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## Outbreak of *Listeria monocytogenes* Infections Associated with Pasteurized Milk from a Local Dairy --- Massachusetts, 2007

On November 27, 2007, a local health officer in central Massachusetts contacted the Massachusetts Department of Public Health (MDPH) to report listeriosis in a man aged 87 years. Pulsed-field gel electrophoresis (PFGE) performed on the patient's *Listeria monocytogenes* isolate produced a pattern indistinguishable from that of isolates from three other cases identified in residents of central Massachusetts in June, October, and early November 2007. MDPH, in collaboration with local public health officials, conducted an investigation, which implicated pasteurized, flavored and nonflavored, fluid milk produced by a local dairy (dairy A) as the source of the outbreak. This report summarizes the results of that investigation. In all, five cases were identified, and three deaths occurred. This outbreak illustrates the potential for contamination of fluid milk products after pasteurization and the difficulty in detecting outbreaks of *L. monocytogenes* infections.

Dairy A was a family owned and operated milk product pasteurizing, bottling, and processing facility located in central Massachusetts; the dairy had operated for nearly 50 years. Raw milk was transported by tanker truck to the dairy A processing facility from dairy A's own farm (with nearly 300 cows) and from another, independent farm located 25 miles away. Dairy A produced various milk and nonmilk beverage products in glass and plastic bottles, including several varieties of flavored milk. Retail outlets were located at the dairy and the farm, but the bulk of the dairy's milk products were sold under dairy A's own name and other brand names through home delivery and at various retail establishments in Massachusetts. In addition, bulk cream was distributed to a bakery in Rhode Island, where it was used in cooked products.

### Epidemiologic Investigation

On October 24, 2007, MDPH identified a listeriosis isolate (from patient 3) with a PFGE pattern indistinguishable from an isolate (from patient 1) submitted approximately 120 days earlier (Table). The PFGE patterns associated with these patients had never been observed before in Massachusetts or in PulseNet (the national molecular subtyping network for foodborne disease surveillance). A review of available information on these two patients did not indicate a common exposure. On November 20, MDPH identified a third case (in patient 4) with an indistinguishable PFGE pattern. Attempts were made to interview this patient but were unsuccessful. On November 27, a fourth case (in patient 5) was reported to MDPH and, in the course of investigating that case, samples of coffee-flavored milk produced by dairy A were collected on November 29 from the patient's home for testing. In early December, MDPH determined that the clinical isolate from patient 5 had PFGE

patterns indistinguishable from those of patients 1, 3, and 4. An epidemiologic investigation of patient 5 indicated exposure to milk produced by dairy A. On December 21, a *L. monocytogenes* isolate obtained from the milk sample taken from the home of patient 5 was confirmed to have a PFGE pattern indistinguishable from that of the isolates from the four identified listeriosis patients. MDPH then investigated all 11 cases of listeriosis reported during 2007 in Massachusetts residents for whom no clinical isolates had been submitted to the State Laboratory Institute (SLI) of MDPH for PFGE analysis. The purpose of the investigation was to determine if any patients had exposure to milk products produced by dairy A during the 6 weeks preceding their illness. Telephone interviews were conducted with patients or next of kin. During this retrospective investigation, patient 2 was identified.

A case of outbreak-associated listeriosis was defined as illness in a Massachusetts resident with illness onset in 2007 who 1) was culture-positive for *L. monocytogenes* with PFGE patterns that matched the outbreak patterns generated with *AscI* and *ApaI* restriction enzymes (as established by the first case) or 2) had culture-confirmed *L. monocytogenes* and a history of consuming milk products produced by dairy A during the 6 weeks preceding illness and for whom a bacterial isolate was not available for PFGE analysis.

Five patients had illness consistent with the case definition (Table). All but patient 2 met the first case definition criterion; patient 2 met the second criterion. The median age of patients was 75 years (range: 31--87 years); three were male. All five patients were hospitalized. All three of the males (aged 75--87 years) died; they each had sepsis attributed to *Listeria* and died close to the time of their acute illness onset. The first case in a female was in a woman aged 31 years (patient 2) who had chorioamnionitis at 36 weeks' gestation. She delivered a healthy but premature infant. A placental culture was positive for *L. monocytogenes*. The second case in a female was in a woman aged 34 years (patient 4) who had fever and abdominal pain. She experienced a stillbirth at 37 weeks' gestation, and cultures of her blood, fetal blood, and placental tissue all were positive for *L. monocytogenes*.

Interviews were conducted with patients or patients' families using the CDC extended *Listeria* questionnaire. Patient 4 could not be interviewed. Of the remaining four patients, all but patient 3 were documented to have consumed products from dairy A during the 6 weeks preceding their illness. Patient 1 regularly consumed home-delivered, pasteurized skim milk produced by dairy A. Patient 2 reported drinking pasteurized 2% and whole milk produced by dairy A throughout her pregnancy. Patient 5 reported consuming pasteurized, coffee-flavored milk produced by dairy A.

### Environmental Investigation

On December 17, evidence of *Listeria* growth was reported from the coffee-flavored milk sample from the home of patient 5. On December 21, this organism was confirmed to be *L. monocytogenes* and matched the four clinical isolates by PFGE using the two restriction enzymes. The Massachusetts Food Protection Program (MFPP) inspected dairy A and collected 11 samples of unopened, flavored and unflavored milk products for testing on December 18, in response to the findings on December 17.

