An Outbreak of Food-Borne Illness Associated With Methomyl-Contaminated Salt

ON DECEMBER 21, 1998, THE Fresno County Health Department in California was notified of 8 persons who developed nausea, vomiting, and dizziness within 2 hours of eating at a local Thai restaurant. Although several persons were treated at emergency departments, no one was hospitalized, and all persons recovered in less than 1 day. The Fresno County Health Department inspected the restaurant and obtained several food samples for laboratory studies. Low levels of Bacillus cereus were found in one sample of cooked duck. A stool sample collected from one patient was negative for Campylobacter, Shigella, and Salmonella.

Twelve days later (January 2, 1999), 11 persons reported illness after eating at the same restaurant. The intervals to onset, symptoms, and duration were similar to those of the illnesses reported the previous week. The restaurant closed voluntarily. The Fresno County Health Department interviewed ill patrons, inspected the restaurant again, and obtained additional food samples. Initial case findings in emergency departments of Fresno County hospitals identified 3 additional patients with similar symptoms or cause may seem.

On January 5, 1999, the California Department of Health Services was notified of the repeated occurrence (December 21, 1998, and January 2, 1999) of gastrointestinal tract illness among patrons at a Thai restaurant in central California.

Objective To identify the source of the outbreak.

Design Case-control study; microbiological and toxicological laboratory testing of samples of food, stool, and vomitus.

Setting Thai food restaurant in central California.

Participants Patrons of the restaurant. A case (n = 107) was defined as dizziness, nausea, or vomiting occurring in a person who ate at the restaurant between December 20, 1998, and January 2, 1999, with onset of symptoms within 2 hours of eating. A control (n = 169) was a person who ate at the restaurant during the same period but reported no symptoms.

Main Outcome Measures Odds ratios (ORs) of illness associated with food exposures; ORs of shifts during which illness occurred associated with certain cooks; laboratory results.

Results The median latency period was 40 minutes from beginning eating to first symptom and was 2 hours to onset of diarrhea. The median duration of symptoms was 6 hours. Twenty-six persons (24%) visited the emergency department or were treated by a physician; no person required hospitalization. Patients reported nausea (95%), dizziness (72%), abdominal cramps (58%), headache (52%), vomiting (51%), chills (48%), and diarrhea (46%). Fifty-one cases (48%) included dizziness, lightheadedness, or a feeling of disequilibrium as the initial symptom. Illness was statistically associated with several foods and ingredients, but no single dish or ingredient explained a substantial number of cases. The analysis of food exposures included salt added by cooks, as estimated by using the amount of salt in the recipe for each dish and the amount of each dish eaten by respondents. This association was stronger with increasing levels of salt: ORs for illness among persons who consumed more than 0.42 to 0.84, more than 0.84 to 1.25, and more than 1.25 tsp of salt added to foods in the kitchen were 1.9 (95% confidence interval [CI], 0.6-5.7), 3.0 (95% CI, 1.0-8.8), and 4.0 (95% CI, 1.3-13.5) compared with persons who consumed less than 0.42 tsp (P value for trend = .004). Methomyl, a highly toxic carbamate pesticide, was identified in a sample of vomitus (20 ppm) and in salt taken from containers in the storeroom (mean, 5600 ppm) and the stovetop (mean, 1425 ppm). The oral toxic dose causing illness in 50% of those exposed to methomyl was estimated to be 0.15 mg/kg of body weight (estimated range, 0.09-0.31 mg/kg of body weight). The presence of cook A was associated with shifts during which cases of illness occurred (OR, 10.4; 95% CI, 1.2-157.4).

Conclusion This outbreak of gastrointestinal illness was associated with the consumption of food seasoned with methomyl-contaminated salt. To allow rapid assessment for further investigational and control measures by health officials, physicians should report suspected outbreaks of illness to public health departments, however trivial the symptoms or cause may seem.

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symptoms and exposure history. On January 5, 1999, the California Department of Health Services was asked to assist with the investigation.

**METHODS**

We conducted a case-control study of customers. For persons who ate at the restaurant between December 20, 1998, and January 2, 1999, a case of restaurant-associated illness was defined as dizziness, nausea, or vomiting, with onset of symptoms within 2 hours of eating. Controls were persons who ate at the restaurant on the same days that cases of illness were reported but who did not report illness themselves. By telephone, we administered a questionnaire to cases and controls regarding demographic information, food and beverages consumed, quantity consumed, and clinical symptoms following the meal. We requested from the main chef the quantity of common ingredients, including salt, typically added to each dish. The main chef ensured quality and uniformity of food preparation by training new cooks personally for an extended period and habitually supervising the preparation of all dishes served to customers.

