CONCISE COMMUNICATION

An Outbreak of Campylobacter jejuni Infections Associated with Food Handler Contamination: The Use of Pulsed-Field Gel Electrophoresis

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In 1998, an outbreak of Campylobacter jejuni infections occurred in Kansas among persons attending a school luncheon; community cases were also reported. In a cohort study of luncheon attendees, 27 (17%) of 161 persons reported illness. Consuming gravy (relative risk [RR], 4.2; 95% confidence interval [CI], 1.5–11.7) or pineapple (RR, 2.4; 95% CI, 1.0–5.7) was associated with illness. Both foods were prepared in a kitchen that served 6 other schools where no illness was reported. A cafeteria worker at the luncheon had a diarrheal illness and was the likely source of the outbreak. The pulsed-field gel electrophoresis (PFGE) patterns of the isolates from the food handler and those of 8 lunch attendees were indistinguishable. Isolates from 4 community patients differed. This was the first use of PFGE in a Campylobacter outbreak in the United States; its use was critical in determining that community cases were not linked.

Campylobacter organisms are the most common cause of bacterial foodborne illness. In the United States they cause ~2.5 million illnesses and 124 deaths each year; ~80% of these illnesses are thought to be foodborne [1]. Although most Campylobacter infections are sporadic, most epidemiologic knowledge is derived from outbreak investigations. Outbreaks of Campylobacter illness are rare in the United States; from 1988 to 1997, an average of 5 Campylobacter outbreaks (127 illnesses) were reported each year to the Centers for Disease Control and Prevention (CDC) [2, 3]. Most outbreaks have been associated with consumption of unpasteurized milk, unchlorinated water, or poultry [4–8]. Secondary transmission from 1 infected person to another appears to be uncommon, and outbreaks associated with food handler contamination are extremely rare.

Campylobacter isolates are not routinely subtyped. Although many methods are available for subtyping [9], there is no single method that is standardized and rapid and provides high discrimination, typeability, and simple data interpretation. Macrorestriction analysis by pulsed-field gel electrophoresis (PFGE), which examines polymorphisms throughout the bacterial genome, is a highly discriminatory and useful tool for molecular epidemiologic studies of Campylobacter species [9]. Here we describe an outbreak investigation of Campylobacter jejuni infections in which PFGE was used to help identify the source. To our knowledge, this is the first time that PFGE was used in a Campylobacter outbreak in the United States.

Background

During September 1998, the Kansas Department of Health and Environment (KDHE) was notified of an outbreak of C. jejuni infections in Salina. Initial interviews identified several persons with culture-confirmed C. jejuni infection who had eaten at a “Grandparents’ Day” luncheon at an elementary school, “school X.” Grandparents could attend this luncheon on either 14 or 15 September. Illness was reported among students, staff members, and grandparents who attended the luncheon. C. jejuni infections were also reported among community members not related to school X. No other common event, gathering, or restaurant, except for the Grandparents’ Day luncheon at school X, was identified. An epidemiologic
investigation was conducted in October 1998, to identify the source of the outbreak and to determine whether school X–associated and community cases were related.

**Methods**

**Case finding.** To identify possible outbreak cases, we contacted local hospitals, clinics, laboratories, schools, elder care facilities, the jail, and nearby county health departments. All reported patients with diarrhea were contacted by telephone and were asked a standard set of clinical questions. A clinical case was defined as diarrhea (≥3 loose stools in 24 h) in a resident of Saline County that occurred after 1 August 1998. A confirmed case was defined as a clinical case from whom a stool sample yielded *C. jejuni.*

**Cohort study.** We conducted a telephone cohort study during 9–11 October of persons who attended the luncheon at school X on 14 or 15 September and administered a standardized questionnaire, to obtain information about gastrointestinal illness and food eaten at the lunch. Students in grades lower than 4 were excluded because of concern about their recall. Students and staff members who could not be reached by telephone were interviewed at school. A case was defined as diarrhea (≥3 loose stools within 24 h) with onset after 14 September 1998.

**Traceback.** We investigated the source of food items eaten on 14 September at school X, to determine if there were any common food sources between school X and the community. We compared food production records at the kitchens with school menus, to determine deviations in food production that might be school specific.

