necessary.

Resident-oriented Prevention and Control Measures:

- Isolate ill residents from others by confining them to their rooms (until three days after their last signs or symptoms resolve). Group ill people together (cohort) if possible. Discontinue activities where ill and well residents would be together. Group activities should be kept to a minimum or postponed until the outbreak is over.

- Advise closing the facility to new admissions until at least three days (72 hours) after the symptom resolution of the last case.
- If a resident is transferred to the hospital, notify the facility that the resident is coming from a facility at which an outbreak is occurring.

Staff-oriented Prevention and Control Measures:

- Healthcare personnel who have acute gastrointestinal illness should be excused from patient care activities while they are ill and for 48-72 hours after their signs and symptoms have resolved. Because the virus may be present in stool for as long as 2-3 weeks after an affected person feels better, strict hand washing needs to be stressed.
- Minimize the flow of staff between sick and well residents. Staff should be assigned to work with either well residents or sick residents, but should not care for both groups. (Staff who go back and forth between ill and well residents play a key role in transmitting the virus from resident to resident.)
- Maintain strict hand hygiene when entering and leaving every resident room. That is, hands should be washed with soap and warm water when entering a room and when leaving the room. Alcohol-based hand sanitizers for general hygiene purposes when hands are not visibly soiled should not be depended on to prevent spread of norovirus.
- Gloves should be worn when caring for ill residents or when touching potentially contaminated surfaces.
- Staffs should wear masks when caring for a resident who is vomiting.
- Housekeeping staff should wear gloves and masks when cleaning contaminated or potentially contaminated surfaces or laundry.
- Contaminated linen and bedding should be carefully placed into laundry bags (to prevent generating aerosols) and washed separately in hot water for a complete wash cycle (ideally as a half load for best dilution).
- Use an appropriate disinfectant to clean surfaces frequently (see below).
- Common medical equipment should be adequately disinfected between residents. Consider dedicating pieces of commonly used equipment for use in affected areas.

Visitor-oriented Prevention and Control Measures:

- Recommend discontinuing visitation to health care facilities (e.g., nursing homes) until the outbreak is over. If visitation is allowed, visitors should go directly to the person they are visiting and not spend time with anyone else. They should wash their hands upon entering and leaving the room. They should not visit if they are sick.
- Recommend posting signs to remind visitors who are sick to delay their visit until they are well as well as signs that encourage hand washing.

Management of Norovirus in a Daycare Associated Outbreak:

- Exclude symptomatic children from day care until cessation of illness. Upon return, hand washing of children must be strictly monitored.
- Exclude symptomatic staff from work until 48-72 hours after cessation of illness.
- Staff hand washing, especially after changing diapers and before food preparation, must be strictly enforced.
- If possible, implement a cohort system (whereby infected children and staff are placed together in a separate area away from other children and staff).
- Staff should wear gloves and masks when cleaning contaminated or potentially contaminated surfaces or laundry.

Management of Norovirus in a Restaurant or Hotel Associated Outbreak

Food handlers and preparers with gastroenteritis caused by norovirus should not work until three days (72 hours) after complete resolution of signs and symptoms. In addition, because the virus continues to be present in the stool for as long as 2-3 weeks after the person recovers, 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 handle food (e.g., working the cash register or hostessing).

Appendices

- A. Instructions for Collection of Specimens
- B. Checklist for Gastrointestinal Disease Outbreak – Healthcare Facility

References

Centers for Disease Control and Prevention. Updated Norovirus Outbreak Management and Disease Prevention Guidelines. MMWR March 4, 2011/ Vol. 60 (No. RR#3)

Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. October 25, 2002 / Vol. 51 / No. RR-16

Centers for Disease Control and Prevention. "Norwalk-Like Viruses" Public Health Consequences and Outbreak Management Recommendations and Reports June 01, 2001 / 50(RR09); 1-18

Appendix A

Instructions for Collecting Norovirus Specimens

ERD will approve and coordinate testing for norovirus with Scientific Laboratory Division (SLD) by calling 505-383-9125.