We calculated the amount of salt consumed per person for the dishes prepared at the restaurant by multiplying the amount of salt estimated to have been added by the main chef in each dish by the proportion of the dish that was consumed, as reported by study subjects. We then added the salt quantities for all dishes eaten by each person. For trend analysis, we created 4 categories of equal intervals (≤0.42, >0.42 to 0.84, >0.84 to 1.25, and >1.25 tsp of salt). Odds ratios (ORs) for illness among persons with different levels of salt exposure were compared by using the Mantel-Haenszel $\chi^2$ test and $P$ value for trend. For the association of dichotomous exposures and illness, we calculated ORs and their 95% confidence intervals (CIs). For the difference between the means in 2 groups, we used the $t$ test.

After the restaurant reopened, we counted the number of customers for 3 days and added their total charges to arrive at an average estimate of money spent per customer, which was $11.62. We knew the gross income for the restaurant for all days between December 20, 1998, and January 2, 1999. For example, on January 2, 1999, the total was $1239.36. The number of customers was thus estimated as the ratio of those gross incomes divided by $11.62. For January 2, 1999, this estimate was 107 ($1239.36/$11.62). Because of the intense media publicity and short latency period, we assumed that there were no cases that we did not identify. Attack rates for all days were calculated as the number of known cases divided by the estimated total number of customers.

**Restaurant Investigation**

The restaurant was open for lunch and dinner on all days between December 20, 1998, and January 2, 1999, except December 25, 1998, and January 1, 1999. Restaurant staff were assigned to work lunch, dinner, or both shifts. It was unknown which cook prepared dishes for particular customers. However, to investigate the potential association between particular employees and illness, an exposure was defined as the presence or absence of an individual cook during a shift and an outcome regarding whether a case occurred during that shift.

The owners of the restaurant were interviewed extensively about cooking practices, ingredients of menu items, and employees. Because reported symptoms were similar on December 21, 1998, and January 2, 1999, we considered the possibility of an intentional outbreak. We therefore interviewed all employees about not only food preparation but also possible conflicts among employees or with the restaurant owners. We visited the restaurant and observed the preparation of dishes. We collected information on pest-control measures and obtained and cataloged 80 food samples from the restaurant.

Agricultural-grade methomyl is a white crystalline solid with a slight sulfurous odor. It is packaged in 8-ounce, red-and-white, foil-lined bags and manufactured by a single company in the United States. This highly toxic agricultural pesticide is designated a class 1 chemical by the Environmental Protection Agency and was identified in a sample of vomitus. Methomyl is classified as a restricted-use pesticide because of its high toxicity to humans. Because it can be legally purchased and used in Fresno only by users registered with the office of the Fresno County Agricultural Commissioner, we asked the commissioner’s office to compare the names and addresses of restaurant staff with their list of registered users.

**Laboratory Investigations**

The Public Health Laboratory at the Fresno County Health Department, the West Coast Analytical Service, the California Veterinary Diagnostics Laboratory of the University of California, Davis, and the California Department of Food and Agriculture Laboratory tested food and water samples and a specimen of vomitus for one or more of the following: bacterial pathogens, including *Bacillus cereus* and *Staphylococcus aureus*; emetine (ipecac); metals, minerals, and anions; boron; nitrate and nitrite; organic molecules; detergent; mycotoxins (trichothecenes: DON, T2, and DAS); glutamate and γ-aminobutyric acid; biogenic amines (cadaverine and putrescine); and organophosphates and carbamates, including methomyl. A sample of salt was specifically analyzed for methomyl from the bulk container in the storeroom and the stovetop container by using liquid chromatography/mass spectrometry. In addition, crystals from the storeroom salt were separated by using carbon tetrachloride and floating crystals analyzed via high-performance liquid chromatography.

To estimate the toxic dose of methomyl associated with illness in 50% of those exposed (TD$_{50}$), we used data from January 2, 1999, the last day before the restaurant was closed and the day samples of salt were obtained. First,
we determined the concentration of methomyl in the stovetop sample of salt (a small container from which cooks added salt directly to the food) that reflected concentrations placed into dishes on January 2. Second, using the total number of diners on January 2, 1999 (n=107), we modeled the TD50 through logistic regression. Third, we divided the obtained value of the TD50 by the average of the estimated body weight of customers to obtain an estimate of the TD50 per kilogram of body weight. Fourth, to indicate the variance in our estimate, we conducted a sensitivity analysis.

