Viral Gastroenteritis in the Adult Population: The GI Peril

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KEYWORDS

- Gastroenteritis • Gastrointestinal illness • Adult • Elderly • Rehydration • Norovirus
- Vomiting • Diarrhea

KEY POINTS

- Viral gastroenteritis is common and causes diarrhea in all age groups worldwide.
- Norovirus is the leading cause of viral gastroenteritis for adults.
- Norovirus is a winter peril because of the combination of low infectious dose, viral shedding for a long duration before and after illness, and resistance with low temperatures.
- Dehydration and hypovolemia are consequences for complicated cases of gastroenteritis in vulnerable populations.

INTRODUCTION

Acute infectious diarrhea is caused by viruses, bacteria, and protozoa. In mild cases patients may not even contact their health care provider, and even if they do, stools may not be tested. A careful history should include the duration of symptoms and the frequency and characteristics of stool. Severe diarrhea alone, defined as greater than 4 liquid stools per day for more than 3 days, is often a bacterial cause. Fever and peritoneal signs may indicate infection with an enteric pathogen. Blood in the stool is usually an indication of an inflammatory process from invasive bacteria. Residence, recent and remote travel, occupational exposures, pets, and hobbies can provide clues to the origin of the diarrhea. Studies have shown that most cases of acute infectious gastroenteritis are viral. This article focuses on viral gastroenteritis.

Viral gastroenteritis is inflammation of the lining of the stomach, small intestine, and large intestine. Viral gastroenteritis is extremely common and causes millions of cases of diarrhea annually.[1] This disease affects infants, adults, and the elderly population alike and is a worldwide issue and major public health concern. The financial burden to society through direct and indirect costs can be overwhelming. The death rate worldwide continues to be high but has improved over recent decades because of early treatment, including use of oral rehydration therapy and improved nutrition

and water sanitation measures. Most people recover completely without any complications as long as they avoid dehydration.

TYPES OF VIRUSES

The 4 major groups of viruses that cause viral gastroenteritis are Caliciviridae (primarily norovirus), enteric adenoviruses, astrovirus, and rotavirus. Other infrequent causes of gastroenteritis include bocaviruses, coronaviruses, toroviruses, Aichi virus, picobirnavirus, and cytomegalovirus.[2] The "stomach flu" is not viral gastroenteritis because it is not caused by the influenza virus.

Norovirus, also called *Norwalk-like viruses*, named after the location in which the first outbreak was identified, is a single positive-strand RNA virus with a nonenveloped protein coat and cup-shaped depression.[2] This group of viruses includes many genotypes and subgroups, likely because of mutations developed during RNA replications. The GII.4 strain has evolved as the pandemic strain in the United States.[2] Norovirus can be seen throughout the year but predominantly between November and April. It can affect patients of all ages. Norovirus is recognized as the leading cause of foodborne-disease outbreaks in the United States. The Centers for Disease Control and Prevention (CDC) estimates that each year more than 20 million cases of acute gastroenteritis are caused by noroviruses.[3]

Sapovirus is another virus in the Calciviridae family that can affect children and adults, but is seen much less frequently than the norovirus. Sapovirus has been classified into 5 genogroups, but only 4 of them are seen in humans: GI, GII, GIV, and GV.[2]

Adenoviruses are nonenveloped double-stranded DNA viruses. There are approximately 51 different types, but only 3 serotypes (31, 40, and 41) cause gastroenteritis. They typically infect children younger than 2 years and are uncommonly seen in adult shedding, and therefore they are not discussed in this article.

Astrovirus, although seen in children, can also infect adults. Approximately 8 "classic" serotypes are known, with 2 additional types of this single-stranded RNA virus identified recently.[2] Astrovirus infections can occur year-round but like norovirus are most active in the winter months.

Rotavirus is a double-stranded RNA structure subdivided into 7 serogroups, with group A being the most important one for humans. It is seen primarily in children, but adults with close contact with infected children may also become infected.

SYMPTOMS

Norovirus typically starts with nausea and vomiting, followed by abdominal cramping and watery diarrhea. Additional symptoms include fever, chills, fatigue, myalgia, and headaches. Usually the symptoms are self-limiting, with symptomatic early treatment. The incubation period of 1 to 2 days is similar in sapovirus and norovirus, but sapovirus tends to last a little longer (approximately 6 days).

