

## Norwalk-Like Viral Gastroenteritis Outbreak in U.S. Army Trainees

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An outbreak of acute gastroenteritis hospitalized 99 (12%) of 835 U.S. Army trainees at Fort Bliss, El Paso, Texas, from August 27 to September 1, 1998. Reverse transcriptase polymerase chain reaction tests for Norwalk-like virus were positive for genogroup 2. Gastroenteritis was associated with one post dining facility and with soft drinks.

Norwalk viral gastroenteritis has been identified as an important cause of illness among military troops (1-3). We report the epidemiologic, environmental, and laboratory investigations of a large foodborne outbreak of acute gastroenteritis in military trainees in which a Norwalk-like virus, genogroup 2 (NLV2), was identified by reverse transcriptase-polymerase chain reaction (RT-PCR).

### The Outbreak

From August 27 to September 1, 1998, 99 soldiers with acute gastroenteritis, assigned to the Fort Bliss Air Defense Artillery Training site, El Paso, Texas, were admitted to the William Beaumont Army Medical Center for observation and hydration. The criteria for admission were lack of medical care in barracks and isolation of cases to contain the outbreak. All soldiers admitted to the medical center with gastroenteritis were isolated in a temporary medical facility. The most prominent symptoms were acute nausea, vomiting, abdominal pain, diarrhea, and fever (Table 1). The median hospital stay was 24 hours (12 to 72 hours). Initial clinical laboratory

evaluations suggested acute viral gastroenteritis (Table 2). All soldiers were from the same unit and lived near each other in the training area compound, a rectangular block of 15 buildings. The hospitalization rate for gastroenteritis in this

Table 1. Frequency of symptoms in hospitalized soldiers

Symptom	No. <sup>a</sup>	%
Nausea	79/90	88
Vomiting	72/90	80
Abdominal pain	68/90	76
Diarrhea	60/90	67
Fever/chills	37/90	41
Headache	20/90	22
Photophobia/eye pain	3/90	3

<sup>a</sup>90 records were abstracted from 99 hospitalized soldiers

Table 2. Frequency of selected findings in hospitalized soldiers

Sign/finding	No.	%
T <sub>max</sub> > 99.5°F	28 / 90	38
T <sub>max</sub> > 100.4°F	17 / 90	19
WBC > 10,600	10 / 60 <sup>a</sup>	17
Platelets < 150,000	22 / 60 <sup>a</sup>	37

<sup>a</sup>Sixty of 90 abstracted records reported white blood cells and platelet counts.

T<sub>max</sub>, maximum temperature.

WBC, white blood cells.

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## Dispatches

unit for the week of August 27 was 99 (12%) of 835. The compound had two dining facilities, DF1 and DF2, located across from each other in the center of the compound. Preliminary interviews with hospitalized patients implicated DF1, which was closed on August 28. Although some patients preferred one dining facility over the other, in general they dined as directed by their drill sergeants or where the wait was shortest. In addition to U.S. soldiers, the unit trained small numbers of US marines and Japanese defense force personnel, who also used these dining facilities.

Patients, food handlers, facility engineers, post public health officers, and training unit officers were interviewed, and the training compound and dining facilities were inspected. Sign-in rosters, menus, and meal preparation documents, as well as daily personnel status reports and training schedules, were reviewed. Cases were mapped by building of residence. Foodborne outbreak questionnaires were administered to 86 of the hospitalized patients available for interview; a randomly chosen (using the last digit of Social Security numbers: 3,5,7) group of 198 soldiers who had not sought medical care; and US marines and 15 Japanese defense force troops (total 323 questionnaires).

Because of the time elapsed since the start of the outbreak, the questionnaire was designed with a food preference format, based on the foods listed on the previous week's menu. Data were abstracted from 90 inpatient records and 323 questionnaires and meal sign-in rosters from August 25 to August 27, 1998, and were analyzed for trends by SPSS, a statistical software package. The case definition for acute gastroen-

teritis was three or more loose diarrheal stools (with or without vomiting) within a 24-hour period in the week before the outbreak, with or without admission to the hospital. To better characterize the point source of the outbreak, 98 (77.8%) of 126 cases with onset on August 27 to August 28 were termed "first wave" cases and were compared with propagated cases and controls for association with selected exposures (Table 3).