**Laboratory analysis.** At the KDHE laboratory, stools were cultured onto *Campylobacter* 5% sheep blood agar with Blaser antibiotic supplement (Difco) containing 10 µg/mL vancomycin, 2.5 µM polymyxin B, 5 µg/mL trimethoprim, 15 µg/mL cephalothin, and 2 µg/mL amphotericin B. Plates were incubated at 42°C in a 2-L jar, with a microaerophilic atmosphere of 8%–10% CO₂ and 5%–7% oxygen produced by an Anerocult C sachet (EM Science), for 48 h. Colonies with typical *Campylobacter* morphology were tested for oxidase reaction, Gram’s stain appearance, and hippurate utilization. When available, isolates cultured at other laboratories were forwarded to the KDHE for confirmation. Isolates were sent to the KDHE and CDC for subtyping. DNA preparation, macrorestriction using *Sma*I, and PFGE were done as reported elsewhere [10].

**Statistical analysis.** We computed relative risks (RRs) and 95% confidence intervals (CIs), using Epi Info version 6.04 (CDC, July 1996).

**Results**

We identified 129 persons who met the case definition; 33 had stool samples obtained. Twenty-seven samples yielded *C. jejuni,* the other 6 yielded no pathogens. Dates of diarrheal onset ranged from 24 August to 14 October 1998. Twelve (44%) of the 27 culture-confirmed patients reported some association with school X. Table 1 shows demographic and clinical characteristics.

**Cohort study.** We interviewed 245 persons (144 students, 54 staff members, and 47 grandparents) who ate lunch at school X on 14 or 15 September. Ten (29%) of the 34 grandparents who ate at the school on 14 September became ill, compared with none of the 13 grandparents who ate on 15 September (*P* = .04). Therefore, we limited additional analyses to persons who ate the school lunch on 14 September. Of the 161 persons who reported eating the school lunch on 14 September, 27 (17%) met the case definition. Two food items were significantly associated with illness: gravy (attack rate, 22/87 [25%]; RR, 4.2; 95% CI, 1.5–11.7) and pineapples (attack rate, 19/88 [22%]; RR, 2.4; 95% CI, 1.0–5.7). Mashed potatoes were also associated with illness, but the results did not reach statistical significance (attack rate, 24/117 [21%]; RR, 4.4; 95% CI, 0.9–14.9). No other food or drink exposure was associated with illness. The canned pineapple was opened at school X and placed on the salad bar by cafeteria workers. The instant gravy and mashed potato mixes were prepared in the school district kitchen that supplied school X and 6 other schools, where no illness was reported.

Three staff members and 6 students had illness onset between 10 and 14 September before eating the implicated lunch. One staff member, a food handler, was at school on 14 September and reported having severe abdominal cramps and profuse diarrhea and making numerous trips to the bathroom while serving lunch that day. The diarrhea was so severe that the person wore a protective pad to absorb any stool incontinence. Although kitchen duties are shared, the primary responsibilities of this person were filling condiment containers (e.g., dressing, pineapple) between lunch periods, assisting children when needed (e.g., opening utensils or food wrapped in plastic), and cleaning tables.

**Traceback.** Food is supplied directly from distributors to the 4 kitchens in the district. Meals are prepared in the kitchens and distributed to 20 schools daily. A traceback of food items served on 14 September identified no single shipment that went only to the kitchen that supplied school X or to school X itself. No differences were observed in the product received by the 4

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<tr>
<th>Table 1. Demographic and clinical characteristics of patients with confirmed and clinical Campylobacter jejuni infection, Salina, Kansas, 1998.</th>
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<tbody>
<tr>
<td>Characteristic</td>
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<tr>
<td>Median age, years (range)</td>
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<tr>
<td>Female</td>
</tr>
<tr>
<td>Diarrhea</td>
</tr>
<tr>
<td>Bloody diarrhea</td>
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<td>Vomiting</td>
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<td>Fever, any</td>
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<td>Consulted health care provider</td>
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<tr>
<td>Took antibiotics</td>
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<td>Hospital or emergency room visit</td>
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**NOTE.** Data are no. (%) of patients, except where noted.
kitchens in the preceding week. The instant gravy mix, canned pineapple, and instant mashed potato mix were nationally distributed, and no other C. jejuni outbreaks were reported to the CDC during this period. C. jejuni would not likely survive manufacturing and preparation procedures for these products.

