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Public Health

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NOROVIRUS INFECTIONS

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The 'Norwalk agent' is named for an outbreak of gastroenteritis which occurred in Norwalk, Ohio in 1972.

The Norwalk virus is the prototype strain of genetically and antigenically diverse single-stranded RNA (ribonucleic acid) viruses, previously called *small round-structured viruses* (SRSVs), that are classified in the genus Norwalk-like viruses in the family *Caliciviridae.* Norovirus can be divided into three distinct genogroups: GI, GII and GIII. The GI and GII Noroviruses infect humans and include five and ten genetic clusters, respectively; GIII Norovirus infects pigs and cows.

Other genera in the *Caliciviridae* family include "Sapporo-like viruses," which also cause gastroenteritis among both children and adults as well as *Lagovirus* and *Vesivirus*, neither of which are pathogenic for humans.

Since human noroviruses have not been grown in cell culture and there are no convenient animal models in order to study immunity and illness, the knowledge about these viruses comes from the study of outbreaks and experimental human infection.

Epidemiology

During the early 1990s, breakthroughs in the cloning and sequencing of Norwalk virus led to the development of sensitive molecular assays (e.g., reverse transcription-polymerase chain reaction or RT-PCR), nucleotide hybridization probes and enzyme-linked immunosorbent assays (ELISA). Using these assays, researchers demonstrated that Norovirus are a common cause of outbreaks of nonbacterial gastroenteritis in the United States and in other countries.

The burden of Norovirus-caused endemic disease is unknown because simple and sensitive diagnostic assays are not readily available. Annually, approximately 4,500,000 episodes of diarrhea leading to 10,000 hospitalizations and 50 deaths occur among adults in Louisiana (extrapolation from Centers for Disease Control and Prevention (CDC) estimation). An etiologic agent is identified in less than 10% of these cases. Norovirus have been reported to account for 5% to 17% of cases of diarrhea in the community and 5% to 7% of cases requiring treatment by physicians.

Although rotavirus is the leading cause of severe diarrhea among children, data from recent studies demonstrate that Norovirus also might be a factor in childhood gastroenteritis (approximately 20%).

Fecal-oral spread is probably the primary Norovirus transmission mode, although air particles and fomite transmission might facilitate spreading during outbreaks. Frequently during an outbreak, primary cases result from exposure to a fecally-contaminated vehicle (food or water), whereas secondary and tertiary cases among contacts of primary cases result from person-to-person transmission. For the 348 outbreaks of Norovirus gastroenteritis reported to the CDC during January 1996 to November 2000, food was implicated in 39%, person-to-person contact in 12% and water in 3%; eighteen percent could not be linked to a specific transmission mode.

Nursing Homes and Residential Institutions

Protracted outbreaks of Norovirus disease have been reported among elderly persons living in institutional settings, (e.g., nursing homes). In certain cases, the outbreak was initially caused by a common-source exposure to a fecally-contaminated vehicle (e.g., food or water). Later, the outbreak spreads through person-to-person transmission among the residents; this spread is facilitated by the enclosed living quarters and reduced levels of personal hygiene that result from incontinence, immobility, or reduced mental alertness. Because of underlying medical conditions, the disease among these persons can be severe or fatal.

Restaurants and Catered Events

Norovirus outbreaks have implicated multiple food items, including oysters, salads, sandwiches, cakes, frosting, raspberries, drinking water and ice. In certain outbreaks, the implicated food is fecally-contaminated with Norovirus at its source (e.g., oysters harvested from fecally-contaminated waters or raspberries irrigated with sewage-contaminated water). However, foodhandlers might contaminate food items during preparation. The risk for contamination through foodhandlers is increased when the food item is consumed without further cooking (e.g., ready-to-eat foods), and when a semi-liquid food (e.g., cake frosting or salad dressing) is contaminated so that a small inoculum is mixed and spread to multiple persons.

