



## ***Salmonella* Oranienburg Infections Associated with Fruit Salad Served in Health-Care Facilities --- Northeastern United States and Canada, 2006**

During June--July 2006, a total of 41 culture-confirmed *Salmonella* serotype Oranienburg infections were diagnosed in persons in 10 northeastern U.S. states and one Canadian province. This report describes the epidemiologic, environmental, and laboratory investigations of this outbreak by federal, state, and local health agencies; the Food and Drug Administration (FDA); and the Canadian Food Inspection Agency. The results of the investigations determined that illness was associated with eating fruit salad in health-care facilities. Although the fruit salads were produced by one processing plant, the source of contamination was not determined. This outbreak highlights the importance of laboratory-based surveillance of *Salmonella*, including molecular subtyping, and timely communication of public health information.

On July 19, 2006, the New Hampshire Department of Health and Human Services (NHDHHS) began an investigation after *S.* Oranienburg was identified in stool specimens collected from two patients, two employees, and one cafeteria patron at a local hospital. On July 21, the Massachusetts Department of Public Health began an investigation after the state public health laboratory identified *S.* Oranienburg in stool specimens collected from three ill persons at a long-term--care facility. State public health laboratories in Massachusetts and New Hampshire subtyped *S.* Oranienburg isolates by pulsed-field gel electrophoresis (PFGE) and submitted the PFGE patterns to PulseNet, the national molecular subtyping network for foodborne disease surveillance. PulseNet compares these patterns within and among states and categorizes isolates with indistinguishable patterns into potential clusters of cases. The *S.* Oranienburg isolates from New Hampshire and Massachusetts had indistinguishable PFGE patterns (both with *Xba*I pattern JJXX01.0056 and *Bln*I pattern JJXA26.0017); this uncommon pattern combination was designated the outbreak strain. NHDHHS coordinated the outbreak investigation with other state health departments, all of which were members of OutbreakNet, a network of local, state, and federal epidemiologists and public health agencies that investigate outbreaks of foodborne, waterborne, and other enteric illnesses.

Epidemiologists were contacted in jurisdictions that reported *S.* Oranienburg isolates with the outbreak strain during June--December 2006. To develop hypotheses regarding sources of the *S.* Oranienburg infections, NHDHHS reviewed interview records for all patients who had been interviewed by state and local health departments. Investigators also conducted extended interviews; interviewers sought information regarding nearly 300 sources of exposure, including consumption of 234 specific food items.

A case was defined as culture-confirmed *S.* Oranienburg infection with the outbreak strain and illness onset from June 15 to July 31. Forty-one cases of *S.* Oranienburg with the outbreak strain occurred in 10 U.S. states and one Canadian province: Massachusetts (12), New Hampshire (nine), New York (four), Pennsylvania (three), Vermont (three), Kentucky (two), Maine (two), Maryland (two), Connecticut (one), New Jersey (one), and Ontario, Canada (two). Date of illness onset ranged from June 15 to July 25 ([Figure](#)). The median age of patients was 59 years (range: 8 months--96 years); 31% of cases were in persons aged

>70 years. Twenty-eight (68%) patients were female. Symptoms reported by patients included diarrhea (74%) (i.e., three or more loose stools in a 24-hour period), abdominal cramps (52%), fever (39%), vomiting (23%), and bloody diarrhea (16%). Seven (17%) patients were hospitalized as a result of their *Salmonella* infections. No deaths were reported.

Among the 41 cases, 30 (73%) occurred among persons who worked, stayed, or ate in a health-care facility during the 7 days preceding illness onset, including 10 already-hospitalized patients, 10 residents of a long-term-care facility, nine employees of health-care facilities, and one visitor who had eaten in a hospital cafeteria. The interviews with 33 of the 41 patients suggested that illness was associated with eating fruit salad in a health-care facility; 23 (70%) reported eating fresh fruit salad, 19 (83%) of whom had eaten fresh fruit salad in a health-care facility.

A case-control study was conducted to identify risk factors for infection. Case-patients were eligible for the study if they experienced diarrhea, were able to respond to the questionnaire, and had an isolate with the outbreak PFGE patterns. For case-patients who were residents or patients of a health-care facility, controls were selected randomly from a list of residents or patients who were in the facility at the same time as the case-patient. For case-patients who were employees, controls were selected randomly from a list of employees who worked in the facility at the same time as the case-patient. Controls for community case-patients (i.e., patients who were not exposed as employees or patients in health-care facilities) were well neighbors of the case-patient and were identified through a reverse telephone directory. Controls must not have had diarrhea since June 1 and must have been eating a solid diet during the 7 days before illness onset in the case-patient (i.e., the food-recall period). Based on hypotheses generated during interviews with case-patients, the questionnaire included 75 exposures focused on individual types of fresh fruit and on fruit salad eaten during the food-recall period. Questionnaires were administered by telephone or in person during August 15--September 6, 2006.