Astroviruses have a short incubation period of 36 to 48 hours, although symptoms may not occur for up to 3 to 4 days after exposure. Diarrhea is the predominant symptom, with some vomiting possible, but symptoms are typically milder than with norovirus or rotavirus. Older adults tend to experience abdominal pain, headache, and nausea with the diarrhea but not vomiting or fever.

Rotavirus has an incubation period of 2 to 6 days, with symptoms lasting 3 to 7 days. The typical diarrhea is associated with abdominal cramps without vomiting. Fever, anorexia, headache, and malaise are common. Generally the symptoms are more severe for children than adults.[1]

Symptoms of dehydration, such as dry mucous membranes, lethargy, hypotension, and oliguria, may not be evident but should be assessed throughout the illness. Gross blood or mucus in the stool is an unusual finding in viral gastroenteritis, and other causes should be considered if present.

TRANSMISSION

Transmission occurs through the fecal-oral route and occurs from person to person, because the virus is present in the stool and vomitus of the infected person, and from contaminated food and water. Infected people can contaminate surfaces, food, drinks, and items in their environment. With vomiting, the virus can become airborne. Therefore, touching contaminated surfaces, sharing of cold food and drink, ingesting contaminated food or water, or even swallowing airborne particles can render a person infected.

A very low infectious dose of only 18 to 20 viral particles makes norovirus gastroenteritis highly contagious from the moment one feels ill until weeks after. The very short incubation period allows for a rapid spread before an outbreak may be considered. Even asymptomatic adults can shed the virus in their stools, thereby unknowingly promoting the spread of infection. The combination of a low infectious dose, viral shedding before and for weeks after illness, and resistance to temperatures from freezing to 60°C and to many common household cleaners makes norovirus a challenge for health care providers.[2] Norovirus can live for months on surfaces until they are disinfected with a bleach solution. Infected people even after symptoms have abated can still spread the infection through their stools for up to 8 weeks.

Since norovirus has been identified, it is clear that it causes most episodes of viral gastroenteritis in adults. In fact, 90% of outbreaks previously of unknown cause are noroviruses.[2] In addition to human costs, economic losses in supplies, closed beds, and staff time off is thought to exceed $650,000 in the United States annually.[4]

New variant strains of norovirus seem to have emerged recently across the world through mutation, much like influenza viruses. These norovirus strains have been associated with an increase in the number of annual outbreaks. In 2002, a genetic shift in circulating strains was noted with the emergence of the GII.4-2002 variant strain.[5] Subsequently, not only was activity higher in the spring but also an unusually high number of outbreaks occurred in the winter season 2002–2003 worldwide.[5] This type of pattern repeated in 2004 with the GII.4-2004 strain and again in 2006 with the GII.4-2006a and GII.4-2006b strains.[5]

Researchers examined the trends in morbidity and mortality based on these gastroenteritis outbreaks in the elderly. Many episodes of gastroenteritis do not result in laboratory testing, so in addition to laboratory surveillance and norovirus outbreak surveillance, they investigated unspecified gastroenteritis in general practitioner office visits and hospital visits, and unspecified gastroenteritis as a primary or secondary cause of death. The trends identified in their research supported their hypothesis that norovirus epidemics are associated with morbidity and mortality in the elderly in Netherlands. These trends may be influenced by the evolution of viruses, and indicate that gastroenteritis should not be taken lightly in the elder population.[5]

Sapovirus is spread similar to norovirus and primarily affects children younger than 5 years. However, it has been found to be spread by asymptomatic adults. It has been spread from infected asymptomatic adult health care workers to elderly patients.[2]

Astrovirus is spread through the fecal-oral route but is uncommon in the adult population, although it has been seen in nosocomial and epidemic diarrhea.[2]

Rotavirus is the most common cause of gastroenteritis in children and affects adults much less frequently. However, approximately one-third of parents of infected

children also become infected with rotavirus.[2] Rotavirus outbreaks have occurred in nursing home settings and from contaminated food and water.

Another study examined the causes of gastroenteritis, especially in the elderly, through testing 4024 stool samples collected over 7 seasons. Of these samples, taken from people ages 1 month to 99 years, 1241 were found to contain at least 1 identifiable agent. Rotavirus was the most common causative virus, followed by norovirus.[6] Norovirus, however, was the leading identified virus in all samples from patients aged 6 years and older, with the highest numbers in those older than 65 years.[6] The authors point out that elderly people seem to be more susceptible to norovirus and would benefit from early identification and treatment to avoid outbreaks.