Cruise Ships

Passengers and crew members on cruise ships and naval vessels are frequently affected by outbreaks of Norovirus gastroenteritis. These ships dock in countries where levels of sanitation might be inadequate, thus increasing the risk for contamination of water and food taken aboard or for having a passenger board with an active infection. After a passenger or crew member brings the virus on board, the close living quarters on ships amplify opportunities for person-to-person transmission. Furthermore, the arrival of new and susceptible passengers every one or two weeks on affected cruise ships provides an opportunity for sustained transmission during successive cruises. Norovirus outbreaks extending beyond 12 successive cruises have been reported.

Communicability period: In an experimental study, viral shedding in stool began 15 hours after virus administration and peaked 25 to72 hours after virus administration. Unexpectedly, viral antigen could be detected by ELISA in stool specimens collected seven days after inoculation in both symptomatic and asymptomatic persons. In a later study of infected volunteers, viral antigen in stool was detected less than two weeks after administration of virus. Anecdotal evidence from outbreak investigations also demonstrates that viral shedding can occur for a prolonged period and in the absence of clinical illness. However, the epidemiologic significance of these findings is unclear.

Norovirus are hardy, ubiquitous and extremely persistent in the environment, resisting disinfection and chlorination.

Infectious dose: The infectious dose of Norovirus is very low: inoculums as low as ten (10) viral particles may be sufficient to infect an individual. This low dose readily allows spread by droplets, fomites, person-to-person transmission and environmental contamination, as evidenced by the increased rate of secondary and tertiary spread among contacts and family members.

Pre-symptomatic shedding may occur. In an experiment, viral shedding was detected by RT-PCR as early as 18 hours after inoculation.

Viral shedding at the peak may reach 10^5 to 10^7 (100,000 to ten million) viral particles /g of stools.

Prolonged duration of viral shedding was observed in the same experiment. Shedding lasted from 13 to 56 days, with a median of 28 days. Viral shedding that can occur among asymptomatic persons increases the risk for secondary spread and is of concern in foodhandler-related transmission. The ability of the virus to

survive relatively high levels of chlorine and varying temperatures (i.e., from freezing to 60°C) facilitates spread through recreational and drinking water and food items, including steamed oysters. Because of the diversity of Norovirus strains, lack of complete cross-protection and lack of long-term immunity, repeated infections can occur throughout life.

Characteristics of norovirus that facilitate their spread during epidemics

Characteristic	Observation	Consequences
Low infectious dose	As low as 10 viral particles	Permits droplet or person-to-person spread, secondary spread, or spread by foodhandlers
Prolonged asymptomatic shedding	2 to 4 weeks	Increased risk for secondary spread or problems with control regarding foodhandlers
Environmental stability	Survives <10 ppm chlorine, freezing, and heating to 60°C	Difficult to eliminate from contaminated water; virus maintained in ice and steamed oysters
Substantial strain diversity	Multiple genetic and antigenic types	Requires composite diagnostics; repeat infections by multiple antigenic types; easy to underestimate prevalence
Lack of lasting immunity	Disease can occur with reinfection	Childhood infection does not protect from disease in adulthood; difficult to develop vaccine with lifelong protection

The incubation period is in the range of 12 to 48 hours.

Approximately 50% of persons exposed to Norovirus experience illness acquire short-term homologous immunity (i.e., against the same strain) that is correlated with serum antibody levels. Certain studies also demonstrated, paradoxically, that persons with higher levels of preexisting Norovirus antibodies would probably experience illness if exposed to the virus.

A trend for higher rates of viral shedding, seroconversion and clinical illness was observed among those with higher levels of preexisting antibody. Researchers hypothesized that certain persons might be genetically more susceptible to Norovirus infection and disease. If true, this hypothesis could explain why those with greater levels of preexisting antibody are more likely to experience Norovirus infection and disease after re-exposure to the virus.

Pathogenesis

Genogroup I viruses preferentially bind blood group A and O antigens, while genogroup II viruses predominantly bind A and B antigens. Individual norovirus strains may be capable of infecting only a subset of the human population, although the diverse binding profiles found within genogroup I and genogroup II viruses likely collectively make nearly all individuals susceptible to norovirus infection. Recurrent infections can occur throughout life because of the great diversity of norovirus strains and the lack of cross-strain or long-term immunity.

