

Research Note

Multistate Outbreak of Multidrug-Resistant *Salmonella* Newport Infections Associated with Ground Beef, October to December 2007

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ABSTRACT

In late October 2007, an outbreak of multidrug-resistant *Salmonella* Newport infections affected 42 case patients in California, Arizona, Idaho, and Nevada. A case-control study implicated ground beef from one chain store. Despite detailed ground beef purchase histories—including shopper card information for several case patients—traceback efforts by both the U.S. Department of Agriculture, Food Safety and Inspection Service and the California Department of Public Health were unable to identify the source of contamination. Case patients consumed multiple types of ground beef products purchased at numerous chain store A retail locations. These stores had received beef products for grinding from multiple beef slaughter-processing establishments. Detailed retail grinding logs and grinding policies that prevent cross-contamination between batches of ground beef products are crucial in the identification of contaminated beef products associated with foodborne illness.

In late October 2007, the California Department of Public Health (CDPH) noted an increase in *Salmonella* Newport isolates resistant to chloramphenicol, a marker for multidrug resistance. Historically in California, clusters of multidrug-resistant (MDR) *Salmonella* infections have predominantly occurred among the Hispanic population and have often been associated with consumption of raw milk and/or raw milk products (2). Previous outbreaks of MDR *Salmonella* Newport in the United States have been associated with consumption of ground beef (11). Among the six initial cases of this outbreak, all were non-Hispanic, and the isolates shared an extremely rare pulsed-field gel electrophoresis (PFGE) pattern; this PFGE pattern accounted for only 0.2% of all *Salmonella* Newport isolates posted to the national PulseNet database at that time. In all, 42 MDR *Salmonella* Newport isolates with indistinguishable PFGE patterns by two enzymes were identified in California, Arizona, Nevada, and Idaho, from October to December 2007. A case-control study was conducted by the CDPH, the Arizona Department of Health Services, the California Emerging Infections Program, and the Centers for Disease Control and Prevention. This report summarizes the results of the epidemiologic investigation that linked these

MDR *Salmonella* Newport infections to consumption of contaminated ground beef purchased from several grocery stores of the same chain (chain store A).

MATERIALS AND METHODS

Epidemiologic investigation. A case was defined as a culture-confirmed MDR *Salmonella* Newport infection in a U.S. resident, with symptom onset on or after 1 October 2007 and an isolate matching the outbreak PFGE patterns (*Xba*I JJPX01.0422–*Bln*I JJPA26.0196). The CDPH Microbial Diseases Laboratory conducted a national PulseNet search to identify isolates with the outbreak patterns.

Hypothesis-generating questionnaires were administered by phone to case patients in California and Arizona during the first 2 weeks of November. Foods consumed by more than 50% of the case patients were included on the case-control study questionnaire. Case-control study interviews were conducted during the last week of November and the first week of December. Controls were defined as persons without self-reported diarrhea in the 2 weeks prior to interview and were matched to cases by age (younger than 18 years, 18 to 64 years, and 65 years and older) and neighborhood, using reverse address lookup, with the case patient's address as the anchor. Case patients provided information about foods consumed during the 7 days prior to the onset of illness. Controls provided information about foods consumed during the month of October to match exposure period to that of the case patients. Case patients and controls were asked about

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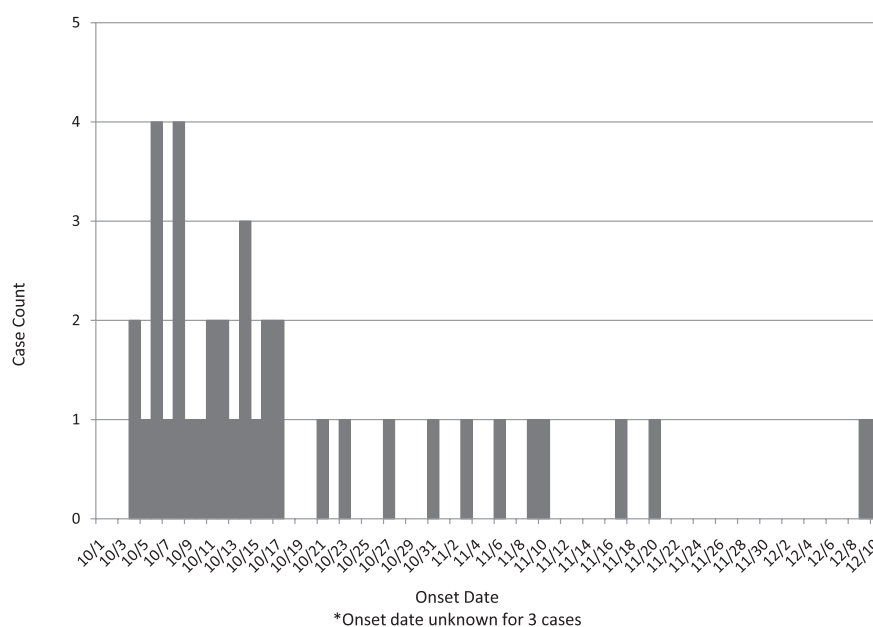