The proportion of each dish that was eaten was reported by 58 persons who dined on January 2, 1999. The number of teaspoons of salt added routinely by chefs to each dish was multiplied by the number of grams of salt per teaspoon (5 g/tsp). Laboratory tests determined the methomyl concentration in the stovetop salt sample. Because dishes were cooked an average of 2 to 3 minutes, we tested the degradation of methomyl in boiling water for 3 minutes; 80% of methomyl remained. We therefore calculated the total amount of methomyl ingested by each person by multiplying 80% of the concentration of methomyl per gram of salt by the amount of salt that was added in the kitchen and consumed by each person.

We identified 40 persons from the case group and 38 controls who had eaten at the restaurant on January 2, 1999. The actual number of patrons who were not ill was assumed to be 67. The number of cases was 45 persons. We calculated the weight-adjusted TD50 by dividing the estimated TD50 by the average estimated weight of the customers on January 2, 1999.

We conducted sensitivity analyses regarding the calculated TD50 by varying several factors: weight of customers between the median (57.1 kg) and the mean (60.0 kg); proportion of methomyl that remained after cooking (between 50% and 100%); and relationship of the number of cases to the number of controls (between 1:1 and 1:1.76).

We examined restaurant invoices and obtained shipment and distribution information from the salt distributor. We also asked the salt producer for information on salt production and quality-control procedures.

RESULTS
The restaurant employed 12 cooks, 10 wait staff, and 2 dishwashers who sometimes helped with preparing vegetables. Generally, all employees ate food from the restaurant at the end of their shifts. The dishes were prepared differently for cooks and wait staff. Usually, 2 dishes were prepared in a large quantity for each group; however, the cooks’ dishes contained fish sauce instead of salt. The cooks were Laotian, and wait staff were either Thai or American. Meals for employees were usually prepared by a single cook, frequently the owner.

Although the owners indicated occasional problems with their cooks, staff denied conflicts with the owners, even when interviewed privately. Staff reported occasional tensions between cooks and wait staff. The restaurant owners described an incident in July 1998 when the tires of their car and one waitress’s car were slashed.

We conducted 317 interviews. Of the persons interviewed, 132 reported illness, and 107 met the case definition and had a known onset of illness. Of the 185 persons who did not report illness, 16 were excluded because their day of dining was unknown or they visited the restaurant on a day for which no illness was reported, leaving 169 controls. No restaurant staff met the case definition. Sixty-one percent of cases and 60% of controls were female. Cases were more likely to be adults (>17 years of age) than were controls (OR, 3.5; 95% CI, 1.2-12.6). The median (range) age of cases and controls was 31 years (4-70 years) and 36 years (2-83 years), respectively (P=.53). Five children became ill.

The median interval from food consumption to illness was 40 minutes (range, 5-120 minutes), and the median duration of symptoms was 6 hours (range, 1-168 hours). The median interval from the start of the meal until onset of diarrhea was 2 hours. Of 107 cases, 102 (95%) reported nausea; 76 (72%), dizziness; 62 (58%), abdominal cramps; 56 (52%), headache; 54 (51%), vomiting; 51 (48%), chills; 49 (46%), diarrhea; 15 (14%), fever; 8 (7%), weakness; 9 (8%), lightheadedness; 2 (2%), tingling; 2 (2%), blurry vision; and 2 (2%), sweating. The following symptoms were mentioned once for each: fatigue, excessive salivation, droopy eyelids, drowsiness, feeling drunk, dry mouth, eye pain, hives, and numb extremities. The initial symptom was reported as dizziness, lightheadedness, or the feeling of disequilibrium by 51 patients (48%), as nausea by 28 (26%), and as abdominal cramps or pain by 15 (14%). To an open-ended question on the taste of the food, case patients gave a variety of answers: bitter (n=4), sweet (n=2), bland (n=3), salty (n=2), sour (n=2), uncooked (n=2), foul (n=1), metallic (n=1), “like MSG” (n=1), rancid (n=1), spicy (n=1), and tart (n=1). Twenty-six persons (24%) visited the emergency department or were treated by a physician. Diagnoses of food poisoning, gastroenteritis, diarrhea, and acute gastritis were made. No biological sample was taken in the emer-
gery department or by physicians. There were no hospitalizations or deaths.