Infection is characterized by damage to the microvilli in the small intestine. Upon microscopic investigation, villi are found to be blunted, although the mucosa and epithelium remain intact. A recent study demonstrated increased epithelial cell apoptosis and damage to tight junction proteins. Diarrhea is induced by D-xylose and fat malabsorption, with enzymatic dysfunction observed at the brush border, along with leak flux and anion secretion. Vomiting is related to virus-mediated changes in gastric motility and delayed gastric emptying.

Notably, no histopathologic lesions can be identified in the gastric mucosa of infected patients. Noroviruses do not invade the colon, so fecal leukocytes are typically absent, and hematochezia is rare.

Clinical Description

The illness is characterized by acute onset of nausea, vomiting, abdominal cramps and diarrhea. Vomiting is relatively more prevalent among children, whereas a greater proportion of adults experience diarrhea. Patients can experience vomiting alone, a condition first identified as 'winter vomiting disease'. Constitutional symptoms (e.g., headache, fever, chills and myalgia) are frequently reported. The illness lasts 12 to 60 hours. Although rare, severe dehydration caused by Norovirus gastroenteritis can be fatal with this outcome, occurring among susceptible persons (e.g., older persons with debilitating health conditions). No long-term sequelae of Norovirus infection have been reported.

Laboratory Tests

Electron Microscopy and Immune Electron Microscopy

Under the electron microscope, Norovirus can be identified by their characteristic morphology. Approximately 10^6 to 10^7 per ml of virus in stool is required for visualization by EM; therefore, this technique is useful only for specimens collected during the early stages of illness when substantial quantities of virus are shed.

Enzyme Immunoassays

The expression in baculoviruses of the capsid proteins of Norovirus that self-assemble into stable virus-like particles has allowed the detection of these viruses by ELISAs. To develop assays to detect virus in fecal specimens, the expressed capsid antigens have been used to generate hyperimmune antibodies in laboratory animals. These assays have been reported to detect the presence of 10^4 to 10^6 viral particles per ml in clinical specimens. To date, these assays have been type-specific, but broadly reactive tests are under development.

The baculovirus-expressed viral antigen can be directly used for detection of antibodies to Norovirus in a patient's sera by enzyme immunoassay. Because certain adults have preexisting immunoglobulin G (IgG) antibodies to Norovirus, a single serum specimen is insufficient to indicate recent infection. Seroconversion, defined as a greater than four-fold rise in IgG antibody titer during acute- and convalescent-phase sera, is indicative of a recent infection. In outbreak settings, if at least half of affected persons seroconvert to a specific Norovirus, that viral strain can be designated as etiologic. Titers can begin to rise by the fifth day after onset of symptoms, peak at approximately the third week and begin to fall by the sixth week. Hence, for IgG assays, the acute-phase serum should be drawn within the first five days and the convalescent-phase serum during the third to sixth weeks. In certain cases where diagnosis is critical (e.g., when a foodhandler is implicated as the source of an outbreak), single assays of serum immunoglobulin A (IgA) antibody can be successful if specimens are collected seven to 14 days after exposure. In addition to potential difficulties in obtaining an adequate number of serum specimens during outbreaks, serologic assays are currently limited by the fact that the available array of expressed Norovirus antigens is insufficient to detect all antigenic types of Norovirus.

Nucleic Acid Hybridization Assays and RT-PCR

Nucleic acid hybridization assays and RT-PCR assays to detect Norovirus genome in clinical and environmental specimens have provided a sensitive and specific tool for Norovirus-outbreak investigations. High sensitivity of these assays (i.e., ability to detect 10^2 to 10^4 viral particles per ml in stool) is both an asset and a liability because extreme care is required to avoid contamination in the laboratory. In addition, although the available primers for RT-PCR assays detect multiple strains of Norovirus, certain strains can escape detection. Efforts are ongoing to develop universal or degenerate primers that would detect the majority of Norovirus strains that cause gastroenteritis outbreaks.