Kirk and colleagues[7] conducted a review of literature describing the epidemiology of gastroenteritis and food-borne illnesses in elderly living in long-term care facilities (LTCFs). Their review showed that enteric infections are primarily acquired from infected persons or contaminated foods, and less often from poor personal hygiene or contaminated environments or water.

DIAGNOSIS

Diagnosis is generally based on symptoms, and in mild cases infected persons may not even contact their health care provider. For severe symptoms lasting several days, health care providers are typically sought out and may test a stool sample to determine the type of virus or to rule out bacterial or parasitic causes. A full diagnostic workup is indicated whenever the following conditions exist: profuse watery diarrhea with signs of hypovolemia (eg, hypotension, tachycardia, pale, clammy, dizziness); small stools with blood or mucus; bloody diarrhea; temperature greater than 38.5°C; passage of greater than 6 unformed stools in 24 hours or illness lasting greater than 48 hours; severe abdominal pain; currently hospitalized or recently taking antibiotics; diarrhea in the elderly or immunocompromised; or systemic illness with diarrhea, especially in pregnant women. Fever may not be present, especially in the elderly. A history of recent food consumption of unpasteurized dairy products, undercooked meat, or seafood is helpful because these are known to be responsible for outbreaks of viral gastroenteritis.

No specific guidelines exist for when to obtain stool cultures. In the elderly, infectious diarrhea may be thought to be fecal incontinence, fecal impaction overflow, irritable bowel syndrome, or even related to a change in medication.[7] In LTCFs, complete surveillance for sporadic disease may be difficult because the patient-to-staff ratio is high and staff may not have the necessary training or experience. If a patient is responding to conservative treatment and avoiding dehydration, samples are usually not obtained. Continuing symptomatic therapy for several days if the patient does not have severe disease is common.

Stool cultures should be obtained on initial presentation for immunocompromised patients, those with significant comorbidities, and those with underlying inflammatory bowel disease. Reverse transcription–polymerase chain reaction (RT-PCR) confirmation is the preferred diagnostic method for these viruses. Stool samples should be collected from infected persons during the acute phase when sensitivity is highest. Some laboratories may require a specific number of suspected cases before sensitivity testing is performed.

A prospective cohort study conducted in Berlin, Germany from August 2005 to August 2007 examined the causes and characteristics of community-acquired acute gastroenteritis in 104 adult patients. In 82% of patients, stool specimens and serologic tests detected enteric pathogens, identified as *Campylobacter* spp (35%), norovirus

(23%), *Salmonella* spp (20%), and rotavirus (15%).[8] The high percentage of severe viral gastroenteritis identified in this study shows the importance of comprehensive microbiologic analysis to support rapid diagnosis and prevention of the spread of infection in hospitalized adults.[8]

Some serologic evidence shows past infection in many young adults, but there is no long-term protective immunity and reinfections are common. Short-term immunity could occur for a few months or up to 1 year, but the immunity is for the specific causative virus and not for any different genotype.

TREATMENT

The goal of treatment is symptom relief and avoiding complications. Most cases do not require specific treatment. Some believe that over-the-counter loperamide and bismuth subsalicylate may help decrease episodes of stooling but should be avoided early in the course to allow for elimination of the virus. Bismuth subsalicylate is believed to reduce the length and severity of abdominal cramping. Antibiotic therapy is not required. Diuretics may need to be omitted for a day or 2 until diarrhea decreases.

Oral rehydration to avoid dehydration should begin as soon as the adult is able to sip clear liquids or suck on ice chips. Once vomiting has ended, fluid intake is encouraged. Reestablishing fluid and electrolyte balance in mild disease can often be accomplished by drinking fruit juices, sports drinks, broths, and caffeine-free soft drinks. High-sugar beverages of any type may increase diarrhea. Small frequent servings of liquids are less likely to increase vomiting than large quantities consumed quickly.

