In August and September 2009, PulseNet, the national molecular subtyping network for foodborne disease surveillance, detected a multistate cluster of *Salmonella* Montevideo infections with an indistinguishable pulse-field gel electrophoresis (PFGE) pattern (XbaI PFGE pattern JIXX01.0011). Cases were geographically dispersed, and the age and sex distributions were typical for reported *Salmonella* cases. Montevideo is the seventh most common *Salmonella* serotype in the United States; of 1,225 PFGE patterns in the PulseNet Montevideo database, the outbreak strain pattern is the most common. PulseNet monitored this pattern and detected an increase in the number of isolates in November 2009, leading CDC to begin coordinating a multistate investigation. This report summarizes the results of that investigation, which identified 272 cases from 44 states and the District of Columbia, with illness onset from July 1, 2009, to April 14, 2010. In a multistate case-control study, consumption of salami was associated with illness. Purchase information from membership card records helped determine specific brands of Italian-style meat products associated with cases. The outbreak strain was identified in salami products, one company A facility environmental sample, and sealed containers of black and red pepper used to produce company A salami products. This outbreak highlights the importance of preventing post-processing contamination of ready-to-eat products from raw ingredients such as spices.

**Epidemiologic Investigation**

To detect associations between risk factors and illness, a structured questionnaire was used that asked whether patients had exposure to any of the approximately 300 food and animal items in the week before illness onset. Fifty-three questionnaires from patients in 18 states were completed during November 30–December 16, 2009. Most frequently reported foods included eggs, chicken, and bananas. When compared with the percentage of the population that report eating those specific foods, no hypothesis emerged. Next, open-ended interviews of 16 patients from eight states were conducted from December 16, 2009, to January 14, 2010. Twelve patients (75%) reported consumption of any Italian-style meats in the week before illness onset, nine (75%) reported eating salami, and nine (58%) reported shopping at a national warehouse store chain. From December 18, 2009, to January 14, 2010, the Washington State Department of Health (WADOH) collected information from seven patients regarding food purchased at national warehouse chain using information obtained from membership cards; five of the seven patients purchased and consumed a company A salami product before illness onset. State health departments and CDC collected additional membership card information from patients. Among 35 patients with membership cards, 19 purchased company A salami products before illness onset: 16 purchased a company A salami variety package, and three purchased a company A salami deli tray. Both products contained pepper-coated salami.

State and local health departments and CDC conducted a case-control study during January 16–20, 2010. Case-patients who had specimen collection dates after September 15, 2009, were enrolled. Controls were well persons matched to cases by neighborhood. Case-patients were asked about exposures a week before illness onset; controls were asked about exposures in the week before the interview. Forty-three case-patients and 43 controls were enrolled from 20 states. Case-patients were more likely than controls to report consumption of salami (matched odds ratio [mOR] = 8.0) (Table). Consumption of any Italian-style meat, including salami, capocollo, calabrese, or sopressata, was significantly associated with illness (mOR = 4.5). Adding freshly ground black pepper to foods was not associated with illness.

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*Membership cards used in this investigation were from a national warehouse store chain. Members must use their card to purchase products, and customer purchases can be tracked by the chain for sales and product safety purposes.*

† Controls were matched using a reverse address directory protocol. Potential controls were selected by entering a neighboring street address and zip code of each patient into a reverse address search engine. The search engine will produce telephone numbers of residents in the same neighborhood as the case-patient.
As of April 30, 2010, a total of 272 patients from 44 states and the District of Columbia were reported; illness onset dates ranged from July 1 to April 14, 2010 (Figure). Median age of patients was 37 years (range: <1–93 years); 53% (144 of 272) were female. Twenty-six percent (52 of 203) were hospitalized; no deaths were reported.

**Product Testing and Traceback**

Initial testing conducted by a private laboratory of unopened company A salami purchased at retail found *Salmonella* Senftenberg, a different *Salmonella* serotype, with PFGE pattern JMPX01.0004. WADOH subsequently tested the bacterial culture from the private laboratory and identified *S.* Senftenberg as well as the outbreak strain of *S.* Montevideo. The State Hygienic Laboratory at the University of Iowa isolated the outbreak strain of *S.* Montevideo from leftover salami from a patient’s home. In total, either the outbreak strain or *S.* Senftenberg was isolated from six open company A salami products collected from patients’ homes and three sealed retail products. The products contained peppered salami, spicy soppressata, spicy calabrese, or prosciutto.

From July 1, 2009, to April 14, 2010, PulseNet identified 11 persons who had illness caused by *S.* Senftenberg with PFGE pattern JMPX01.0004. Among nine ill persons interviewed, two reported purchasing a recalled salami product during the week before illness onset. These cases were not included in the overall case count.

On January 23, 2010, company A voluntarily recalled approximately 1.3 million pounds of ready-to-eat salami products. On January 31, the recall was expanded, adding approximately 17,000 pounds of product after *Salmonella* was isolated from an unopened retail company A peppered salami product collected by the Illinois Department of Public Health. Based on epidemiologic information provided by the Minnesota Department of Health, the U.S. Department of Agriculture Food Safety and Inspection Service (USDA-FSIS) collected additional salami products for testing and identified the outbreak strain. On February 16, the recall was expanded again to include approximately 115,000 pounds of salami products.

