IN LATE 2006, CDC BEGAN RECEIVING REQUESTS FROM NUMEROS STATE PUBLIC HEALTH DEPARTMENTS FOR INFORMATION ABOUT A PERCEIVED INCREASE IN THE NUMBER OF OUTBREAKS OF ACUTE GASTROENTERITIS (AGE), ESPECIALLY THOSE INVOLVING PERSON-TO-PERSON TRANSMISSION IN LONG-TERM–CARE FACILITIES. NO NATIONAL SURVEILLANCE SYSTEM EXISTS FOR AGE OUTBREAKS, INCLUDING THOSE CAUSED BY NOROVIRUS, UNLESS FOODBORNE TRANSMISSION IS SUSPECTED. IN THE ABSENCE OF NATIONAL SURVEILLANCE DATA, CDC ATTEMPTED TO BETTER CHARACTERIZE THE OUTBREAKS OF AGE BY ANALYZING INFORMATION FROM THE FOLLOWING SOURCES: (1) DETAILED DATA ON RECENT AGE OUTBREAKS IN THREE OF THE STATES THAT HAD CONTACTED CDC ABOUT A POSSIBLE INCREASE (NORTH CAROLINA, WISCONSIN, AND NEW YORK); (2) EMERGENCY DEPARTMENT (ED) SYNDROMIC SURVEILLANCE DATA FROM BOSTON, MASSACHUSETTS; (3) BASIC EPIDEMIOLOGIC DATA ON AGE OUTBREAKS FROM A CDC SURVEY OF STATE HEALTH DEPARTMENTS; AND (4) LABORATORY DATA FROM CDC. THE ANALYSIS SUGGESTS THAT A NATIONAL INCREASE HAS OCCURRED IN THE FREQUENCY OF AGE OUTBREAKS CAUSED BY NOROVIRUS (INCLUDING FATAL CASES IN LONG-TERM–CARE FACILITIES). TWO NEW COCIRCULATING GI.4 NOROVIRUS STRAINS EMERGED NATIONWIDE IN 2006 AND LIKELY ACCOUNTED FOR THIS INCREASE IN ACTIVITY. IMPROVED NATIONAL SURVEILLANCE OF OUTBREAKS, INCLUDING THOSE WITH PERSON-TO-PERSON TRANSMISSION; DEVELOPMENT OF ACCESSIBLE, AFFORDABLE, AND TIMELY CLINICAL TESTS; AND INCREASED ACCESS TO A NOROVIRUS STRAIN SEQUENCING DATABASE AT CDC WILL LEAD TO MORE ACCURATE ASSESSMENT OF THE MORTALITY AND MORTALITY ASSOCIATED WITH NOROVIRUS AND MORE RAPID IDENTIFICATION OF NEWLY EMERGING NOROVIRUS STRAINS. 

North Carolina 
During January-December 2006, the North Carolina Division of Public Health received 17 reports of outbreaks clinically and epidemiologically consistent with norovirus infection among residents of long-term–care facilities, compared with 3 in 2005 and 21 in 2004. Norovirus was confirmed by reverse transcription–polymerase chain reaction (RT-PCR) in all 12 outbreaks for which stool specimens were available. A total of 573 residents and 288 staff members were affected in the 17 outbreaks, and 36 patients required hospitalization. One patient aged 90 years died in association with an AGE outbreak in a long-term–care facility after experiencing loose stools, fever, and dehydration for 3 days; gastrointestinal illness was recorded as the primary cause of death. Outbreaks lasted from 2 to 35 days (median: 12 days). The largest confirmed norovirus outbreak at a long-term–care facility affected 77 residents and 67 staff members. 

Outbreaks were preceded by illness among food handlers in four of the 17 long-term–care facilities, suggesting that these outbreaks might have been caused initially by foodborne transmission. At least two outbreaks were preceded by illness among staff members who also worked at other long-term–care facilities with reported norovirus outbreaks. Many long-term–care facilities used disinfectants that had limited effectiveness against norovirus (e.g., quaternary ammonia compounds) during these outbreaks. Although all AGE and other communicable disease outbreaks in North Carolina are reportable by long-term–care facilities to health departments, in at least four of the 17 outbreaks in 2006, health departments were notified of the outbreaks by emergency medical personnel or residents’ family members rather than directly by the facilities, suggesting incomplete reporting of these outbreaks by long-term–care facilities in this state. 