Limited food samples and cultures of the ice cream and soft drink dispensers were obtained and sent for analysis—the ice cream dispensers had been turned off and left at room temperature for 36 hours before sampling. Post water production facilities were reviewed, and water distribution maps were obtained from the Fort Bliss engineers. Construction in the area had necessitated closure of a nearby water main on August 27, but the main was reopened on the same day. Water samples were taken from multiple sites in the training compound and elsewhere on post. Stool samples were collected from all hospitalized patients and processed for *Salmonella*, *Shigella*, *Campylobacter*, and *Yersinia*. The first 15 samples were processed for *Aeromonas*, *Plesiomonas*, and *Escherichia coli* O157:H7, as well as for fecal leukocytes and ova or parasites, including staining for *Cyclospora* and *Cryptosporidia*. Twenty-four specimens were also sent to the Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, for electron microscopy and PCR testing for NLVs (4).

Of the 222 U.S. soldiers and marines selected to complete a questionnaire as controls, 31 (14.0%) also met the case definition for acute gastroenteritis. Extrapolating to 736 nonhospitalized U.S. soldiers and 24 marines, 106 (14.0%) of

Table 3. Odds ratios (OR) for selected foods and dining facilities

Exposure	Univariate analysis OR	Univariate 95% CI	Multivariate analysis OR	Multivariate 95% CI
Ever ate at DF1 in week prior <sup>a</sup>	9.8	(2.8, 40.2)	7.3	(2.0, 26.4)
Ate in DF1 preferentially <sup>b</sup>	3.7	(2.0, 6.9)	2.4	(1.3, 4.5)
Ever ate at DF2 in week prior <sup>a</sup>	1.1	(0.5, 2.3)	0.6	(0.2, 1.4)
Soft drinks	3.8	(2.0, 7.2)	2.6	(1.3, 5.0)
Crumb cake	2.4	(1.2, 4.8)	1.8	(0.8, 3.8)
Ice cream	1.7	(1.1, 3.0)	1.1	(0.6, 2.0)
Cinnamon rolls	1.7	(0.8, 3.7)	1.3	(0.6, 3.0)
Pie	1.5	(0.9, 2.7)	1.1	(0.6, 2.0)
Ice	1.5	(0.8, 2.9)	1.1	(0.6, 2.0)

Analysis based on inclusion of 98 "first-wave" cases only, as described in text.

Odds ratios (OR) defined as consumed item vs. did not, in all cells except:

<sup>a</sup>OR = 'Yes' vs. 'No'; <sup>b</sup>OR = DF1 vs. any other dining facility.

760 would have been expected to have had unreported illness. Added to the 99 hospitalized troops, this yields a crude unit attack rate among all U.S. trainees of (106 + 99) (23.9%) of 859. Of the 15 Japanese soldiers who were interviewed, nine (60%) had been ill and met the case definition. In all, 40 (16.9%) of the 237 controls also met the case definition and were reclassified as case-patients. An epidemic curve, based on time of symptom onset in cases, was constructed from the 126 identified cases of acute gastroenteritis with completed questionnaires (Figure).

Mapping of the outbreak cases demonstrated a discrete geographic clustering in the training compound, with the exceptions of the Japanese soldiers and two U.S. Army officers. Interviews with the Japanese troops found that they all had used DF1 exclusively for morning and evening meals during the week before illness. The two army officers reported eating just one meal at DF1 at lunch on August 26, with soft drinks and pudding pie as the only food in common. Interviews with food handlers found that a confection baker had become acutely ill while baking in the DF1 facility between 2 a.m. and 4 a.m. on August 26. A DF1 housekeeper (not food handler) also reported self-limited gastrointestinal illness between August 27 and August 29. None of the workers in DF2 reported illness.