Slow introduction of foods that are bland and easy to digest, such as applesauce, bananas, rice, toast or bread, noodles, and potatoes, helps with symptom relief. Avoiding alcohol, caffeine, and fatty foods until full recovery is advised. Secondary lactose malabsorption is common after infectious gastroenteritis and can last weeks to months. Temporarily avoiding lactose-containing foods may be necessary. Other treatments not routinely used in clinical practice but that have shown some promise in studies to shorten duration or alleviate symptoms include nitazoxanide, antisecretory or toxin-binding agents, and probiotics.[2] More research is needed to determine their usefulness and potential side effects.

COMPLICATIONS

Dehydration is the most common complication experienced by patients with viral gastroenteritis. If the fluid lost through vomiting and diarrhea is not replaced by the patient in the form of oral intake, dehydration will result.

Under normal conditions, the intestine can both absorb and secrete fluids. During a diarrheal illness, a net secretion of fluids occurs because of a failure to absorb fluids normally or because of mucosal injury or toxin-induced excessive secretion.[9] When the colon cannot absorb this excessive fluid, it is excreted as diarrhea. Electrolyte imbalance can result with high-volume diarrhea.

Patients most at risk for dehydration include infants, children, older adults, and anyone with a weakened immune system. Dehydration signs include excessive thirst, dark-colored urine, dry skin and mucous membranes, dizziness or lightheadedness, lethargy, and poor capillary refill. Severe dehydration symptoms include all of these symptoms and weakness, confusion, tachycardia, oliguria, and coma. Severe dehydration is a medical emergency and requires immediate attention. Laboratory

abnormalities, such as elevated urine-specific gravity and elevated blood urea nitrogen, may indicate the degree of dehydration. Leukocytosis may be present.

The risk for dehydration is impacted by the severity of the disease, the individual, and the setting in which they are recovering. Elderly persons living alone or in an LTCF often rely on someone else to bring them adequate hydration and monitor them for response. They are clearly a population at risk.

Additionally, dormitory or camp settings where the bathroom and sleeping areas are shared can increase the challenges of confining the disease and those associated with recovery. The embarrassment of frequent vomiting and diarrhea especially when individuals do not feel they have the physical strength to take care of their personal needs adds to the stress of the illness. Recovery from gastroenteritis in this setting in which they are relying on friends to assist them and bring them adequate and appropriate sources of hydration can be problematic. As any of these populations become increasingly weak and tired, they may choose sleep over re-hydration and therefore put themselves at increased risk for dehydration.

Dehydration and hypovolemia are not synonymous. As water is lost from the body's total water, hypernatremia occurs, which is a relative deficit of water in relation to sodium. This condition leads to an intracellular water deficit through the osmotic movement of water into the extracellular fluid, and thus dehydration occurs. Hypovolemia occurs when the extracellular fluid volume is reduced, leading to a shift in intravascular volume, and when severe can cause reduction in tissue perfusion. If significant salt and water loss occurring through diarrhea and vomiting is not replaced, the patient becomes hypovolemic. Thus, patients with severe viral gastroenteritis with a fever, profuse diarrhea, and minimal fluid intake can present with volume depletion evidenced by poor skin turgor, tachycardia, orthostatic changes, and elevated plasma sodium concentration. These patients would have both dehydration and hypovolemia. The intense stimulation of thirst induced by hypernatremia would normally stimulate one to drink, but those with impaired mental status or unable to express their thirst are most at risk.

ORAL REHYDRATION THERAPY FOR MILD TO MODERATE VIRAL GASTROENTERITIS

Oral replacement solutions (ORS) were introduced back in 1945 and were surprisingly similar to some solutions used today. In the 1950s, new commercially prepared solutions were introduced that had too high a carbohydrate level and resulted in multiple episodes of hypernatremia. At that time, ORS were used infrequently and providers relied on intravenous hydration to treat hypovolemia. In the 1960s an effort was undertaken to develop an effective oral rehydration therapy that would be less costly and easy to administer.

In normal adults, the intestine secretes and absorbs a great deal of fluid. Approximately 6500 mL enter the intestine from ingested fluids and secretions combined, and are reduced to approximately 100 mL of stool daily. This passive water absorption is dependent on the osmotic gradient that is dictated by sodium transport via 3 principal mechanisms: sodium/hydrogen exchangers, electrochemical gradient, and sodium-coupled transport with carrier organic solutes such as glucose. In a diarrheal disease such as viral gastroenteritis, many of these processes are disrupted, but the sodium-coupled transport with carrier organic solutes remains intact. This feature is the basis of oral rehydration solutions and how they are effective.