Wisconsin 
During 2006, the Wisconsin Division of Public Health received reports of 106 AGE outbreaks, compared with 23 AGE outbreaks in 2005. Eighty-seven (82%) of the 2006 outbreaks were PCR-confirmed norovirus outbreaks; 45 (78%) of 58 norovirus-confirmed, non-foodborne outbreaks were in long-term–care facilities, compared with three (20%) of the 15 norovirus-confirmed, non-foodborne outbreaks in 2005. 

The 45 outbreaks in long-term–care facilities reported in Wisconsin in 2006 included 2,071 clinical cases; 44 patients were hospitalized, and two died. The primary causes of death were not reported. The duration of outbreaks in long-term–care facilities ranged from 2 to 30 days (median: 11 days). Challenges in investigating these outbreaks included delayed reporting and incomplete collection of clinical data by long-term–care facilities. 

New York 
During October 1, 2006–January 31, 2007, a total of 333 AGE outbreaks were reported in New York, more than four times the number reported during the same period in 2005–2006 (76 outbreaks). Of these 333 outbreaks, 272 (82%) occurred in long-term–care facilities and 26 (8%) in hospitals. Of 216 health-care facility outbreaks with available data, a total of 7,907 patients and 4,317 staff members were affected. Of these, 207 (2.6%) patients and 20 (0.5%) staff members were hospitalized, and 16 deaths among patients with AGE were reported; however the cause of death was not reported. In October 2005, electronic reporting of outbreaks in health-care facilities began in New York, which might have increased the completeness of reporting from these facilities. However, the number of outbreaks reported by traditional means (i.e., fax machine or telephone) increased 298%, from 42 during the 2005–2006 period to 167 during the 2006–2007 period, suggesting a real increase in incidence.
The New York State Department of Health does not routinely perform viral testing at the state laboratory for all AGE outbreaks. Therefore, of the 298 outbreaks that occurred in long-term-care facilities, only 11 (4%) outbreaks had a laboratory-confirmed etiology; four of these had laboratory confirmation of norovirus by RT-PCR, and seven had laboratory confirmation of nonviral etiologies. The majority of outbreaks that did not have a laboratory-confirmed etiology were clinically and epidemiologically consistent with norovirus infection.1

**Boston, Massachusetts**

During December 1, 2006—April 1, 2007, 18 outbreaks characterized by acute onset of vomiting and diarrhea were reported from colleges, day care centers, and health-care facilities in Boston, Massachusetts, affecting 1,327 persons, compared with two such outbreaks during the same period in 2005. Eight of the 2006-2007 outbreaks were attributed to norovirus by RT-PCR testing of stool specimens.

The Boston Public Health Commission (BPHC), which coordinates syndromic surveillance in all 10 Boston hospital EDs, examined data from the city’s EDs to determine whether an AGE increase had occurred. These EDs submit demographic and chief complaint data to BPHC every 24 hours. Chief complaints are grouped into syndromes and analyzed for unusual activity. These data indicated citywide increases in the number of ED visits for a gastrointestinal syndrome defined as nausea, vomiting, or diarrhea among all age groups during December 5, 2006—March 24, 2007. During this 16-week period, ED visits attributable to this gastrointestinal syndrome averaged 96 per day (7.4% of all visits), compared with 74 visits per day (5.8% of all visits) during the same period in the previous year (p<0.001, by Pearson’s chi-square test).

**United States**

CDC solicited information from the health departments of all 50 states and the District of Columbia on the number of (1) AGE outbreaks reported during October-December 2005 and October-December 2006, (2) AGE outbreaks in long-term-care facilities, and (3) norovirus outbreaks confirmed by PCR. Forty states responded, and CDC reviewed data from 24 states that reported at least five outbreaks in both 2005 and 2006. These 24 states reported a total of 1,316 AGE outbreaks with onset during October-December 2006; a median of 50% occurred in long-term-care facilities, and a median of 26% had laboratory confirmation of norovirus by RT-PCR. Of these 24 states, 22 (92%) reported an increase in the number of outbreaks compared with the same period in 2005 (range of increase: 18%-800%). State officials reported that the majority of the outbreaks with no laboratory confirmation of norovirus had epidemiologic and clinical evidence suggestive of norovirus infection.1