At the time the case-control study was conducted, 36 cases of *S. Oranienburg* had been identified in eight states and Canada. Twenty-two case-patients were eligible for the study; one case-patient chose not to participate and was not enrolled. A total of 21 case-patients and 33 controls were enrolled from all eight states and Canada. Case-control data were analyzed using a frequency-matched univariate analysis; three strata were analyzed, with each stratum containing all case-patients and controls for the given exposure location (health-care patients, health-care employees, and community residents). Fourteen (70%) of 20 case-patients, compared with four (13%) of 30 controls, ate fruit salad (matched odds ratio [mOR] = 8.9; 95% confidence interval [CI] = 2.3--35.5). Illness was associated with eating fruit salad in a health-care facility (Table). Twelve (60%) of 20 case-patients, compared with four (13%) of 30 controls, ate fruit salad in a health-care facility (mOR = 6.0; CI = 1.5--23.5). Salads eaten by case-patients were composed of multiple types of fruits; cantaloupe and honeydew melon were the most common fruits in salads eaten in health-care facilities. Cantaloupe was eaten by 10 (50%) case-patients and two (7%) controls (mOR = 7.6; CI = 1.6--36.7); honeydew melon was eaten by nine (45%) case-patients and one (3%) control (mOR = 14.2; CI = 1.8--112.5). Illness was not associated with consumption of individual fruits that were not part of a fruit salad. Use of multivariate analysis with conditional logistic regression was not feasible because of high consumption of multiple types of fruit.

Of 13 health-care facilities with case-patients, information regarding the source of the fruit served was collected for 11 facilities, 10 (91%) of which had served refrigerated, precut cantaloupe and honeydew melon purchased from the same processing plant in Canada. Inspections of the processing plant by the Canadian Food Inspection Agency did not identify any improper practices and determined that the plant was in compliance with its Hazard Analysis and Critical Control Points (HACCP) plan. The processing plant had received the fruit from multiple farms. At the plant, fruit was cleaned, sliced, packaged into containers, and refrigerated. Health-care facilities received the refrigerated, precut fruit as either a premixed fruit salad or as individual fruits that later were mixed on-site by the health-care facility. A traceback investigation of the original source of the cantaloupe and honeydew melons processed in the facility during June 1--July 15 indicated that the cantaloupe and honeydew melons likely originated from the United States; however, no specific farm was identified. No salmonellae were isolated from fruit salad samples collected at health-care facilities with outbreak-related cases or from samples collected by FDA at the point of entry into the United States. The Canadian Food Inspection Agency did not collect samples from the processing plant.

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## Editorial Note:

Salmonellae infect an estimated 1.2 million persons each year in the United States (1). In 2005, 1 year before the outbreak described in this report, a total of 36,184 *Salmonella* infections reported in the United States were laboratory confirmed; 590 (1.6%) were *S. Oranienburg* (2). The 41 cases in this international outbreak highlight the importance of laboratory-based surveillance, which relies on routine submission of *Salmonella* isolates from clinical laboratories to state public health laboratories. Furthermore, this outbreak illustrates the importance of sharing public health information domestically and internationally, because the investigation relied on the timely sharing of information among 10 state health departments, two national health agencies, two national food-regulatory agencies, and multiple local and provincial health departments.

The findings of this investigation indicated that infection with an uncommon strain of *S. Oranienburg* was associated with consumption of fruit salad in health-care facilities. The findings indicated that 1) 70% of case-patients ate fruit salad, 2) case-patients were six times more likely than controls to have eaten fruit salad in a health-care facility, and 3) 10 (91%) of 11 health-care facilities with *Salmonella* infections served refrigerated, precut fruit salad from the same processing plant in Canada. The source of the contamination of the fruit salad was not determined. However, because the fruit salad at the various health-care facilities was provided by several distributors but came from a common processing plant, contamination likely occurred either at the processing plant or earlier in the supply chain, such as at a farm.