The oral solution used to assist with rehydration must include glucose to allow sodium and water to be transported into the circulation. Without adequate glucose, the solution would not be absorbed and would only contribute to the volume of

diarrhea.[9] Likewise, beverages with a higher glucose-to-sodium ratio, such as in fruit juices and soda, will increase diarrheal loss. Therefore, oral rehydration solutions must include glucose and sodium in the correct ratio and be palatable to encourage their consumption. The ORS recommended by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) for global use is detailed in **Box 1**.

Advantages to ORS include the ability to use it in the home, lower cost, and possible avoidance of a trip to the hospital for intravenous hydration. The WHO-ORS composition is readily available and should be manufactured as a pharmaceutical product. A variety of commercially produced oral rehydration solutions are available over-the-counter.

The electrolyte concentration of sports drinks designed for sweat replacement (such as Gatorade) are not the same as those in oral rehydration solutions. Oral rehydration was the focus of a study by Rao and colleagues[9] examining the efficacy, safety, and palatability of Pedialyte, Gatorade, and a New Oral Rehydration Solution (N-ORS) in an adult population with mild to moderate viral gastroenteritis. This randomized double-blind trial took place in a hospital setting, where they measured stool and urine output, fluid intake, body weight, electrolytes, hematocrit, and palatability. The results showed improved stool frequency, consistency, and body weight in all 3 groups, without differences among groups. All other parameters were similar. Subjects with normal electrolytes on admission were able to maintain them throughout the study, but those with hypokalemia or hyponatremia in the Gatorade group were less likely to correct this imbalance.[9] The authors state that this may be a skewed result because the Gatorade group had a higher percentage of hyponatremic and hypokalemic subjects than the other groups. The subjects preferred the taste of the Gatorade and the N-ORS versus the Pedialyte. The authors discuss the importance of this finding, because a sport drink such as Gatorade tends to be relatively less expensive, available in most convenience stores, and well tolerated by the public. Therefore, Gatorade may be effective in helping to treat dehydration associated with mild viral gastroenteritis. Diluted fruit juices and flavored soda drinks with saltine crackers and broth or soup may help rehydrate those who are less severely ill.

INTRAVENOUS THERAPY FOR SEVERE VIRAL GASTROENTERITIS

It is important to monitor patient progress carefully and consider checking electrolytes when symptoms persist and replace them as appropriate. Intravenous fluids are necessary for those with severe dehydration and hypovolemia.

Box 1
Oral rehydration salts recommended by the WHO and UNICEF for global use

- Total osmolality of 245 mmol/L
- Equimolar concentrations of glucose and sodium
- Glucose, 75 mmol/L
- Sodium, 75 mmol/L
- Potassium, 20 mmol/L
- Citrate, 10 mmol/L
- Chloride, 65 mmol/L

Data from World Health Organization. Oral rehydration salts: production of the new ORS. 2006. Available at: http://whqlibdoc.who.int/hq/2006/WHO_FCH_CAH_06.1.pdf. Accessed March 20, 2012.

Treatment for severe cases of viral gastroenteritis leading to hypovolemia is similar to treating hypovolemia from other causes. Intravenous replacement of fluids should be performed at a rate tolerated by the patient depending on their comorbidities. Those with renal and cardiac dysfunction are more prone to fluid overload and pulmonary edema, and thus monitoring of fluid repletion is critical. They may benefit from a fluid challenge over 1 to 2 hours, and then carefully reassessed through monitoring urine output, blood pressure, heart rate, and mental status. In patients with severe hypovolemia and organ dysfunction, rapid fluid replacement at 200 to 300 mL/h for short periods with frequent reassessments is recommended. The most critically ill patients who develop severe systemic inflammatory response syndrome may benefit from additional close monitoring of central venous pressure and pulmonary central wedge pressure. Gastrointestinal tract losses can be replaced by 5% dextrose in 0.45% sodium chloride, with the addition of potassium as needed to replete to normal levels.

Untreated hypovolemia can result in hypercalcemia, hypernatremia, and azotemia. If allowed to progress, renal failure and cardiac dysrhythmias can occur. Decreased tissue perfusion can lead to worsening of existing comorbid conditions and organ failure.