Recommendations Regarding Specimen Collection for Diagnosis of Norovirus

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Specimen should be collected by personnel that have been properly trained.
<table>
<tr><th>If</th><th>Then</th></tr>
<tr><td>Whole Stool (for virus, bacterial and toxin testing)</td><td>Collect 1-2 teaspoons of sample in a leak- proof, screw-cap container. Store and ship at 2°C-8°C. Send sample overnight to the Central Laboratory. Specimen must be received in the laboratory within 7 days of collection. Do not freeze. Note: Frozen samples are acceptable for PCR testing. They are unacceptable for culture or toxin testing.</td></tr>
<tr><td>Vomitus (for Norovirus testing only)</td><td>Collect 1-2 teaspoons of sample in a leak- proof, screw-cap container. Store and ship at 2°C-8°C. Send sample overnight to the Central Laboratory. Specimen must be received in the laboratory within 7 days of collection. Frozen samples are also acceptable, however multiple freeze thaws are to be avoided.</td></tr>
<tr><td>Culture</td><td>Actively growing, pure culture in/on unexpired media. Do not freeze. Store and transport under ambient conditions.</td></tr>
</table></td></tr>
<tr><td>2</td><td>Label specimen with Patient Name or Unique ID Number and the Date and Time of Collection.</td></tr>
<tr><td>3</td><td>Submission form LAB 93 or 96 must be thoroughly completed with patient’s first and last name (or unique patient identifier), gender, date of birth, date and time of collection, specimen source, test requested, submitter’s name, address and contact number. Additional information regarding patients’ address is requested.</td></tr>
<tr><td>4</td><td>Transport specimen to laboratory as soon as possible after collection. Keep submission forms insulated from specimens.</td></tr>
</table>

Stool

Timing. Specimen collection for viral testing should begin on day one of the epidemiologic investigation. Any delays to await testing results for bacterial or parasitic agents could preclude establishing a viral diagnosis. Ideally, specimens should be obtained during the acute phase of illness (i.e., within 48 to 72 hours after onset) while the stools are still liquid or semisolid because the level of viral excretion is greatest then. With the development of sensitive molecular assays, the ability to detect viruses in specimens collected later in the illness has been improved. In specific cases, specimens might be collected later during the illness (i.e., 7 to 10 days after onset), if the testing is necessary for either determining the etiology of the outbreak or for epidemiologic purposes (e.g., a specimen obtained from an ill foodhandler who might be the source of infection). If specimens are collected late in the illness, the utility of viral diagnosis and interpretation of the results should be discussed with laboratory personnel before tests are conducted.

Number and Quantity. Ideally, specimens from more than ten ill persons should be obtained during the acute phase of illness. Bulk samples (i.e., 10 to 50 ml of stool placed in a stool cup or urine container) are preferred, as are acute diarrhea specimens that are loose enough to assume the shape of their containers. Serial specimens from persons with acute, frequent, high-volume diarrhea are useful as reference material for the development of assays. The smaller the specimen and the more formed the stool, the lower the diagnostic yield. Rectal swabs are of limited or no value because they contain insufficient quantity of nucleic acid for amplification.

Storage and Transport. Because freezing can destroy the characteristic viral morphology that permits a diagnosis by EM, specimens should be kept refrigerated at 4°C. At this temperature, specimens can be stored without compromising diagnostic yield for two to three weeks, during which time testing for other pathogens can be completed. If the specimens have to be transported to a laboratory for testing, they should be bagged and sealed and kept on ice or frozen refrigerant packs in an insulated, waterproof container. If facilities for testing specimens within two to three weeks are not available, specimens can be frozen for antigen or PCR testing.

Vomitus

Vomiting is the predominant symptom among children. Specimens of vomitus can be collected to supplement the diagnostic yield from stool specimens during an investigation. Recommendations for collection, storage and shipment of vomitus specimens are the same as those for stool specimens.

Serum

Timing. If feasible, acute- and convalescent-phase serum specimens should be obtained to test for a diagnostic greater than four-fold rise in IgG titer to Norovirus. Acute-phase specimens should be obtained during the first five days of symptoms and the convalescent-phase specimen should be collected from the third to sixth week after resolution of symptoms.