MFPP returned to dairy A on December 26 and collected environmental swab samples from inside the processing facility. On December 27, SLI reported a presumptive positive *Listeria* sp. in a sample of unopened, coffee-flavored milk that had been collected from dairy A on December 19. In response to this finding, MFPP asked the dairy to voluntarily cease all operations and recall its dairy products; dairy A complied with this request on December 27. On December 30, SLI confirmed that *L. monocytogenes* with PFGE patterns identical to the outbreak strain was isolated from the sample

of unopened, coffee-flavored milk.

After closure of dairy A and recall of its dairy products, approximately 100 additional environmental and product samples were collected by MFPP from the dairy's processing facility and adjacent retail store on January 2, 2008. One environmental swab from a floor drain in the finished product area, one skim milk sample, and seven flavored milk samples tested positive for *L. monocytogenes* and matched the outbreak strain by PFGE using the two restriction enzymes. Two additional environmental swabs and four additional samples of milk, both flavored and nonflavored, tested positive for seven distinct strains of *Listeria*, including three different *Listeria* species and three strains of *L. monocytogenes* with PFGE patterns that differed from those of the outbreak strain.

From December 28, 2007, to January 3, 2008, MFPP conducted a full environmental investigation in conjunction with the Food and Drug Administration and the local board of health. The dairy's records indicated that the plant's equipment met federal standards for time, temperature, and flow for effective pasteurization. The facility did not have an environmental monitoring program for *L. monocytogenes*. This is not required by law, but often is implemented as a best practice by larger food processors of ready-to-eat foods. Contamination, as demonstrated by the positive environmental samples, was documented in close proximity to areas where hoses were used to clean equipment. On February 1, 2008, dairy A decided to permanently close the milk processing facility, citing an inability to assume the financial burden that mitigation would require.

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### **Editorial Note:**

Sporadic cases of human listeriosis occur with an annual incidence of approximately 0.27 per 100,000 population in the United States (1). In Massachusetts, 25 to 35 cases are reported each year. Although most listeriosis patients exhibit mild, acute febrile illness not requiring medical care, pregnant women, neonates, elderly persons, and those who are immunocompromised are most at risk for severe disease (2). In pregnant women, infection can lead to miscarriage and stillbirth. Because only those patients with serious manifestations of infection seek medical care, most cases likely go undetected and detection of an outbreak or cluster is difficult.

In this outbreak, results of PFGE analysis indicated a common source for the *L. monocytogenes* found in the clinical isolates of four patients, six samples of flavored and nonflavored milk produced by dairy A, and the environment of the bottling facility of dairy A. The results of the PFGE analysis, in addition to the illness onset dates of the linked patients, support the conclusion that extensive contamination occurred over an extended period.

Physical facility design, product flow, and maintenance procedures likely contributed to contamination of finished product in this outbreak. How the pasteurized milk products became contaminated is unclear, but because records indicate that pasteurization methods at the dairy were adequate, and given the expectation that pasteurization kills *Listeria* organisms, contamination of the product likely occurred after pasteurization.

Outbreaks of listeriosis associated with pasteurized dairy products are rare. This outbreak is only the third reported outbreak of human disease caused by *L. monocytogenes* in the United States in which

pasteurized fluid milk was implicated (3,4). Health officials must be prepared to act quickly with public health interventions, such as closing a dairy, if epidemiologic and laboratory evidence indicates that cases have occurred and are associated with milk products.

PFGE and other systems for genotyping *L. monocytogenes* isolates from clinical specimens can discriminate single-source clusters of foodborne infection (5,6) and can contribute to the identification and investigation of outbreaks (7,8). The outbreak described in this report probably would not have been identified without molecular typing.

Although the effectiveness of PulseNet is well-documented (9), it is entirely dependent upon the consistent and timely submission of all isolates from clinical laboratories to public health laboratories. In Massachusetts, before this outbreak, submission of all *L. monocytogenes* isolates from clinical specimens by clinical laboratories was strongly encouraged but not required. On July 25, 2008, amendments to Massachusetts regulations\* went into effect that require clinical laboratories to submit all clinical isolates of *L. monocytogenes* to SLI for PFGE analysis.

The findings from this outbreak underscore the importance of physical facility and equipment design and cross-contamination controls, particularly in older facilities that manufacture perishable, ready-to-eat foods that have a long shelf-life and that support the growth of *L. monocytogenes* under refrigeration.

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\* 105 Code of Massachusetts Regulations 300.172 (Submission of selected isolates and diagnostic specimens to the Hinton State Laboratory Institute).

**Table**

TABLE. Characteristics of patients with *Listeria monocytogenes* infections associated with pasteurized milk from a local dairy — Massachusetts, 2007

Patient	Month of illness onset	Age (yrs)	Sex	Case definition*	Known exposure to dairy A	Underlying conditions	Outcome
1	June	78	Male	PFGE match	Yes	Renal failure	Died
2	September	31	Female	Culture-confirmed, exposure to milk from dairy A	Yes	Pregnant	Premature, healthy infant
3	October	75	Male	PFGE match	No	Unspecified	Died
4	November	34	Female	PFGE match	No	Pregnant	Stillbirth
5	November	87	Male	PFGE match	Yes	Multiple	Died

\* A case of outbreak-associated listeriosis was defined as illness in a Massachusetts resident with illness onset in 2007 who 1) was culture-positive for *L. monocytogenes* with pulsed-field gel electrophoresis (PFGE) patterns that matched the outbreak patterns generated with AscI and ApaI restriction enzymes or 2) had culture-confirmed *L. monocytogenes* and a history of consuming milk products produced by dairy A during the 6 weeks preceding illness and for whom a bacterial isolate was not available for PFGE analysis.

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