1. Collect a fresh stool specimen (do not use a preservative or any enteric transport media) in a clean, dry container (e.g., urine cup). A minimum volume of one cc is recommended, however, even smaller quantities are acceptable. Collection is best during the first 48 - 72 hours of illness; however, norovirus can be found by PCR in formed stool up to seven days after symptoms resolve. While norovirus can be detected from vomitus specimens, this specimen type is NOT preferred. If vomitus is the only specimen available for testing, it may be submitted if testing is approved by ERD and coordinated with SLD.
2. Label each specimen container with the patient's first name, last name, date of birth, date and time of collection, and name of the facility. Complete all of the information requested on the submission form clearly and carefully. Testing may not be performed if the specimen container is improperly labeled or if the submission form is incomplete.
3. Please indicate the facility name on the submission form. Numerous norovirus outbreaks may be under investigation within a single geographic area and the facility name is used to track the specimen and to direct appropriate reporting.
4. Specimens for norovirus testing should be refrigerated (not frozen) after collection and placed on ice during transport to SLD. They can be stored in a refrigerator for up to seven days and be acceptable for testing.
5. If requested, SLD can rule out *Salmonella*, *Shigella*, and Shiga-toxin positive *E. coli* (STEC). A portion of the stool specimen should be placed in Cary Blair enteric transport medium (pink liquid). Specimens collected in Cary Blair transport medium should be maintained at room temperature. Do not ship specimens in Cary Blair on ice.
6. Indicate "Norovirus Testing, PCR" on the outside of the shipping container. Many specimens are received by SLD each day and this will help to rapidly direct the specimens to the appropriate laboratories for testing. If specimens for norovirus testing are collected over a weekend, the specimens should be refrigerated at 35-45 degrees Fahrenheit and processed for shipment to SLD on Monday unless specific arrangements have been pre-coordinated with SLD.

Appendix B

Checklist for Gastrointestinal Disease Outbreak in Health Care Facility

Meet with director and/or infection preventionist:

- ✓ Explain the role of the department of health in helping to control/prevent the outbreak.
- ✓ Explain the disease.
- ✓ Encourage them to educate residents and visitors about how to prevent the spread of infection.
- ✓ Ensure that the facility understands proper sample submission protocol for specimen testing.
- ✓ Distribute educational materials (e.g. CDC setting specific fact sheets and hand washing poster).

Evaluate the facility's policy for residents who are sick:

Do they isolate ill residents from others by confining them to their rooms?	Yes	No
If ill individuals are not housed in private rooms, does the facility group ill residents together when possible (i.e., cohorting)?	Yes	No

Evaluate the facility's policy for staff members who are sick:

Are there clear criteria for excluding staff from work?	Yes	No
Are there criteria for returning to work after exclusion?	Yes	No
Are criteria being effectively implemented?	Yes	No

Evaluate visitor policies:

Are visitors restricted during outbreaks?	Yes	No
If visitation is allowed, are visitors directed to go to the person they are visiting and not spend time with anyone else?	Yes	No
Do visitors wash their hands upon entering and leaving the room?	Yes	No
Are visitors reminded not to visit if they are sick?	Yes	No

Evaluate residents' hand washing:

Are soap, running water, and paper towels available?	Yes	No
Is hand washing done properly (lather with soap for at least 20 seconds, rinse, turn off water with paper towel after drying hands)?	Yes	No
Are the sinks adequate and appropriate for varying levels of activities of daily living?	Yes	No
Do staff assist impaired residents wash their hands?	Yes	No
Do residents wash their hands:		
· After using the toilet?	Yes	No
· Before and after eating snacks and meals?	Yes	No

Evaluate staff hygiene: (Discretely observe hand washing several times during your visit.)