Number and Quantity. Ideally, ten pairs of specimens from ill persons (i.e., the same persons submitting stool specimens), and ten pairs from well persons (controls) should be obtained. Adults should provide five to seven milliliters of blood and children should provide three to four milliliters.

Storage. Specimens should be collected in tubes containing no anticoagulant and the sera should be spun off and frozen. If a centrifuge is not available, a clot should be allowed to form, and the serum should be decanted and frozen. If this step cannot be accomplished, the whole blood should be refrigerated but not frozen.

Environmental Specimens

Because human noroviruses cannot be grown in cell culture, current detection methods (e.g., RT-qPCR) allow detection of norovirus RNA in water, food, and environmental specimens; however, validated methods are available only for water (at CDC), and shellfish (at FDA's Gulf Coast Seafood Laboratory). If a food or a

water source is strongly suspected as the source of an outbreak, a sample should be obtained as early as possible with respect to the time of exposure, and the CDC or FDA should be contacted for further guidance on testing.

Food samples should be stored frozen at -4°F (-20°C), and water samples should be stored refrigerated or chilled on ice at 39°F (4°C). Detection of norovirus in food requires appropriate elution and concentration techniques which need to be adapted for each food vehicle. At present, these methods are not available routinely, except for shellfish. Water can be tested for noroviruses after concentration of large volumes (e.g., up to 100 L of water) through specially designed filters. Environmental surface swabs have also been demonstrated to detect norovirus RNA in specific outbreak settings. Depending on the specific situation, epidemiologic findings, and expected level of contamination, collection of environmental specimens might be warranted and should be pursued in consultation with the CDC.

Surveillance

Norovirus infections are not reportable conditions. However, outbreaks of gastroenteritis are reportable.

Case Definition

During an outbreak investigation case definitions are customized to fit the investigation (see Food Outbreak Investigation).

Investigation (see Outbreak Investigation)

Control

Although person-to-person spread might extend Norovirus gastroenteritis outbreaks, the initiating event is often the contamination of a common vehicle (e.g., food or water). Consequently, efforts to prevent both the initial contamination of the implicated vehicle and subsequent person-to-person Norovirus transmission will prevent the occurrence and spread of Norovirus gastroenteritis outbreaks.

Foodborne Transmission

Theoretically, any food item can potentially be infected with Norovirus through fecal contamination. However, certain foods are implicated more often than others in outbreaks of Norovirus gastroenteritis. Shellfish (e.g., oysters or clams) tend to concentrate in their tissues Norovirus that contaminate the waters from which they are harvested; even harvests meeting bacteriologic standards of hygiene can contain Norovirus. In addition, cooking (e.g., steaming) might not completely inactivate Norovirus. Until reliable indicators for routine monitoring of viral contamination of harvest waters and shellfish are available, measures to prevent the contamination of harvest waters with human waste (e.g., surveillance of the shoreline for potential sources of fecal contamination and restricting boaters from dumping waste overboard) are probably a useful means of preventing shellfish-associated Norovirus gastroenteritis outbreaks.

Food contamination by infectious foodhandlers is another frequent cause of Norovirus gastroenteritis outbreaks. Because of the low infectious dose of Norovirus and the high concentration of virus in stool, even a limited contamination can result in substantial outbreaks. Ready-to-eat foods that require handling but no subsequent cooking (e.g., salads and deli sandwiches) pose greater risk.

- For three days after resolution of illness, ill foodhandlers should be excluded from work
- For three weeks after resolution of illness, foodhandlers should wash their hands and wear gloves whenever they handle food ready to be served. Data from recent human volunteer and epidemiologic studies demonstrate that viral antigen can be shed for a longer duration after recovery from illness and in the absence of clinical disease. Although data are limited regarding whether this detectable vi-

ral antigen represents infectious virus, foodhandlers should be required to maintain strict personal hygiene at all times.

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.