Fruits such as cantaloupe and honeydew melon previously have been associated with salmonellosis outbreaks in the United States. During 1973--2003, a total of 11 cantaloupe-associated salmonellosis outbreaks were reported to CDC (3). Reported outbreaks were associated both with whole melons contaminated in growing fields and with precut melons. Cut fruit can be contaminated during processing when rind is removed and fruit is sliced (4,5). Furthermore, because the inner flesh of melons contains nutrients that can support microbial growth, improper refrigeration of cut fruit can cause bacteria proliferation (4,5). Although *S. Oranienburg* was not identified in any of the fruit salad samples collected, the samples were obtained several weeks after illness-onset dates in case-patients.

*Salmonella* outbreaks have not been frequently identified in health-care facilities in the United States, perhaps because not all cases are recognized. Current guidelines for the management of diarrhea discourage testing for *Salmonella* in hospitalized patients who have been in a facility for >72 hours unless an outbreak is suspected, the diarrhea is bloody, or the patient is an infant (6). These guidelines might make health-care facilities less likely to detect outbreaks of salmonellosis or recognize that they are part of larger outbreaks, such as the one discussed in this report (7,8). During this outbreak, only two of the 13 health-care facilities with cases recognized that an outbreak was occurring, likely because most facilities only identified one or two cases. In the Massachusetts and New Hampshire facilities, the initial outbreaks were recognized after three and five cases were identified in each facility, respectively. After both facilities implemented an active surveillance program for staff members and patients, eight additional cases were identified, suggesting that certain cases might not have been detected in the facilities that adhered to the 72-hour testing policy. Evaluation is needed to determine whether expanding the criteria for bacterial testing of stool specimens from inpatients beyond the presence of bloody diarrhea would improve foodborne outbreak detection and ultimately the safety of the food supply.

## Acknowledgments

This report is based, in part, on contributions by L Caine, MPH, Elliot Hospital, Manchester, New Hampshire; A Yartel, MPH, K Sinclair, MSN, Maine Center for Disease Control and Prevention; E Harvey, B Bolstorff, K Foley, Maine Dept of Public Health; P Alexakos, MPH, L Carlson, MD, City of Manchester New Hampshire Health Dept; K Larson, Maryland Dept of Health and Mental Hygiene; J Manning, MPH, New Hampshire Dept of Health and Human Svcs; M Malavet, MSA, New Jersey Dept of Health and Senior Svcs; S Schoenfeld, MSPH, Vermont Dept of Health; public health laboratories in Connecticut, Kentucky,

Maine, Massachusetts, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, and Canada; PulseNet; the Food and Drug Administration; and DD Blaney, MD, EIS Officer, CDC.

## References

1. Voetsch AC, Van Gilder TJ, Angulo FJ, et al. FoodNet estimate of the burden of illness caused by nontyphoidal *Salmonella* infections in the United States. *Clin Infect Dis* 2004;38(Suppl 3):S127--34.
2. CDC. *Salmonella* surveillance: annual summary, 2005. Atlanta, GA: US Department of Health and Human Services, CDC; 2006. Available at <http://www.cdc.gov/ncidod/dbmd/phlisdata/salmonella.htm>.
3. Bowen A, Fry A, Richards G, Beuchat L. Infections associated with cantaloupe consumption: a public health concern. *Epidemiol Infect* 2006; 134:675--85.
4. Ukuku DO, Sapers GM. Effect of sanitizer treatments on *Salmonella* Stanley attached to the surface of cantaloupe and cell transfer to fresh-cut tissues during cutting practices. *J Food Prot* 2001;64:1286--91.
5. Ukuku DO, Pilizota V, Sapers GM. Effect of hot water and hydrogen peroxide treatments on survival of salmonella and microbial quality of whole and fresh-cut cantaloupe. *J Food Prot* 2004;67:432--7.
6. Guerrant RL, Van Gilder T, Steiner TS, et al. Practice guidelines for the management of infectious diarrhea. *Clin Infect Dis* 2001;32:331--51.
7. Bruins MJ, Fernandes TM, Ruijs GJ, et al. Detection of a nosocomial outbreak of salmonellosis may be delayed by application of a protocol for rejection of stool cultures. *J Hosp Infect* 2003;54:93--8.
8. Bauer TM, Lalvani A, Fahrenbach J, et al. Derivation and validation of guidelines for stool cultures for enteropathogenic bacteria other than *Clostridium difficile* in hospitalized adults. *JAMA* 2001;285:313--9.