FIGURE 1. Symptom onset date of MDR *Salmonella* Newport outbreak cases, October to December 2007, United States (n = 39).*

consumption of ground beef, chicken, tomatoes, milk, cheese, eggs, bananas, and raw onions. Case patients were asked to provide grocery store shopper card information if available. Odds ratios and 95% confidence intervals were calculated with SAS 9.1 software (SAS Institute, Cary, NC). A two-tailed P value <0.05 was considered statistically significant.

Environmental investigation. Product isolates collected during the U.S. Department of Agriculture, Food Safety and Inspection Service (FSIS) Pathogen Reduction–Hazard Analysis and Critical Control Point *Salmonella* Verification Testing Program are subject to PFGE and antimicrobial resistance testing at the U.S. Department of Agriculture, Agricultural Research Service (6). Each *Salmonella* isolate is cut by a primary enzyme (*Xba*I) and, on request, by a secondary enzyme (*Bln*I). The PFGE patterns are uploaded to the VetNet database maintained by the Agricultural Research Service. A VetNet pattern search was conducted by the FSIS to match the unique PFGE *Xba*I pattern of the outbreak strain to isolates collected from meat and poultry establishments during FSIS *Salmonella* testing.

Grocery shopper card purchase information was sought from case patients. Using shopper card information, the FSIS and the CDPH conducted traceback investigations of case patients' ground beef purchases at multiple retail locations. Investigators met with store meat managers to review in-store grinding procedures and policies. Investigators reviewed grinding logs, and invoices for the day's ground beef purchased by case patients had been fabricated to identify specific beef suppliers of interest. Investigators conducted traceforward investigations at FSIS-regulated establishments where ground beef–positive *Salmonella* Newport isolates that exhibited the outbreak PFGE *Xba*I pattern were recovered in 2007.

RESULTS

Epidemiologic investigation. The CDPH Microbial Diseases Laboratory noted an increase in chloramphenicol-resistant *Salmonella* Newport isolates in late October 2007. A PulseNet search conducted on 31 October 2007 identified 10 isolates with the same pattern in the United States during

the previous 60 days. In all, 42 isolates with a two-enzyme (*Xba*I and *Bln*I) PFGE match were identified between October 2007 and January 2008. Isolates from three California case patients were confirmed by the National Antimicrobial Resistance Monitoring System and met the System's definition of MDR (1).

The 42 case patients were from California (22), Arizona (16), Nevada (3), and Idaho (1). Onset dates ranged from 4 October to 10 December 2007 (Fig. 1). The median age of case patients was 41 years (range, <1 to 94 years); 56% of the case patients were female. The majority (82%) of patients was non-Hispanic white. Twenty-five (74%) of 34 patients had bloody diarrhea. Seventeen (46%) of 37 patients were hospitalized; there were no deaths.

Fifteen case patients in California and Arizona completed the hypothesis-generating questionnaire. Twenty-one case patients and 36 controls were enrolled from the four states in the case-control study. In univariate analysis, no single food item was significantly associated with illness. There was a borderline-significant association with purchasing ground beef from chain store A (42% [8 of 19] of cases versus 18% [6 of 33] of controls, P value of 0.06) (Table 1). Case patients were more likely to have shopped for groceries at chain store A in the week prior to the onset of illness, as compared with controls during the month of October (81% of cases compared with 67% of controls, P value of 0.25), although the association was not statistically significant. Among case patients and controls who had shopped at chain store A, no single food item was associated with illness. However, among persons who consumed ground beef at home during the week prior to the onset of illness or in the month of October for controls, 80% of the case patients purchased their ground beef from chain store A compared with 26% of controls (odds ratio = 11.3, 95% confidence interval = 1.9 to 69.1, P value = 0.005). The investigation did not identify a link between any of the illnesses and ground beef purchased at other store chains. At

TABLE 1. Food consumption and exposure history for cases and controls

Exposure	No. (%) of cases	No. (%) of controls	Odds ratio	95% confidence interval	P value
Ground beef at home	12 (57)	28 (78)	0.38	0.1–1.2	0.1
Ground beef in restaurant	6 (40)	19 (56)	0.53	0.2–1.8	0.3
Ever cook ground beef	15 (79)	29 (81)	0.9	0.2–3.6	0.9
Chicken at home	12 (71)	31 (86)	0.39	0.1–1.6	0.18
Chicken at restaurant	12 (63)	22 (63)	10	0.3–3.2	1
Raw onion	7 (37)	22 (61)	0.37	0.1–1.2	0.09
Grocery shop at chain store A	17 (81)	24 (67)	2.1	0.6–7.7	0.25
Ground beef from chain store A	8 (42)	6 (18)	3.3	0.9–12	0.06

the time of the case-control study, none of the patients contacted for this investigation had leftover ground beef available for testing.