Waterborne Transmission

Although waterborne outbreaks are far less common than foodborne outbreaks, Norovirus gastroenteritis outbreaks have been associated with sources of contaminated water, including municipal water, well water, stream water, commercial ice, lake water and swimming pool water. Because current analytic methods do not permit direct monitoring of Norovirus in water, indicator organisms (e.g., coliform bacteria) have been used as proxy indicators of fecal contamination. However, because the size, physiology and susceptibility to physical treatment and disinfection of bacterial indicators differ from those of Norovirus, inherent limitations of this approach exist. Until reliable methods for assessing the occurrence and susceptibility to treatment of Norovirus are available, prevention methods should focus on reducing human waste contamination of water supplies. If drinking or recreational water is suspected as being an outbreak source, high-level chlorination (i.e., 10 ppm or 10 mg per L for greater than 30 minutes) might be required for adequate disinfection; however, even this method might be insufficient in certain cases.

Person-to-Person Transmission

Person-to-person spread of Norovirus occurs by direct fecal-oral and airborne transmission. Such transmission plays a role in propagating Norovirus disease outbreaks, notably in institutional settings (e.g., nursing homes and day care centers), and on cruise ships. Although interruption of person-to-person transmission can be difficult, certain measures might help.

Frequent handwashing with soap and water is an effective means of prevention. The recommended procedure is to rub all surfaces of lathered hands together vigorously for more than ten seconds and then thoroughly rinse the hands under a stream of water.

Because spattering or aerosols of infectious material might be involved in disease transmission, wearing masks should be considered for persons who clean areas substantially contaminated by feces or vomitus (e.g., hospital or nursing home personnel).

Soiled linens and clothes should be handled as little as possible and with minimum agitation. They should be laundered with detergent at the maximum available cycle length and then machine dried.

Because environmental surfaces have been implicated in the transmission of enteric viruses, surfaces that have been soiled should be cleaned with an appropriate germicidal product (e.g., 10% solution of household bleach) according to the manufacturer's instructions. In situations in which the epidemic is extended by periodic renewal of the susceptible population (e.g., camps and cruise ships), the facility or institution might have to be closed until it can be cleaned appropriately.

Hospital precaution and isolation: Standard precautions.

Cleaning /Disinfection

Facility employees who clean up vomitus are at higher risk for illness. There are numerous reports of norovirus transmission through aerosolized vomitus. Gloves are usually worn by employees who clean vomitus, but they rarely wear gowns or aprons and masks while cleaning vomitus. Masks have been shown to re-

duce the risk for norovirus infection among employees. To reduce the risk for norovirus transmission through aerosolized vomitus:

1) remove vomitus and fecal material carefully to limit aerosolization (e.g., soaking up vomitus or diarrhea with paper towels or other disposable cloths with minimal agitation and removing those into impervious bags)

2) thoroughly clean surfaces and disinfect with freshly made 5,000 ppm hypochlorite solution or other EPA-registered norovirus disinfectants

3) wear appropriate personal protective equipment (PPE) (e.g., gloves, masks, and gowns) when cleaning vomitus or feces.

Guidelines for the Control of a Suspected or Confirmed Outbreak of Viral Gastroenteritis in a Long Term Care Facility

3/4/2010

Norovirus is the most common cause of viral gastroenteritis. The virus is widespread and the disease affects all populations. Norovirus is transmitted by hands contaminated through the fecal-oral route, directly from person to person, through contaminated food or water, or by contact with contaminated surfaces or fomites. Aerosolized vomitus also has been implicated as a transmission mode. Because of high infectivity and persistence in the environment, transmission of noroviruses is difficult to control through routine sanitary measures. Although gastroenteritis cause by norovirus is usually self-limited, elderly persons, young children and those with severe underlying medical conditions are at increased risk for complications because of volume depletion and electrolyte disturbances.

The incubation time of norovirus is typically 24 to 48 hours but ranges from ten to 72 hours, with illness usually resolving within 48 hours, although symptoms in some cases can last up to three days. Symptoms include any or all of the following: abdominal cramps, nausea, vomiting, diarrhea, headache, joint pain and low-grade fever. Norovirus infection in healthy adults typically requires ingestion of at least 100 organisms; however, in experimental situations, symptoms have occurred after ingestion of as few as ten organisms. It is estimated that as many as 30% of persons with Norovirus in their stools are asymptomatic. In addition, post-symptomatic shedding of the virus can continue for up to 14 days after the resolution of symptoms.