Cases occurred sporadically between December 20, 1998, and January 2, 1999 (Figure 1). The estimated total number of customers varied between 83 (December 20, 1998) and 153 (December 27, 1998). The estimated attack rates between December 20, 1998, and January 2, 1999, varied between 0% (on December 22, 24, 28, and 29) and 38% on January 2, 1999. No other outbreaks or cases of a similar illness were reported to the California Department of Health Services or the Fresno County Health Department during 1998 or 1999.

Approximately 100 dishes were available on the restaurant menu. Illness was associated with consumption of several dishes, but no single dish accounted for case numbers sufficient to explain the outbreak. We found the strongest association between illness and eating ground meat (indefinite OR, 95% CI [lower limit], 1.5), duck (OR, 10.0; 95% CI, 1.2-462.0), chicken coconut soup (OR, 9.0; 95% CI, 2.3-49.0), and garlic chicken (OR, 7.7; 95% CI, 1.5-74.0). However, among these, none accounted for more than 15 (14%) cases.

Because no specific dish could account for the majority of cases, we examined the association between illness and specific ingredients. Consumption of chili oil (OR, 3.2; 95% CI, 1.5-7.1), lime leaf (OR, 2.4; 95% CI, 1.3-4.3), and lemon grass (OR, 2.4; 95% CI, 1.2-4.5) was associated with illness, but even these could not account for more than 34 (32%) cases. Consuming any of the vegetarian dishes appeared protective (OR, 0.3; 95% CI, 0.1-0.7), as did consumption of any appetizer (OR, 0.5; 95% CI, 0.3-0.9) and any of the rice dishes (OR, 0.6; 95% CI, 0.3-1.1).

Salt, glutamate, and sugar were added to almost all dishes. Whereas glutamate and sugar were uniformly distributed among dishes, salt was not. The 4 dishes most associated with illness—ground meat, duck, chicken coconut soup, and garlic chicken—contained between 1 and 2 tsp of salt. The majority of appetizers and vegetarian dishes, which were protective for illness, contained less than 1 tsp of salt. In addition, 3 customers did not consume any salt added by cooks in the kitchen, and none of them reported illness. To further evaluate the association between salt consumption and illness, we examined the odds of reporting illness at different levels of exposure to salt added to foods in the kitchen (Figure 2). There was an estimated dose response: the association between cases and exposure to salt estimated to have been added to foods in the kitchen became stronger with increasing levels of salt exposure. Odds ratios of persons who consumed more than 0.42 to 0.84, more than 0.84 to 1.25, and more than 1.25 tsp of salt added to foods in the kitchen were 1.9 (95% CI, 0.6-5.7), 3.0 (95% CI, 1.0-8.8), and 4.0 (95% CI, 1.3-13.5) in comparison with those of persons who consumed 0.42 tsp or less (P value for trend <.004). Adults ate a median of 1.0 and children a median of 0.4 tsp of salt added to foods in the kitchen (P <.001).

Presence of employees during shifts was known from December 21, 1998, through January 2, 1999, the dates during which 106 of the 107 cases occurred. The presence of only one cook (cook A) was associated with illness among customers (OR, 10.4; 95% CI, 1.2-157.4). This cook was present when 73 (69%) of 106 cases became ill. Cooks A and B were present during 16 (80%) of the 20 shifts, when 104 (98%) of the 106 cases occurred.

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The restaurant contained a small kitchen. Condiments for seasoning were maintained on a table close to the cooks and included vinegar, oyster sauce, red wine, soy sauce, and chili oil. Small plastic containers of salt, sugar, and glutamate, filled from the storeroom, were also kept on the stovetop for use in food preparation. These small containers were refilled approximately every 2 days.

Sugar, salt, and glutamate were stored in large bulk containers in the storage room. No enamelware or earthenware was used, except 2 pots for preparation of curry dishes. Neither pot had glazing. The cooks reported no recent change in cooking practices. Dishes were made fresh for each customer, and almost nothing was precooked and reheated. The one exception was sticky rice, which was usually prepared the day before and then stored in the refrigerator. The table salt for customers was placed in tabletop shakers, and these were refilled directly from a retail-purchased container that was maintained in the dining area. This salt had a different source than did the storeroom salt that was used in the kitchen for food preparation.

Methomyl was not used by the pest control company hired by the restaurant to perform biweekly treatments. The last visit by the company was on December 15, at which time hydroprene and acephate were sprayed.