Are soap, running water, and paper towels available?	Yes	No
Is hand washing done properly (lather with soap for at least 20 seconds),		

rinse, turn off water with paper towel after drying hands) or use of alcohol-based products if hands not visibly soiled?	Yes	No
Do staff wash their hands:		
· Upon entering and leaving every resident's room?	Yes	No
· After each diaper change or after assisting a resident with using the bathroom?	Yes	No
· Before preparing food or assisting residents with meals?	Yes	No
· Before administering medicine/treatments?	Yes	No
· Before eating?	Yes	No
· After toileting?	Yes	No
Do staff wear gloves when caring for ill residents or when touching potentially contaminated surfaces?	Yes	No
Are gloves discarded and hands washed immediately after completing patient care?	Yes	No

Evaluate environmental controls:

Has administration adjusted staffing to minimizing the flow of staff between sick and well residents?	Yes	No
Have activities where ill and well residents are together been discontinued?	Yes	No
Are group activities kept to a minimum or postponed until the outbreak is over?	Yes	No
Is there a policy for denying new admissions until the incubation period expires after the resolution of the last case?	Yes	No
Is an <u>appropriate</u> disinfectant used? (For example, 1/4 cup bleach per gallon of water prepared daily)?		
Are areas contaminated with vomitus and/or diarrhea cleaned immediately with appropriate disinfectant?	Yes	No
Is a disinfectant used <i>at least</i> daily to clean surfaces such as handrails, doorknobs, physical/occupational therapy equipment?	Yes	No
Are contaminated linen and bed curtains placed into laundry bags immediately upon removal or use?	Yes	No
Are contaminated linen, laundry bags, and bed curtains washed separately in hot water for a complete wash cycle – ideally as a half load for best dilution?	Yes	No
Do housekeeping staff wear gloves when cleaning contaminated or potentially contaminated surfaces or laundry?	Yes	No
Do housekeeping staff wear masks when cleaning contaminated or potentially contaminated surfaces or laundry? (If norovirus suspected)	Yes	No

Are written hand washing instructions/reminders posted?

Yes No

Evaluate the cleanliness of the food preparation area.

Is there a hand washing sink in the kitchen with soap, running water, and paper towels?	Yes	No
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NOROVIRUS

What are noroviruses?

Norovirus is a virus that causes the “stomach flu,” or vomiting and diarrhea, in people.

What are the symptoms of illness caused by noroviruses?

Common symptoms are nausea, vomiting, diarrhea and stomach cramping. Sometimes people have a low-grade fever, chills, headache, muscle aches and a general sense of tiredness. Norovirus illness usually begins 24 - 48 hours after exposure, but can appear as early as 12 hours after exposure. The illness is usually brief, with symptoms lasting only 1 or 2 days. Sometimes people are unable to drink enough liquids to replace what they lose from vomiting and diarrhea, and they can become dehydrated and need to see a doctor. This problem usually occurs only among the very young, the elderly, and persons with weakened immune systems.

How is norovirus spread?

Noroviruses are very contagious and spread easily from person to person. The virus is found in the stool (feces) and vomit of infected people. People can become infected in several ways, including:

- eating food or drinking liquids that are “dirtied” or contaminated by infected food handlers
- touching objects contaminated with norovirus and then touching their mouth before hand washing
- having direct contact with an infected person and then touching their mouth before hand washing
- drinking water contaminated by sewage.

Persons working in day-care centers or nursing homes should pay special attention to children or residents who have norovirus illness. This virus can spread quickly in such places.

How long are people contagious?

People infected with norovirus can spread the germ from the moment they begin feeling ill to at least three days after recovery. Some people may be contagious for as long as two weeks after recovery. Persons sick with norovirus should not prepare food while they have symptoms and for three days after they recover. **Good hand washing is important.** Infected people do not become long-term carriers of norovirus.

Who gets norovirus infection?

Anyone can become infected with these viruses. Because there are many different strains of norovirus, norovirus infection and illness can re-occur throughout a person’s lifetime.

What treatment is available for people with norovirus infection?

Currently, there is no medication or vaccine for norovirus. Norovirus infection cannot be treated with antibiotics. By drinking fluids, such as juice or water, people can reduce their chance of becoming dehydrated.

Sports drinks do not replace the nutrients and minerals lost during this illness.

Do infected people need to be kept home from school, work or daycare?

Since the virus is passed in vomit and stool, children should not go to day care or school while they have diarrhea or vomiting. Once illness ends, children can return to daycare, but hand washing must be strictly monitored. Persons who work in nursing homes, take care of patients, or handle food should stay out of work until at least three days after symptoms end.

Can norovirus infections be prevented?