OUTBREAKS

Viral gastroenteritis outbreaks occur in settings where many people gather together, such as homes, dormitories, cruise ships, restaurants, schools, camps, childcare centers, sporting events, hospitals, military residents, and nursing homes. Many of these patients will end up in emergency departments, and the most vulnerable of them will be admitted.

In 1979–1995, gastroenteritis rates in hospital discharges had decreased in the United States. Lopman and colleagues[10] conducted a study examining gastroenteritis-associated hospital discharges in the United States from 1996–2007. They wanted to determine if the rates had continued to decrease in the setting of increased norovirus activity over recent years. They used the Nationwide Inpatient Sample (NIS) as a nationally representative database of hospital inpatient stays in the United States. They attempted to estimate the proportion of cause-unspecified gastroenteritis codes that were due to norovirus using indirect approaches. They determined that the rate of cause-unspecified gastroenteritis increased by 41% from 1996 to 1997 to 2006 through 2007. Results across age groups revealed a decrease in rates for children but increased by more than 50% for adults and the elderly.[10] Estimates of norovirus-associated hospitalizations and rotavirus-associated activity in nonpediatric age groups increased over the study period.[10] This study highlights the high number of cause-unspecified gastroenteritis and the need for increased diagnostic testing in emergency, inpatient, and LTCF settings. Reliable testing would help to identify and rapidly treat outbreaks.

To determine the importance of norovirus and other enteric viruses as the cause of sporadic and outbreak cases of acute gastroenteritis, Liu et al[4] conducted a study in Beijing, China from July 2007 through June 2008. They examined 557 stool samples consisting of 503 sporadic cases and 54 samples of 4 outbreaks. Their results included detection of norovirus in 26.6% of all cases. Norovirus was present throughout most of the study period but was most evident in the winter and early spring. Norovirus coinfected with rotavirus, astrovirus, and sapovirus. Additionally, the GII.4/2006 genotype was the predominant strain identified.

Outbreaks of norovirus gastroenteritis are especially concerning in vulnerable populations, such as the elderly and individuals who are immunocompromised. Schwartz and colleagues[11] describes an outbreak of norovirus genotype II.4 variant strain in a hematologic and transplantation hospital unit that started from 1 patient with B-cell chronic lymphocytic leukemia who had undergone hematopoietic stem cell transplantation 7

months prior. Stool samples were negative for bacteria and parasites, and the cause of gastrointestinal symptoms was originally thought to be intestinal graft-versus-host disease. Within 6 days of admission, 4 other patients developed vomiting and diarrhea, which prompted laboratory screening for norovirus. In total, 11 patients and 11 staff members contracted norovirus; an attack rate of 3.3% for patients and 10.5% for staff members, which is considered much lower than previously reported rates exceeding 50%. Isolation precautions were followed immediately after norovirus was identified, which may have decreased the attack rate. Staff members were dismissed and did not return to work for 48 hours after symptoms ceased. Stool samples remained positive for norovirus RNA for a median of 30 days, but no transmission was observed after the 48-hour asymptomatic interval.[11] Histo-blood groups and secretor status typing were examined and all 11 infected patients were secretor-positive phenotype; 3 of these patients died.[11] The authors stress the importance of meticulous measures to prevent the transmission of norovirus gastroenteritis to this vulnerable population.

In outbreaks related to contamination of food or water, the source should be identified quickly so that public health measures can be taken immediately. Most foodborne cases of gastroenteritis in the United States are from norovirus and the source is either contaminated food or from infected food handlers themselves.

Outbreaks have even occurred in professional sports organizations. Overall, 21 players and 3 staff members from 13 National Basketball Association (NBA) teams in 11 states were affected by a norovirus outbreak from November to December 2010.[3] Some players identified that a gastrointestinal illness was present in their homes before they became ill. Others described illness occurring in their homes the week after their illness. Both situations indicate the continued spread of this outbreak in otherwise healthy individuals.

A new study approached the topic of frequency of outbreaks by surveying members of the Association for Professionals in Infection Control and Epidemiology about outbreak investigations conducted over the past 24 months in U.S. hospitals. Four organisms were responsible for nearly 60% of all outbreaks reported:

Norovirus (18%)
Staphylococcus aureus (17%)
Acinetobacter spp (14%)
Clostridium difficile (10%)[12]

Norovirus outbreaks occurred more often in rehabilitation, long-term care acute units/hospitals, and behavioral health settings than in medical surgical units, and were associated with the highest number of closures in all settings.[12] The authors concluded that norovirus is emerging as an increasingly common hospital-associated infection that could lead to unit closures.