The organism is not an enveloped virus and thus is resistant to low concentrations of chlorine, such as would be found in swimming pools and drinking water and is also relatively heat resistant, surviving temperatures up to 60ºC. The virus is inactivated by bleach at a 1:50 concentration (note: for comparison purposes regarding the hardiness of norovirus, viruses such as HIV and Hepatitis B are inactivated by concentrations of 1:100 bleach). Norovirus are more difficult to kill with ethanol than are vegetative bacteria and enveloped viruses. Ethanol in concentrations of 60% to 70% (the usual concentration in commercially available hand sanitizers), if correctly applied to all surfaces of the hands will eradicate more than 99% of the vegetative bacteria and enveloped viruses after 30 seconds of contact time. A full minute of contact time with 70% ethanol is required to inactive norovirus. Only 30 seconds of contact time with 85% ethanol is required to inactivate caliviruses, but this concentration is not commercially available in a hand sanitizer.

Hand hygiene is the most important means of preventing the spread of infection. This statement is true for norovirus as well as for most other communicable diseases. However, hand hygiene to prevent the spread of enveloped viruses and spore-forming bacteria requires more than the usual effort.

The Centers for Disease Control and Prevention (CDC) recommends that handwashing consist of a minimum of 20 seconds of washing using soap and warm water. This 20-second time period should include friction to all hand surfaces. Sanitizing alcohol gels can be used as an alternative for hand-washing, provided that the hands are "socially clean," are free of organic matter and adequate contact time (at least one minute) is observed.

These guidelines have been developed to help stop the spread of viral gastroenteritis in nursing homes. As these viruses are **highly contagious and very hardy**, stringent adherence is necessary. Preventive measures should be continued for at least three days after the outbreak appears over, since infected persons continue to shed the virus after they have recovered.

1. Isolate ill residents from others by confining them to their rooms (until three days after their last symptoms). Group ill people together 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.

2. Ideally, keep all residents in their rooms and serve meals in rooms.

3. Ill staff should remain out of work for three days following the *cessation* of diarrhea and/or vomiting. If staff shortages are experienced, convalescent staff may be used in positions that have no, or reduced contact with patients.

4. 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 an important role in transmitting the virus from resident-to-resident.

5. Staff should wash their hands when entering and leaving *every* resident room.

6. Staff should wear gloves when caring for ill residents or when touching potentially contaminated surfaces. Gloves should be discarded and hands washed immediately after completing patient care.

7. Masks should be worn when caring for residents who are vomiting.

8. Use a disinfectant to frequently clean surfaces such as handrails, doorknobs, physical/ occupational therapy equipment, etc. (Think of items that are touched regularly and make sure that they are cleaned frequently.) The recommended disinfectant is *freshly made* bleach solution (e.g. one cup bleach to nine cups of water). For surfaces that could corrode or be damaged by bleach, concentrated phenol solutions may be used (e.g., Amphyl, Mikro-Bac II). These should be mixed at twice the manufacturers' recommended concentration to kill norovirus. **These chemicals can be dangerous. Follow all safety instructions.** Other effective cleaners include parachlorometaxylenol (e.g., EcoTru), or peroxomonosulphate (e.g.,Virkon). These should be mixed at the manufacturers' recommended concentrations. Commonly used quarternary ammonium disinfectants do not appear to be effective against norovirus.

9. Contaminated carpets should be cleaned with detergent and hot water, then disinfected with hypochlorite (if bleach-resistant) or steam-cleaned. Housekeeping staff should wear gloves and masks when cleaning contaminated or potentially contaminated surfaces or laundry. Contaminated linen and bed curtains 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.

10. It may be prudent to discontinue visitation to the nursing home 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.

CONTACT THE OFFICE OF PUBLIC HEALTH (OPH) FOR ASSISTANCE AS SOON AS AN OUTBREAK IS SUSPECTED AT 800-256-2748. OPH CAN ALSO PROVIDE FREE LABORATORY TESTING OF RESIDENTS AND STAFF DURING AN OUTBREAK.

Acknowledgments: CDC, Florida and Virginia Departments of Health