
Control and Prevention of Viral Gastroenteritis

Stephan S. Monroe

Diarrheal illness remains 1 of the top 5 causes of death in low-income and middle-income countries, especially for children <5 years of age. Introduction of universal childhood vaccination against rotaviruses has greatly reduced the incidence and severity of illness in upper-income and lower-income settings. For adults, norovirus is the leading cause of sporadic cases and outbreaks of diarrheal illness and is responsible for nearly 21 million episodes annually in the United States, of which 5.5 million are foodborne. Public health efforts to control and prevent norovirus illness have focused on rapid outbreak detection and source identification and control of transmission in institutional settings.

Diarrheal illness remains 1 of the top 5 causes of death in lower-income and middle-income countries (1), especially for children <5 years of age. In the ≈40 years since the initial detection of Norwalk virus (2) and rotavirus (3) by electron microscopy in stool samples of patients with gastroenteritis, there has been increased recognition of the role of enteric viruses as a major cause of diarrhea-associated illness and death in young children and adults. Unfortunately, standard improvements in water and sanitation that reduce the incidence of enterically transmitted bacteria do not appear to be equally effective for reducing the incidence of enterically transmitted viruses. Thus, other public health approaches have been pursued for the control and prevention of viral gastroenteritis.

For children <5 years of age, rotavirus is the leading cause of diarrhea-associated illness and death. Fortunately, safe and effective vaccines against rotavirus illness are now available in many countries. Introduction of universal childhood vaccination against rotaviruses greatly

Author affiliation: Centers for Disease Control and Prevention, Atlanta, Georgia, USA

DOI: 10.3201/eid1708.110824

reduces the incidence and severity of illness in upper- and lower-income settings (4). As a result, the World Health Organization recommended in 2009 that rotavirus vaccines be included in all national immunization programs (5).

In adults, norovirus is now recognized as the leading cause of sporadic cases (6) and outbreaks of diarrheal illness and is responsible for ≈21 million episodes annually in the United States, of which 5.5 million are foodborne (7). Efforts to develop effective vaccines for norovirus have been hindered by lack of a cell culture system to propagate the virus, large genetic diversity of norovirus strains, and apparent lack of long-term immunity generated by natural infection. Recent work on characterizing the interaction between noroviruses and their putative cellular receptors, histo-blood group antigens, may provide insights for development of specific antiviral compounds (8).

Public health efforts to control and prevent norovirus illness have focused primarily on outbreak detection and control. The implementation of CaliciNet, as described by Vega et al. (9), provides a useful new public health tool for rapid identification of norovirus outbreaks. Similar to the successful PulseNet network for molecular typing of foodborne bacteria (10) and NoroNet in Europe (11), CaliciNet will enable linking of cases with identical sequence fingerprints into clusters of illness that may have a common exposure. This linking will be particularly useful in cases of illness related to food products with low levels of contamination in which identification of exposure to a common food source may be difficult by epidemiologic methods alone.

Because a large proportion of norovirus illness results from foodborne exposures, considerable effort has gone into development of methods for detecting and eliminating virus contamination from food items, particularly shellfish (12) and fresh produce (13). Additionally, because

outbreaks of norovirus illness often occur in institutional settings, efforts are under way to standardize effective methods for disinfection of contaminated surfaces (14).

Finally, several other viruses, including astrovirus, sapovirus, and as described by Drexler et al. (15), Aichi virus, are also responsible for diarrheal illness in children and adults. Although the incidence and severity of illness caused by these pathogens may not warrant immediate development of vaccines, work continues to document their relative contributions to diarrhea-associated illness and death. Thus, although there is optimism for universal vaccination to prevent illness and death from severe rotavirus diarrhea and for reduction of norovirus illness by rapid outbreak detection and source identification, there are still many challenges remaining for the control and prevention of viral gastroenteritis.

Dr Monroe is director of the Division of High-Consequence Pathogens and Pathology at the Centers for Disease Control and Prevention. His primary research interests are the biology and epidemiology of high-consequence pathogens and public health policy regarding these pathogens.