The database of the Fresno County Agricultural Commissioner identified one registered user of methomyl who lived at the same apartment complex as cook A and another registered user who was a relative of cook B. In 2001, Fresno County had a population of 799,407, with 2,809 (0.4%) registered methomyl users.

The one stool sample collected did not yield Campylobacter, Shigella, or Salmonella. Bacillus cereus was not identified in abnormal levels in any food item. The sample of vomitus tested negative for emetine (ipecac). The food and water samples were within nontoxic levels of the metals tested. Rice was negative for mycotoxins (trichothecenes). Neither nitrate nor nitrite was found in the vomitus sample, and the screen for potentially toxic organic compounds identified only γ-tocopherol. Among the samples tested for glutamate, there were 2 (chili with fish sauce with 17.5 mg/mL and soy sauce with 28.4 mg/mL) that had slightly elevated levels; the salt and sugar samples did not contain glutamate. Samples tested for cadaverine, putrescine, and tyramine were within levels that were unlikely to cause adverse effects. The extended organophosphate screen of the vomitus sample did not detect measurable levels of any compound tested, while the extended carbamate screen detected methomyl. The samples that tested positive for methomyl contained the following concentrations: salt from the storeroom container (measured in 2 laboratories), 4800 ppm and 6400 ppm (mean, 5600 ppm); salt from the stovetop container (measured in 2 laboratories), 1200 ppm and 1650 ppm (mean, 1425 ppm); curry chicken, 305 ppm; chicken coconut soup, 52 ppm; garlic chicken, 34 ppm; chili oil, 28 ppm; Thai salsa, 26 ppm; rice, 19 ppm; duck, 20 ppm; vomitus, 20 ppm; glutamate from the storeroom container, 8 ppm; and sugar from the stovetop container, 1 ppm.

Microscopic examination of the storeroom salt revealed 2 types of crystals, 1 resembling sodium chloride (common table salt) and 1 resembling methomyl (Figure 3). High-performance liquid chromatography analyses of the second type of crystal confirmed the presence of methomyl in purities between 65% and 100%.

For January 2, 1999, we calculated the TD$_{50}$ as 8.6 mg of methomyl. The average estimated weight of customers was 57.1 kg, resulting in a TD$_{50}$ of 0.15 mg/kg of body weight. In the sensitivity analysis, the TD$_{50}$ ranged from 0.09 to 0.31 mg/kg of body weight.

According to restaurant invoices, the salt in the storeroom came directly from the distributor’s warehouse in 11.3-kg bags. The distributor sold about 500 bags weekly to customers in the area. The salt producer shipped salt bags in his own vans directly to the distributor’s warehouse, where the bags were not repacked. No methomyl-containing products were purchased, stored, or shipped by the distributor or the salt producer. Drivers routinely checked bags and culled any wet or torn bags immediately. The ponds from which the salt was generated were protected from runoff contamination. In addition, the production process prevented the inclusion of substances other than sodium chloride (99.95%) and water (0.03%). The company distributed more than 8000 tons of salt monthly throughout the United States, and no similar incidents were reported in 1998 or 1999.

Using the results of this investigation, the Fresno Police Department initiated a criminal investigation that is ongoing. Extensive interviews of restaurant staff and others have been conducted by the department. To date, no arrests have been made.

COMMENT

Clinical, epidemiologic, and laboratorv evidence suggests that the outbreak described in this report was associated with consumption of foods containing methomyl-contaminated salt at a restaurant. Estimated doses of methomyl were sufficient to cause symptoms but not hospitalization or death.

We were unable to identify how contamination could have occurred unintentionally. First, reports from the salt...
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producer and distributor indicate little to no possibility for contamination at production or distribution. In addition, no similar outbreaks were reported, making widespread contamination during production or distribution unlikely. Second, different pesticides were used for routine administration at the restaurant, methomyl is a restricted agricultural pesticide, the salt bags purchased at the time were substantially different in size and color than the bags in which methomyl is sold, and the extent of contamination by methomyl found in the salt would make unintentional contamination highly unlikely.

Some circumstantial and epidemiologic evidence raised the possibility of intentional contamination by restaurant personnel. The owners described tensions with and among staff and an incident of slashed vehicle tires. Easy access to the storeroom container of salt was limited to employees and owners of the restaurant. Through the connection with a relative, cook B had ready access to methomyl, although he was not a registered user. It is important that another registered user lived at the same apartment complex as cook A, since he was the only cook who was significantly associated with the shifts during which illness occurred.