A multiagency investigation conducted by USDA-FSIS, the Food and Drug Administration (FDA), and the Rhode Island Department of Health (RIDOH) at company A revealed black and red pepper applied to salami products post-lethality was contaminated with *Salmonella*. Testing by RIDOH found the outbreak strain in 29% (five of 17) of black pepper samples and 9% (one of 11) of red pepper samples intended for use in production of company A salami products. FDA initiated investigations at pepper suppliers of company A: spice company B, spice company C, and spice company D. Samples of spice companies B and D pepper collected by FDA and RIDOH at company A tested positive for the outbreak strain. As a result, spice company B voluntarily recalled approximately 53,000 pounds of crushed red pepper on February 25, 2010, and spice company D voluntarily recalled two lots of black pepper totaling nearly 55,000 pounds on March 5, 2010. During March 1–30, a total of 12 additional recalls were issued by companies that received the initial pepper products associated with spice companies B and D.

Pepper tracebacks revealed that the pepper originated from three Asian countries. Based on traceback

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TABLE. Number and percentage of *Salmonella* Montevideo case-patients and controls reporting consumption of salami, any Italian style meat, or fresh ground pepper — United States, July 1, 2009–April 14, 2010

<table>
<thead>
<tr>
<th>Food item</th>
<th>Case-patients (n = 43) No (%)</th>
<th>Controls (n = 43) No (%)</th>
<th>mOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salami</td>
<td>22  55.0</td>
<td>6 15.4</td>
<td>8.0 (1.9–71.1)</td>
</tr>
<tr>
<td>Any Italian style meat*</td>
<td>25  58.1</td>
<td>9 21.9</td>
<td>4.5 (1.7–14.7)</td>
</tr>
<tr>
<td>Freshly ground black pepper</td>
<td>26  66.7</td>
<td>28 70.0</td>
<td>0.8 (0.3–2.1)</td>
</tr>
</tbody>
</table>

Abbreviations: mOR = matched odds ratio; CI = confidence interval.

* Includes salami, capocollo, calabrese, soppressata, and prosciutto.

§ If onset dates were not available, the date was estimated using the isolation date minus 3 days.


**The lethality step for salami production is the fermenting and drying stages of the process. Ready-to-eat products can become contaminated if raw materials or ingredients, such as pepper, are added after the lethality step.**
information, no *S.* Montevideo was isolated from samples collected earlier in the distribution chain than company A. The number of *S.* Montevideo cases with the outbreak strain identified by PulseNet returned to the baseline of sporadic cases by early 2010.

**Reported by**


**Editorial Note**

This nationwide outbreak of *Salmonella* Montevideo infections was associated with salami products containing contaminated imported black and red pepper. This outbreak highlights the importance of preventing product contamination between its production and its use and the potential for spices, such as pepper, to contaminate ready-to-eat products.

Several *Salmonella* outbreaks associated with salami and other fermented sausage products have been reported from Europe (2–6). However, these outbreaks were caused by insufficient curing time, low water activity, and high pH of the salami, allowing *Salmonella* to survive (2–6). In contrast, the outbreak described in this report was from contaminated pepper applied to salami after lethality steps. Although spices are sometimes known to harbor various fungi and bacteria, few reports have documented spices as being associated with human illness. Eight spice-associated *Salmonella* outbreaks occurred during 1973–2009, accounting for 1,656 human illnesses. In September 2008, an outbreak of *Salmonella* Rissen infections was associated with ground white pepper (J. Higa, CDC, personal communication, 2009). An increasing number of dried spice recalls have occurred over...
the past several years, with only two during the 1990s and 16 during 2000–2004 (7). Effective methods exist to treat spices, including steam, ethylene oxide treatments, and irradiation. However, companies are not required to treat spices, and manufacturers are not required to use treated spices in their products. These methods have increased importance given the frequent use of spices in ready-to-eat foods and the potential for contaminated spices to cause widespread outbreaks. FDA is working with spice trade organizations and with other agencies to develop recommendations on spice safety standards and to safeguard against contaminated spices entering commerce.

Membership cards helped provide important brand-specific information in this investigation. During hypothesis generation, it was learned that many patients reported shopping at different locations of a national warehouse chain. This prompted WADOH to collect data on items purchased by patients based on membership card records. Information gathered from these cards, with patient permission, helped determine the brand name and purchase dates of implicated products. Based on this information, USDA-FSIS traced back lots of ingredients, which helped FDA identify lots of black and red pepper used to produce the contaminated salami products. As this investigation demonstrates, membership and shopper cards can provide critical information to quickly identify potentially contaminated foods and should be considered for use in future foodborne disease outbreak investigations.

Acknowledgments

The findings in this report are based, in part, on contributions by Rhode Island Dept of Health, Washington State Dept of Health; state and local health departments in Alaska, Alabama, Arizona, California, Colorado, Connecticut, District of Columbia, Delaware, Florida, Georgia, Iowa, Idaho, Illinois, Indiana, Kansas, Louisiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Missouri, Mississippi, North Carolina, North Dakota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin, West Virginia, and Wyoming; Food Safety and Inspection Svc, US Dept of Agriculture; Food and Drug Admin; and Div of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC.

References