Laboratory findings. The number of stool samples sent from Saline County to the state laboratory increased from 19 in September 1997 to 63 in September 1998. Similarly, the number that grew C. jejuni increased from 0 in September 1997 to 9 in September 1998. In contrast, there was no increase in either the number of stool samples sent to the state laboratory or the number that grew C. jejuni from 8 counties surrounding Saline County. Twenty-two C. jejuni isolates from Kansas were tested by PFGE (figure 1): 14 from Saline County and 9 from other counties. All 9 isolates from persons associated with school X were indistinguishable by PFGE. The other 5 isolates from Saline County produced banding patterns that differed from those of the school X isolates, and all but 2 were different from each other. The remaining 8 isolates were from patients from other counties; these isolates had PFGE patterns that differed from the pattern associated with school X and the patterns associated with Saline County community cases.

Discussion

Although campylobacteriosis is the most common cause of foodborne illness in the United States [1], outbreaks are relatively rare [2, 3], and those caused by ill food handlers are even rarer. Campylobacter organisms have a relatively low infectious dose. However, they do not survive well or multiply on foods that are exposed to oxygen, and thus are not likely to be transmitted from an ill food handler [11]. To our knowledge, this is only the second published report of an ill food handler identified as the likely source of a Campylobacter outbreak [12]. The other food handler–associated outbreak occurred in an Israeli military base in 1982. The investigation identified a temporary dishwasher who reported having acute gastrointestinal symptoms while working during a meal. Strains isolated from the ill food handler and the ill soldiers were characterized by somatic O serotyping and were found to be C. jejuni O:11. Although serotyping is a fairly simple technique and could be used to effectively differentiate strains, it is not widely used in clinical and microbiology laboratories; antisera production is very time and labor intensive [9].

Although PFGE has been used during investigations of C. jejuni outbreaks in Europe and Asia [10, 13, 14], this is the first reported outbreak of Campylobacter infections in the United States in which PFGE was used. Although 1 common event, the luncheon, was associated with illness, this event explained less than half the laboratory-confirmed infections in the county. Investigators, assuming that most of the infections were linked, continued to look for a source that could explain a larger proportion of the cases. Molecular subtyping of the isolates proved critical; the PFGE results confirmed that all school X–associated cases were related but that the community cases differed from the school strain and from each other and thus likely were sporadic infections.

Recently, the CDC, the US Food and Drug Administration, and state health department laboratories established a national molecular subtyping network, PulseNet, which permits rapid

Figure 1. Smal-digested Campylobacter jejuni isolates tested by pulsed-field gel electrophoresis. Lanes 1, 8, and 15, λ phage DNA markers; lanes 2-4, 6, 7, and 10-14, selected isolates from persons associated with school X (lane 14, ill food handler); lanes 5 and 9, selected isolates from patients in the community.
comparison of PFGE patterns through an electronic database [15]. The addition of Campylobacter species to the PulseNet system would enable rapid detection and investigation of outbreaks and facilitate prevention strategies. Since there are relatively few Campylobacter outbreaks each year [2, 3], the additional work would be minimal.

The number of community cases is above the number that would be expected in Salina. Cases were identified through routine passive surveillance combined with active monitoring. Thus, the numbers likely reflect a real increase and not an increase due to heightened awareness and increased case finding. The cause of the increase is unknown.

This cohort study identified 9 persons at school X who reported illness before the luncheon. Although no cultures were done for 6 persons, 3 had stool samples that yielded C. jejuni with the outbreak PFGE pattern. It remains unclear how these persons became ill; extensive interviews with these 3 patients identified no common event, gathering, or restaurant. However, all 3 were staff members at the school, and it is likely that they had some common exposure, followed by one of them, the food handler, becoming the source of the subsequent outbreak.

Kansas State regulations require that food handlers with diarrhea be excluded from work; however, these regulations were not followed. Despite years of efforts to educate food handlers about the risks of pathogen transmission, ill food handlers continue to play a role in foodborne disease outbreaks. Additional strategies, such as paid sick leave, are needed to discourage exclusion due to diarrhea illness. Although Campylobacter outbreaks resulting from food handler contamination are rare, they do occur. In this investigation, PFGE was critical in helping identify the source of the outbreak. PFGE is a useful tool for epidemiologic studies and, when used regularly, can potentially quicken response capabilities; its use should help elucidate the cause of future Campylobacter outbreaks.

Acknowledgments

We thank the staff of the Salina-Saline County Health Department, including William G. Null, Paul Richardson, Margaret Knoll, Jolene Funk, Diane Cline, and Del Meier, and Mabel Ann Nicholson for laboratory assistance.

References