**CDC Laboratory Surveillance**

During 2006, the National Calicivirus Laboratory at CDC tested 761 stool specimens from 126 AGE outbreaks in the United States for norovirus by RT-PCR.2 Outbreak settings included cruise ships (n=37), long-term-care facilities and assisted-living facilities (n=37), restaurants and catered events (n=13), hospitals and health-care centers (n=seven), colleges and schools (n=three), parties (n=three), and other settings (n=26). Norovirus was confirmed in 114 (90%) of these outbreaks, and 87 (76%) of these were associated with two new GII.4 norovirus variants (Minerva and Laurens) by partial capsid gene-region sequencing.3 The Minerva strain was detected in 13 (60%) of 25 outbreaks during October-December 2006 on cruise ships and in eight states; during January-June 2007, the same strain caused 66 (54%) of 122 outbreaks on cruise ships and in 19 states. The Laurens strain was detected in 10 (40%) of the 25 outbreaks during October-December 2006 and 33 (27%) of the 122 outbreaks during January-June 2007. The partial capsid sequences of the Minerva and Laurens strains are identical to the GII.4 strains (GII.4-2006a and GII.4-2006b) reported in 2006 in Europe.4

**CDC Editorial Note:** This report highlights widespread increased frequency of norovirus-like illness outbreaks and ED visits during October-December 2006 and January-June 2007. This increase was associated with the emergence of two new cocirculating strains of norovirus GII.4. A previous increase in norovirus outbreaks in the United States also was associated with the emergence of new strains.5 Whether the increase in outbreaks is a result of increased pathogenicity or transmissibility of new strains, lower immunity in the population, or other factors is unclear. During late 2006 and early 2007, increases in AGE outbreaks consistent with norovirus6 were reported by many state health departments. A high proportion of specimens tested were positive for norovirus, which suggests that the increase in AGE outbreaks was associated with norovirus infection. The magnitude and consistency of increases in multiple states suggest an actual increase rather than increased reporting resulting from increased awareness of and testing for norovirus.

A large proportion of AGE outbreaks in 2006 occurred among residents of long-term-care facilities, a population that has higher attack rates from AGE than non-institutionalized populations.6 Illness compatible with norovirus infection was the primary cause of death recorded for a resident of a long-term-care facility in North Carolina; in addition, two deaths in Wisconsin and 16 deaths in New York were associated with AGE outbreaks in healthcare facilities. Norovirus infection as a confirmed cause of death has not been reported previously in the United States. Additional investigation of deaths associated with AGE outbreaks in health-care settings is needed to better understand the role of norovirus.

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Noroviruses are the most common cause of sporadic cases and outbreaks of AGE. Transmission occurs via foodborne and person-to-person routes as well as through contact with contaminated environmental surfaces. The low infectious dose of norovirus (<10 viral particles) required for transmission, in addition to the virus’s environmental persistence and prolonged shedding after recovery, coupled with the shared toilet facilities, close living quarters, and immobile or incontinent residents in long-term-care facilities predispose these facilities to prolonged outbreaks with high attack rates. Control of norovirus outbreaks depends on consistent enforcement of measures such as strict hand hygiene and use of effective environmental disinfectants (see sidebar). The findings in this report are subject to at least two limitations. First, no national surveillance system exists for AGE or norovirus outbreaks that are transmitted from person to person; reporting methods and completeness of reporting vary substantially by state. Thus, this report likely underestimates the number of norovirus outbreaks and cannot accurately quantify the increase in frequency from 2005 to 2006. Second, laboratory testing for norovirus is limited to the state public health laboratories, and norovirus testing is not routinely performed on all specimens from all AGE outbreaks; the low number of outbreaks with norovirus confirmation likely reflects this. During October-December 2006, only 29% of all reported AGE outbreaks in 24 states had laboratory confirmation of norovirus. States such as Wisconsin that routinely test specimens from outbreaks determined that a high proportion were attributable to norovirus.

In June 2006, the Council for State and Territorial Epidemiologists passed a resolution stating that all AGE outbreaks should be reportable nationally, regardless of mode of transmission (i.e., foodborne or person to person). This will be implemented in 2008 through the National Outbreak Reporting System. In addition to better surveillance, specific protocols are needed to investigate the role of norovirus in diarrheal deaths, particularly among older adults. Development and application of new, easy-to-use norovirus assays for routine clinical practice could better define the prevalence of norovirus among persons with AGE who seek health-care services. CaliciNet, a centralized database at CDC, is used to collect and compare norovirus sequences to identify emergent strains, track more virulent strains in real time, and determine the role of contaminated foods in their emergence; this database soon will be widely accessible to state and local health departments.

REFERENCES


*AGE outbreaks are considered consistent with norovirus if all of the following criteria are met: (1) vomiting in >50% of affected persons, (2) mean or median incubation period of 24-48 hours, (3) mean or median illness duration of 12-60 hours, and (4) no bacterial pathogens isolated from stool culture.1