Traceback and traceforward investigations. FSIS investigators followed up on shopper card information collected from 11 case patients and visited nine Arizona, two California, and one Nevada chain store A locations. Based on the shopper card information, case patients had purchased multiple and various types (percent lean) of ground beef products prior to illness onset, but had not purchased ground beef patties. Seven establishments were identified that directly supplied beef products to chain store A locations in California, Arizona, and Nevada (Fig. 2). Four of the establishments (I, J, K, and L) provided primal cuts of beef to stores in all three states. Bench trim from the primal cuts was ground into 80% (80/20) lean ground beef at individual chain store A locations. Three establishments (B, C, and E) supplied ground beef products to chain store A locations. Establishment B, a grinding plant, supplied coarse ground beef for regrinding to stores in California, Arizona, and Nevada. Establishment C, a slaughter–processing establishment, supplied coarse ground beef to chain store A locations in Arizona for regrinding. Establishment E, a grinding plant, supplied preformed ground beef patties to

chain store A locations in Arizona. Establishment A, a slaughter–processing plant, and establishment D, a processing plant, supplied both establishments B and E with boneless beef products for grinding. Establishment B also received boneless beef products from foreign establishment G (Fig. 2).

Chain store A locations did not regularly clean the grinder between batches of various blends of ground beef; it is likely that individual ground beef products were commingled with the subsequent batch of ground beef products. Additionally, the chain store locations did not record the sources of the bench trim on daily grinding logs, and information on the source of coarse ground beef was recorded incompletely or inaccurately at some stores. This made it difficult for the investigators to collect establishment and lot numbers for specific ground beef products purchased by case patients.

In September 2007 one *Salmonella* Newport ground beef isolate, indistinguishable (by *Xba*I) from the outbreak strain, was recovered during FSIS sampling at establishment E. Establishment E supplied ground beef patties to store chain A locations in Arizona and, as previously stated, no case patients reported consuming that type of ground beef. Establishment F, a small processing plant, was the source of a second 2007 FSIS ground beef isolate indistinguishable by two enzymes (*Xba*I and *Bln*I) from the outbreak strain.

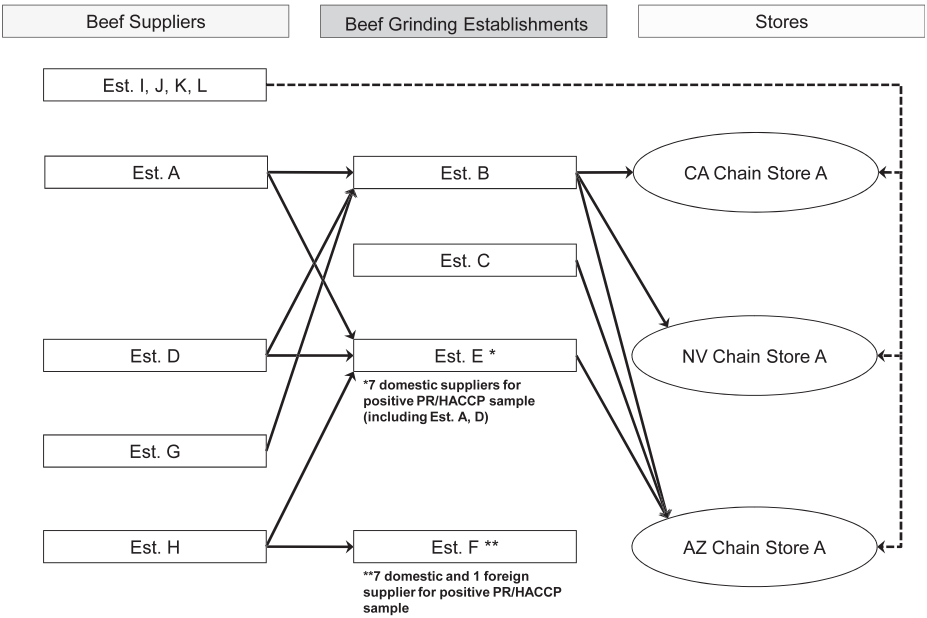


FIGURE 2. Beef product suppliers for chain store A supermarkets.