You can decrease your chance of coming in contact with noroviruses by following these practices:

- Wash hands frequently with water and soap. (Sanitizing gel may be substituted when hands are not visibly soiled.)
- Promptly disinfect contaminated surfaces with household chlorine bleach-based cleaners.
- Wash soiled clothing and linens.
- Avoid food or water from sources that may be contaminated.

NOROVIRUS

¿Qué son los norovirus?

Los norovirus son un grupo de virus que causan la “gripe estomacal”, o vómitos y diarrea en las personas.

¿Cuáles son los síntomas de una enfermedad causada por los norovirus?

Los síntomas habituales son náuseas, vómitos y retorcijones en el estómago. Algunas personas pueden tener una fiebre baja, escalofríos, dolor de cabeza, dolores musculares y una sensación general de cansancio. La enfermedad comienza normalmente entre 24 y 48 horas después de haber estado expuesto, pero puede aparecer tan sólo 12 horas después. La enfermedad normalmente es breve, los síntomas sólo duran 1 ó 2 días. A veces si no se toman suficientes líquidos para reponer los que se están perdiendo por vómitos y diarrea, las personas pueden deshidratarse y tendrán que ir al médico. Este problema, por lo general, sólo ocurre en los que son muy jóvenes, las personas mayores y los que tienen su sistema inmune debilitado.

¿Cómo se transmiten los norovirus?

Los norovirus son *muy* contagiosos y se transmiten fácilmente de persona a persona. El virus se encuentra en las heces y vómitos de las personas infectadas. Se puede transmitir de varias formas, como por ejemplo:

- Al comer algo o beber líquidos contaminados por las personas infectadas que los manipularon.
- Al tocar objetos contaminados con los norovirus y después, sin lavarse las manos, tocarse la boca.
- Por contacto directo con una persona infectada y después, sin lavarse las manos, tocarse la boca.
- Al beber agua contaminada con desechos residuales o aguas negras.

Las personas que trabajen en centros de cuidado infantil o residencias para ancianos deben prestar especial atención a los niños o residentes que estén enfermos con este virus. Estos virus se pueden transmitir rápidamente en estos lugares.

¿Por cuánto tiempo puede una persona con este virus contagiar a otros?

Las personas infectadas pueden transmitir el germen desde el momento en que empiecen a sentirse enfermas hasta tres días después de haberse recuperado. Algunos pueden ser contagiosos hasta por dos semanas después de haberse recuperado. Las personas enfermas con norovirus no deben preparar alimentos mientras tengan síntomas y deben esperar hasta que hayan pasado 3 días sin síntomas. **Es importante lavarse bien las manos.** El virus no permanece en las personas y, por eso, no son portadoras del virus.

¿Quién puede contraer una infección por norovirus?

Cualquiera puede contraerla. Puesto que existen muchas cepas (variedades) diferentes del norovirus, las infecciones pueden darse más de una vez en la vida de una persona.

¿Cómo se tratan las infecciones por norovirus?

Hoy día no existe medicación o vacuna para los norovirus. La infección no se puede tratar con antibióticos. Para reducir la posibilidad de quedar deshidratado, es necesario beber muchos líquidos, como agua o jugos. Las bebidas deportivas no reemplazan los nutrientes y minerales que se pierden con esta enfermedad.

¿Es necesario quedarse en casa y no ir a la escuela, a la guardería o al trabajo?

Puesto que el virus se encuentra en el vómito y las heces, los niños no deben ir a la escuela o a la guardería mientras tengan diarrea o vómitos. Una vez se recuperen, pueden regresar, pero deben lavarse las manos con mucho cuidado. Las personas que trabajan en residencias de ancianos, cuidan de pacientes o manipulan alimentos no deben ir a trabajar hasta que hayan pasado tres días sin ningún síntoma.

¿Se pueden prevenir estas infecciones?

Para reducir las posibilidades de tener contacto con los norovirus, haga lo siguiente:

- Lávese las manos con frecuencia con agua y jabón. (En lugar de lavárselas puede usar un gel desinfectante para manos cuando no se vean sucias).
- Desinfecte las superficies contaminadas con blanqueador de cloro.
- Lave todas las prendas de vestir y ropa de cama que se hayan ensuciado.
- Evite tomar agua o comida que puedan provenir de fuentes contaminadas.

NOROVIRUS