References

- World Health Organization. Ten leading causes of deaths in 2008 [cited 2011 Jun 1]. <http://www.who.int/mediacentre/factsheets/fs310/en/index.html>
- Kapikian AZ, Wyatt RG, Dolin R, Thornhill TS, Kalica AR, Chanock RM. Visualization by immune electron microscopy of a 27-nm particle associated with acute infectious nonbacterial gastroenteritis. *J Virol*. 1972;10:1075–81.
- Flewett TH, Bryden AS, Davies H. Letter: virus particles in gastroenteritis. *Lancet*. 1973;2:1497. doi:10.1016/S0140-6736(73)92760-8
- Jiang V, Jiang BM, Tate J, Parashar UD, Patel MM. Performance of rotavirus vaccines in 73 developed and developing countries. *Hum Vaccin*. 2010;6:532–42. doi:10.4161/hv.6.7.11278
- Rotavirus vaccines: an update. *Wkly Epidemiol Rec*. 2009;84:533–40.
- Hall A, Rosenthal M, Gregoricus N, Greene SA, Ferguson J, Henao OL, et al. Incidence of acute gastroenteritis and role of norovirus, Georgia, USA, 2004–2005. *Emerg Infect Dis*. 2011;17:1381–8.
- Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson M-A, Roy SL, et al. Foodborne illness acquired in the United States—major pathogens. *Emerg Infect Dis*. 2011;17:7–15.
- de Rougemont A, Ruvoen-Clouet N, Simon B, Estienney M, Elie-Caille C, Aho S, et al. Qualitative and quantitative analysis of the binding of GII.4 norovirus variants onto human blood group antigens. *J Virol*. 2011;85:4057–70. doi:10.1128/JVI.02077-10
- Vega E, Barclay L, Gregoricus N, Williams K, Lee D, Vinjé J. Novel surveillance network (CaliciNet) for norovirus gastroenteritis outbreaks, United States. *Emerg Infect Dis*. 2011;17:1389–95.
- PulseNet [cited 2011 Jun 1]. <http://www.cdc.gov/pulsenet/index.htm>
- NoroNet [cited 2011 Jun 1]. <http://www.noronet.nl/noronet/index.jsp>
- Maalouf H, Schaeffer J, Parnaudeau S, Le Pendu J, Atmar RL, Crawford SE, et al. Strain dependent norovirus bioaccumulation in oysters. *Appl Environ Microbiol*. 2011;77:3189–96. doi:10.1128/AEM.03010-10
- Predmore A, Li J. Enhanced sanitization of a human norovirus surrogate in fresh vegetables and fruits by a combination of surfactants and sanitizers. *Appl Environ Microbiol*. 2011; [Epub ahead of print]. doi:10.1128/AEM.00174-11
- Nowak P, Topping JR, Fotheringham V, Gallimore CI, Gray JJ, Iturriza-Gómara M, et al. Measurement of the virolysis of human GII.4 norovirus in response to disinfectants and sanitizers. *J Virol Methods*. 2011;174:7–11. doi:10.1016/j.jviromet.2011.03.004
- Drexler JF, Baumgarte S, de Souza Luna LK, Eschbach-Bludau M, Lukasev N, Drosten C. Human Aichi virus shedding in high concentrations in patients with acute diarrhea. *Emerg Infect Dis*. 2011;17:1544–8.

Address for correspondence: Stephan S. Monroe, Centers for Disease Control and Prevention, 1600 Clifton Rd NE, Mailstop A30, Atlanta, GA 30333, USA; email: smonroe@cdc.gov

Get the content you want
delivered to your inbox.

Sign up to receive emailed
announcements when new podcasts
or articles on topics you select are
posted on our website.

www.cdc.gov/ncidod/eid/subscribe.htm

Table of contents
Podcasts
Ahead of Print
Medscape CME
Specialized topics