The variance in the proportion of ill customers on different days of the outbreak could be due to a number of factors. First, the storeroom container could have been contaminated just one time, most likely on December 20, 1998. If that dose of methomyl was not homogeneously mixed, the stovetop container could have had varying concentrations of methomyl from day to day through being refilled from random parts of the storage container (refilling occurred on average every 2 days). Second, the storage container or perhaps even the stovetop container could have been contaminated repeatedly, although we believe the latter possibility is less likely because the perpetrator risked being observed at some point. Third, and in combination with any of the possibilities above, there could have been perhaps intentionally exaggerated variation in the amounts of salt added to dishes by cooks. Because we did not know which cook prepared the dish for which person, we could not assess the association of the cooks with cases.

No cook or wait staff reported illness. Cooks usually prepared their own meal and used fish sauce instead of salt because of ethnic food preference. However, food for the wait staff was cooked with salt. They usually ate a common dish that was prepared for them in a big bowl, mostly by the owner herself. Because methomyl breaks down rapidly under high temperature and the common dish for wait staff had perhaps been cooked longer because of the larger quantity, extended heat exposure may have reduced methomyl in the dish for wait staff to nontoxic levels. Alternatively, staff may have been reluctant to report illness for fear of retribution.

This outbreak indicates that persons who ingest low levels of carbamate in food may present with symptoms that resemble mild gastrointestinal illness caused by bacterial or viral pathogens. Classic muscarinic effects, such as lacrimation, salivation, and bronchospasm, were uncommonly reported. However, dizziness was the first symptom in almost half of the cases, and the early onset of diarrhea, within only 2 hours of food consumption, hinted at a toxic origin rather than an infectious agent. Reports of salivation, even if infrequent, should raise suspicion of potential intoxication with a cholinesterase inhibitor.

Initially, we were unable to identify a toxin that could adequately explain the symptoms in this outbreak. A preliminary laboratory screening for organic toxic compounds was essentially negative. It was only after careful reexamination of symptoms, negative findings for more common toxins, and knowledge that food-borne outbreaks of chemical origin in Thailand were frequently associated with insecticide contamination, most commonly methomyl,3,4 that we proceeded to test specifically for organophosphates and carbamates.

This outbreak provided an unusual opportunity to estimate the dose of ingested methomyl that was associated with illness. To do these calculations, we had to make several assumptions. First, we assumed an equal concentration of the salt within the stovetop container. Second, we assumed that cooks actually added as much salt as was indicated by the chef. Third, we assumed that the cooking time was relatively constant among dishes and cooks. Fourth, we assumed that the weight of the customers was in line with national weight by age charts. Fifth, we assumed that the proportion of cases among the unidentified customers from January 2, 1999, was not higher than among the identified customers. Nevertheless, we believe that our estimate is valid, and sensitivity analysis showed that the extremes differ by a factor of less than 4. We estimated the TD50 to be 8.6 mg, or 0.15 mg/kg of body weight, with an estimated range of 0.09 to 0.31 mg/kg of body weight. In comparison, the oral lethal dose (LD50) necessary to kill half of exposed male rats is 17 mg/kg.5 The lethal dose of a fatal human episode of methomyl poisoning has been reported to be 12 to 15 mg/kg, an approximately 40- to 170-fold higher exposure than that experienced by restaurant customers.6

To our knowledge, this is the first large outbreak of chemical food poisoning with probable intentional background reported in the United States. Acts of intentional contamination with chemicals may cause substantial damage and be difficult to recognize and control. For example, among all foodborne outbreaks reported to the Centers for Disease Control and Prevention between 1993 and 1997, 88% of those with an incubation time of less than 6 hours never had an etiology identified (M. Young, written communication, March 2000). We relied initially on screening tests that did not focus on pesticides. It was difficult and time consuming to find a laboratory willing and able to do more specific tests for pesticides, including methomyl. Ultimately, it was not until 4 months into the investigation that we identified the

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responsible toxic agent. The rapid identification of a toxic agent, just like the identification of a biological organism, is critical to investigations, including criminal investigations. Strengthening laboratory and public health capacity to recognize and control toxin-related outbreaks, perhaps through a network of competent laboratories such as those developed for biological agents, is an important component in the process of improving our public health surveillance and response system.

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An invasion of armies can be resisted; an invasion of ideas cannot be resisted.
—Victor Hugo (1802-1885)