GENERAL INFECTION PREVENTION MEASURES

In all settings, hand hygiene and disinfecting with bleach solution are important measures to prevent the spread of viral gastroenteritis. After an episode of vomiting or diarrhea, contaminated surfaces should be cleaned and disinfected immediately using a bleach-based household cleaner or an Environmental Protection Agency–approved disinfectant.

Clothing or linens that may be contaminated with vomit or fecal matter must be removed and washed using the maximum cycle length and dried in a machine when possible. Soiled items should be handled carefully to avoid spreading the virus.

Individuals infected with norovirus should not prepare food for others while they have symptoms and for 3 days after they recover from their illness.

INFECTION PREVENTION MEASURES IN HEALTH CARE SETTINGS

The CDC developed recommendations for outbreaks in health care settings to help guide practice. Contact precautions should be initiated immediately and continued for a minimum of 48 hours after symptoms have resolved. These measures should include a single room with a dedicated bathroom. Cohorting patients in multioccupancy rooms or in a designated area may be an alternate strategy when private rooms are not available. Extending the isolation and cohorting is recommended for complex medical patients, such as cardiovascular, renal, autoimmune, and immunocompromised patients, because they may experience prolonged viral shedding.[13] Gloves and gowns should be worn when entering patient rooms. Masks and eye protection are advised when providing direct patient care because of the risk of splashes. Staff who may have had norovirus and have since recovered may be the most appropriate personnel to care for symptomatic patients.

Hand hygiene should be actively promoted for patients, visitors, and health care personnel. Soap and water is recommended after care of infected patients or those suspected and not yet confirmed. Alcohol-based hand sanitizers may be used for other routine hand hygiene but are not believed to be as effective against norovirus.

Food handlers must follow strict hand hygiene practices before any food preparation. Shared food should be removed for patients and staff for the duration of the outbreak. Food handlers who become symptomatic with gastroenteritis should be excused from duty immediately and should not return until asymptomatic for a minimum of 48 hours.

Once an outbreak is recognized, rapid identification and confirmation of suspected persons and notification of an infection preventionist should occur. Organizations should develop policies that will enable them to rapidly make clinical and virologic confirmation of suspected cases. If clinical laboratory testing is not immediately available, Kaplan's clinical and epidemiologic criteria should be used to identify a norovirus gastroenteritis outbreak (**Box 2**). Tracking information about outbreaks should include individuals' name, symptoms, dates of outbreak and resolution, and any diagnostic testing results.

Two or more cases should trigger communication to key stakeholders, including clinical staff, environmental services, laboratory administration, and facility administrators. Outbreaks should be reported to local and state health departments, who will report it to the National Outbreak Reporting System (NORS) and CDC. Timely

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Box 2
Kaplan's clinical and epidemiologic criteria to identify a norovirus outbreak

1. Vomiting in more than half of symptomatic cases

2. Mean (or median) incubation period of 24 to 48 hours

3. Mean (or median) duration of illness of 12 to 60 hours

4. No bacterial pathogen isolated from stool culture

If all 4 criteria are present, norovirus is highly likely the cause. However, approximately 30% of norovirus outbreaks do not meet these criteria.

From the Centers for Disease Control and Prevention. Key Infection Control Recommendations for the Control of Norovirus Outbreaks in Healthcare Settings. Available at: http://www.cdc.gov/HAI/organisms/norovirus.html. Accessed January 16, 2012.

communication to staff and visitors is essential to decrease panic and to further prevent the spread of the virus.

The CDC encourages organizations to use the NORS (http://www.cdc.gov/outbreaknet/nors/) for reporting incidence and fluctuations in norovirus in health care settings.[13] This surveillance program was previously used for reporting foodborne disease only but has been expanded to include any enteric outbreak. In addition, the CDC started CaliciNet, a national surveillance system for genetic sequences of noroviruses that may be used to track changes in the epidemiology of health care–associated norovirus infections.[13]

All organizations should have sick leave policies and they should be followed at this time. Staff should not return until they are asymptomatic for 48 hours. Students, volunteers, and any staff not needed for day-to-day management of patient care should be encouraged to avoid the setting until the outbreak has passed. Group activities are generally canceled during outbreaks, and movement in and out of the patient care area should be discouraged.