Time of Grind	Lot/ Batch Number (lot = same source material)	Type of Product Produced (e.g. 80/20, 93% lean)	Package size	Amount (in lbs.) of Product Produced	Production Code of Product Produced	Manufacturer Name -- Source Material Used for Product Produced	Product Code and/or Pack Date of Source Material	Establishment Number for Source Product	Comments	Initials
0700-0830 AM	Lot 001	91/9 Gold Standard Ground Chuck	Catch-weight retail trays	1,250 lbs total of 91/9 Ground Chuck	033109-01 GSGC; Sell-by 04/02/09	Boneless Chuck, twenty-one 60 lb boxes from USA Beef Company	BC031509 USA Packed on 03/15/09; BC031709 USA Packed on 03/17/09	Est. 00321 M	Cleaned and sanitized grinder after Lot 001; excess source material (approx. 10 lbs) made into RTE chili; switched source materials	John Doe ID # 222

FIGURE 3. Ground beef production records at retail: information needed in grinding logs for traceback purposes.

Establishment F could neither be linked to store chain A nor to establishments A, D, I, J, K, or L. Both establishments E and F did have a common foreign supplier of boneless beef, establishment H.

The FSIS issued a public health alert (7) on 20 December 2007, after an exhaustive FSIS investigation could not identify specific production lots that would be subject to a recall. The public health alert advised consumers not to consume ground beef that was ground and sold by chain store A locations between 19 September and 5 November 2007. The original alert was expanded on 15 February 2008 to include ground beef sold between 19 September and 25 November 2007, based on an additional case patient with illness onset of 10 December 2007, who reported a ground beef purchase at store chain A on 23 November 2007.

On 30 January 2008, a public health laboratory isolated *Salmonella* Newport from leftover frozen ground beef retrieved from a California case patient’s freezer. The patient bought the ground beef from a chain store A location on 4 October 2007. On 8 February 2008, the CDPH confirmed that the isolate was MDR *Salmonella* Newport and matched the outbreak strain, with two enzymes by PFGE. The subsequent recovery of the outbreak strain from frozen ground beef confirmed the epidemiologic implication of ground beef from chain store A. Subsequent traceback activities by the FSIS confirmed that this product had been the first product ground at the chain store A location on 4 October 2007, and that establishment B was the sole source of that ground beef product.

DISCUSSION

Ground beef has been identified previously as the source for MDR *Salmonella* Newport and *Salmonella* Typhimurium infections (4, 10). It is important to identify strategies to control MDR *Salmonella* from farm through processing. The judicious use of antibiotics in animal agriculture is important to decrease the emergence of resistant pathogens.

An outbreak of MDR *Salmonella* Newport occurred among residents of California, Arizona, Nevada, and Idaho in late 2007. The epidemiologic and laboratory evidence supported that this outbreak was due to consumption of ground beef purchased at chain store A. Because of chain store

A’s beef grinding policies, it is likely that individual ground beef products were routinely commingled with the next batch of ground beef, although incomplete grinding logs at some store locations hindered conclusive findings on this point.

Patients infected with MDR *Salmonella* have a greater risk of hospitalization and death compared with patients infected with drug-susceptible *Salmonella* (5, 9). During this 2007 outbreak, almost half (46%) of all patients were hospitalized. State and national level surveillance systems for MDR *Salmonella* Newport need to be maintained to enhance detection of outbreaks. Once an outbreak is detected, epidemiologic studies and prompt collection of product (food) samples from case patients are the key to the identification of the source of the infections. Initiation of traceback activities early in an investigation enhances the identification of the source of the outbreak. Supermarket loyalty cards have proved an invaluable resource, providing detailed case patient purchase information. This information, combined with detailed and accurate retail recordkeeping, is crucial to the successful determination of the source of the contamination and the removal of potentially contaminated products from commerce (8). Changes to retail supermarkets’ ground beef policies and recordkeeping could aid investigations. When grinding beef in-store, retail supermarkets should consider separating batches of beef from different sources to prevent commingled product, which may result in the spread of contamination by pathogens, such as MDR *Salmonella* Newport or *E. coli* O157:H7. Retailers should maintain detailed records of grinding activities and logs (Fig. 3) that include documenting cleanup between grinds. Detailed grinding logs are essential for the successful traceback of contaminated beef when implicated in outbreaks and to allow focused, detailed, and prompt recalls to prevent additional infections (3).

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