Univariate analysis of the abstracted questionnaire data showed that soldiers who ate in DF1 in the week before the outbreak were 9.8 times as likely to contract acute gastroenteritis as those who did not use DF1 (95% CI: 2.8, 40.7). Although univariate analysis indicated that illness was also associated with eating crumb cake and cinnamon rolls prepared by the baker,

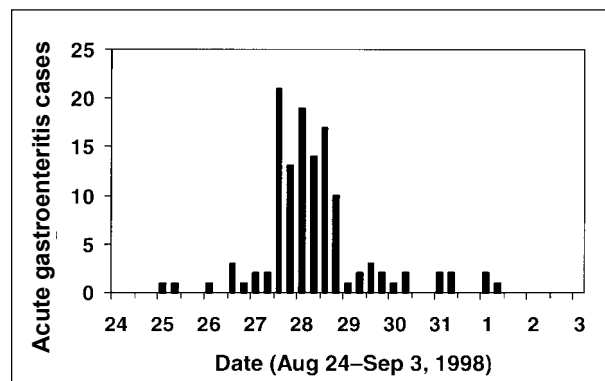


Figure. Date of onset of acute gastroenteritis symptoms (AGE) in 126 soldiers, week of August 24, 1998.

as well as ice cream and soda from DF1, multivariate analysis did not support these associations. Multivariate analysis indicated that the best predictors of illness were dining in DF1 and drinking soda from the dining facility (Table 3).

All post water samples tested negative for fecal coliforms. General sanitation in the dining facilities was satisfactory, and no back-siphoning hazards were found. The soft drink dispensers had antisiphoning valves. Cultures of food specimens were negative except for nonpathogenic coliform bacteria (*Citrobacter diversus* and *Serratia liquefaciens*) isolated from the ice cream dispenser in DF1 and *Enterobacter cloacae* coliform bacteria isolated from the soda fountain in DF2. All stool cultures from hospitalized trainees were negative for bacterial fecal pathogens. No ova or parasites, fecal leukocytes, or bacteriologic pathogens were found. RT-PCR was positive for NLV2 in 17 of 24 stool specimens submitted to CDC for analysis. Electron microscopy was performed on seven specimens, and all were positive for 30-nm particles consistent with NLV.

### Conclusions

This gastroenteritis outbreak was notable for the explosive onset of an intense but brief illness with a short incubation period of 24 to 36 hours. The outbreak curve was characteristic of a point-source, propagated, foodborne illness, with clinical and epidemiologic features suggestive of NLV gastroenteritis, which was subsequently confirmed by RT-PCR (5-14).

NLVs have been identified as the predominant cause of viral gastroenteritis and have been implicated in 42% to 96% of nonbacterial gastroenteritis outbreaks since 1976 (5,10-12).

Although contaminated water is often the vehicle of outbreaks, the water distribution on Fort Bliss is within a closed loop system, and the tight geographic distribution of cases was inconsistent with proximal contamination of the general water supply. In addition, ice from the dining facilities was not associated with illness (Table 3). Interviews supported the hypothesis that the outbreak was caused by point-source contamination of food or drink in DF1.

Statistical analysis showed a strong association between illness and dining in DF1 and weaker associations with several food items, particularly crumb cake prepared by the ill confectioner on the morning of August 26 and

served at meals on August 26 and 27. The weakness of the association could be due in part to recall bias, since the onset of illness occurred fully a week before the investigation. Both pre- and postsymptomatic contamination of foods has been documented in outbreaks traced to food handlers, which could account for a few early, sporadic cases before the major outbreak. The strong statistical association of gastroenteritis with soda drinking suggests contamination of the soft drink dispenser in DF1—a distinct possibility, as NLVs are hardy and persistent in the environment, resisting both disinfection and chlorination (5,8,10). Bacterial contamination of the ice cream dispenser in DF1 and the soda fountain in DF2, while an incidental finding, implies that mechanical transmission of pathogenic organisms is possible in these facilities. A confounding effect, such as a tendency of ill soldiers to drink more soda, could also explain this association. Secondary person-to-person transmission promotes viral propagation in outbreaks and maintains these viruses in circulation. The prompt closure of DF1 and use of temporary medical facilities for quarantine likely decreased secondary propagation in this outbreak.

Limitations of this investigation include inability to identify the viral agent from the confection baker, failure to obtain acute- and convalescent-phase sera from ill DF1 staff and case-patients, design limitations in using food preferences in the survey, and inability to identify the agent in suspect foods, since NLVs cannot be cultured (5-10).

NLVs are distributed worldwide; serum antibody to Norwalk virus in some countries approaches 100% seroprevalence in adults. The ubiquitous nature and persistence of these viral agents make similar future outbreaks of NLV gastroenteritis a near certainty. RT-PCR is a valuable diagnostic tool in the identification of NLVs as the etiologic agent in this setting.

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