Education of staff, patients, and visitors is essential and should include recognition of norovirus symptoms, modes of transmission, prevention of infection, and special considerations for outbreaks. Having resources available for visitors to read in clear simple language will help disseminate the information. Allowing all staff and visitors to have access to personal protective equipment supports the process.

Many organizations have open visitation policies, but should include information regarding limiting visitors during episodes of outbreak. The team will need to screen visitors to determine if they are asymptomatic and encourage them to follow strict hand hygiene practices and contact precautions.

The frequency of cleaning should be increased, and high-touch areas, including door handles, faucets, commodes, toilets, hand/bed railing, telephones, computer equipment, and kitchen preparation areas, require special attention with approved cleaning products. The regular cleaning of the environment should be increased to twice a day, and 3 times a day for high-touch surfaces.[13] The process of cleaning should always be from low contaminated areas such as table tops to high contaminated areas such as commodes and faucets.

Equipment that is shared among patients should always be cleaned with Environmental Protection Agency–registered products, paying special attention to the directions for application and contact time, defined as the time the product must be left on the soiled surface.

When a patient is ready for discharge or transfer, the room should undergo a final cleaning, with all disposable items discarded. Unused linens should be removed and laundered. Nurses can minimize waste through limiting the number of items to those needed and not storing extras in the room.

Cleaning up after an outbreak forces the team to take a look at the environment. All furniture should be able to withstand routine cleaning and disinfecting. Privacy curtains should be removed and laundered. If upholstered furniture is in the patient care area, it should be spot cleaned with an approved product when soiled and then steam cleaned when the patient is transferred or discharged. More research is needed to determine how effective and reliable fogging, ultraviolet irradiation, and ozone mists are in reducing norovirus environmental contamination.[13]

FUTURE RESEARCH

Much still must be learned about these viruses, and specifically about the best strategies to use for controlling the spread of infection. Improvement in detecting causes of

gastroenteritis during outbreaks is imperative, because nearly 25% have an unidentified cause using the most sensitive methods available. Braham and colleagues[14] examined a panel of samples from outbreaks of gastroenteritis that had no identified cause and applied random amplification molecular methods. Virus purification and concentration followed by a single-primer sequence-independent amplification method identified viruses in 5 of 51 previously negative outbreaks. Noroviruses were detected in 4 of these outbreaks that were not identified using 2 available broadly reactive diagnostic methods.[14] This study highlights the potential for future methods of early detection.

Protective immunity and the development of a vaccine for norovirus are current areas of focus for researchers. It is known that histo-blood group antigens (HBGAs) help determine host susceptibility for norovirus infection, and individuals with blood type B or AB are less susceptible to norovirus infections. Additionally, Northern Europeans and Americans from Northern European ancestors lack the fucosyl-transferase 2 enzyme and do not express the H type 1 or Lewis b antigens on their mucosae or in secretions.[15] Reeck and colleagues[15] developed an HBGA blocking assay and wanted to examine the ability of human serum to block interaction of norovirus virus–like particles with H type 1 and 3 glycans. Volunteers were inoculated with norovirus and evaluated. Infected individuals had a peak in blocking titers at 28 days after challenge, and these were higher than in those who developed gastroenteritis.[15] They concluded that blocking antibodies correlate with protection against clinical norovirus gastroenteritis.[15] This information can be used in the development of new vaccines.

Other important research topics are length of shedding of virus after symptoms subside and the likelihood of secondary transmission of norovirus infection; the use of medications that may decrease severity and length of disease; the most important risk factors to consider; and treatment options for severe cases of viral gastroenteritis. All of these factors would have significant impact on the control of this and potentially other viruses.

SUMMARY

Viral gastroenteritis is extremely common, causing millions of cases of diarrhea in all age groups worldwide. Norovirus has been identified as the leading cause of viral gastroenteritis in the adult population. The combination of a low infectious dose, viral shedding before and for weeks after illness, and resistance to temperatures from freezing to 60°C and to many common household cleaners makes norovirus a winter peril. Mild cases require symptomatic treatment alone. Complicated cases, often involving the most vulnerable populations, develop severe dehydration and hypovolemia, requiring the skills of critical care nurses to meet the challenges of care.

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