## Table

**TABLE. Number and percentage of case-patients and controls reporting consumption of fruit and association with illness from the outbreak strain of *Salmonella* serotype Oranienburg, by type of food item — United States and Canada, June–July 2006**

Food item	Cases (n = 21)*		Control (n = 33)*		Matched odds ratio	(95% CI†)
	No.	(%)	No.	(%)		
<b>Any fruit salad</b>	<b>14/20</b>	<b>(70)</b>	<b>4/30</b>	<b>(13)</b>	<b>8.9</b>	<b>(2.3–35.5)</b>
<b>Fruit salad in health-care facility</b>	<b>12/20</b>	<b>(60)</b>	<b>4/30</b>	<b>(13)</b>	<b>6.0</b>	<b>(1.5–23.5)</b>
<b>Cantaloupe</b>						
Any (whole or precut)	15/18	(83)	7/27	(26)	11.5	(2.4–55.5)
In fruit salad	12/20	(60)	2/30	(7)	9.9	(2.2–44.5)
In fruit salad in health-care facility	10/20	(50)	2/30	(7)	7.6	(1.6–36.7)
<b>Honeydew</b>						
Any (whole or precut)	14/19	(74)	2/28	(7)	19.5	(3.4–112.7)
In fruit salad	11/20	(55)	1/30	(3)	16.9	(2.4–119.6)
In fruit salad in health-care facility	9/20	(45)	1/31	(3)	14.2	(1.8–112.5)
<b>Watermelon</b>						
In fruit salad	9/19	(47)	2/30	(7)	6.9	(1.4–33.7)
In fruit salad in health-care facility	8/19	(42)	2/30	(7)	5.8	(1.1–29.8)
<b>Pineapple</b>						
Any (whole or precut)	11/18	(61)	6/27	(22)	6.1	(1.4–27.8)
In fruit salad	8/19	(42)	1/29	(3)	40.6	(3.0–548.4)
In fruit salad in health-care facility	6/19	(32)	1/30	(3)	15.2	(1.6–143.6)
<b>Red grapes</b>						
In fruit salad	7/20	(35)	0/30	(0)	9.8§	(1.5–65.6)
In fruit salad in health-care facility	7/20	(35)	0/31	(0)	13.1§	(1.9–89.0)

\* Case-patients and controls were excluded from analysis if the relevant interview question was not answered or the respondent answered “unknown.”

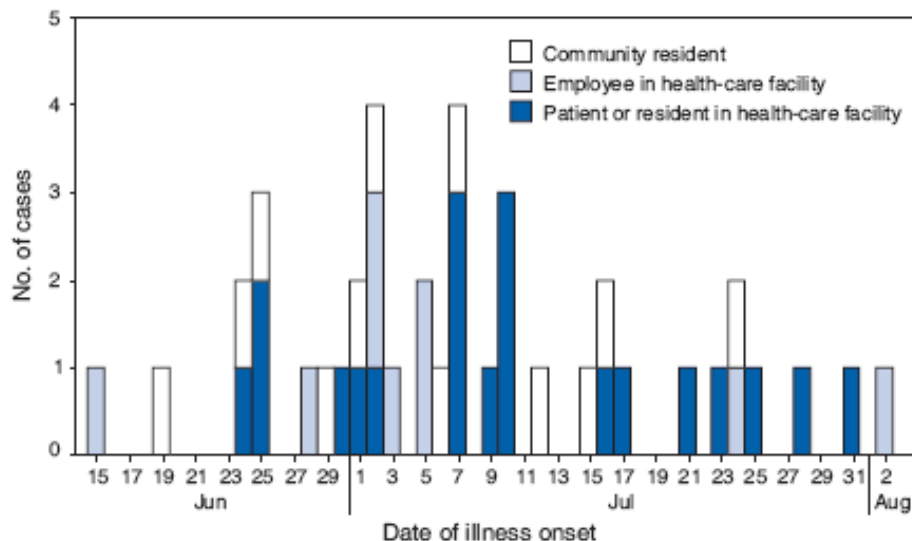
† Confidence interval.

§ Calculation uses a 0.5 continuity correction because of stratum cells that contain zero.

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**Figure**

**FIGURE. Number of culture-confirmed cases (N = 41) of infection with outbreak strain of *Salmonella* serotype Oranienburg, by date of illness onset\* — United States and Canada, June–July 2006**



\* If illness onset date was unknown, date of specimen collection was used.

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**Date last reviewed: 10/3/2007**

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