# Salmonellosis Outbreak at a Chili and Chowder Cook-Off Chincoteague, Virginia September 30, 2017

# ABSTRACT

**Background:** After a chili and chowder cook-off featuring 12 local vendors and attended by ~2,500 people, the Accomack County Health Department received reports of gastrointestinal illness among event attendees. Clinical stool specimens tested positive for *Salmonella* serotype Javiana. An investigation was conducted to determine the source of—or practices that might have contributed to—contamination, and provide recommendations to prevent future outbreaks at similar events.

**Methods:** A cohort study was performed, with event attendees recruited through press releases and subsequent social media posts containing the link to an online survey asking about foods consumed at the cook-off and gastrointestinal illness. A case was defined as three or more episodes of diarrhea in less than 24 hours, or unquantified diarrhea in addition to at least one other symptom (abdominal pain, chills, dehydration, fever, nausea, or vomiting) in someone who consumed cook-off food. In addition to unadjusted relative risks (RRs), Mantel-Haenszel adjusted RRs were calculated to address potential confounding by multiple exposures. Environmental health specialists interviewed food handlers and conducted inspections of restaurants where professional competitors prepared food. Available food samples and stool specimens from ill attendees and asymptomatic food handlers were tested for *Salmonella*. Primary *Salmonella* isolates were subtyped by pulsed-field gel electrophoresis (PFGE) and further characterized by whole-genome sequencing (WGS).

**Results:** Of 438 survey responses, 171 met the case definition. Of all exposures, Chowder A, prepared for the event by a professional vendor off-site, had the strongest association with illness (RR: 8.9; 95% confidence interval: 5.7–13.7). When stratified by exposure to Chowder A, all other chili or chowder adjusted RRs were less than 1.4. Environmental health inspections and interviews did not identify a specific source of contamination. *Salmonella* serotype Javiana was identified in stool specimens from 25 ill local and out-of-state attendees and an uneaten sample of Chowder A, but was not identified in the food handler specimens or raw frozen clam strips.

**Conclusions:** Epidemiologic and laboratory analyses provide evidence Chowder A was the most likely source of illness; however, the original source of *Salmonella* could not be identified. Recommendations to prevent future outbreaks included requiring all food to be prepared at the event site and ensuring safe temperatures are maintained during food preparation and service.

# BACKGROUND

On September 30, 2017, the Chincoteague Volunteer Fire Company (CVFC) hosted its 18<sup>th</sup> Annual Chili/Chowder Cook-off and Classic Car Show at the carnival grounds in Chincoteague, Virginia. The fire company estimated 2,500 people from multiple states in the region attended the event.

After the event, some attendees developed gastrointestinal (GI) illness. The first complaint of suspected foodborne illness was received by the Accomack County Health Department (ACHD) on October 3. On the same day, ACHD found dozens of reports of GI illness in a conversation (started on October 2) on a social media page for Chincoteague Island residents and visitors. Some of the ill cook-off attendees reported seeking health care and receiving diagnoses of *Salmonella* infection.

Salmonellosis is a common bacterial foodborne illness; in Virginia, more than 1,000 cases are reported each year. Nationwide, *Salmonella* infection is estimated to cause more than 1,000,000 illnesses, 19,000 hospitalizations, and 370 deaths each year<sup>1</sup>. Symptoms of infection typically appear 6 to 72 hours after exposure and can include diarrhea, abdominal pain, fever, dehydration, headache, nausea, or vomiting.

Though salmonellosis can be transmitted directly to humans from animals (e.g., from handling chickens or turtles) or from person to person by the fecal-oral route, 94% of illnesses are foodborne<sup>1</sup>. Food can be contaminated by contact with the feces of animals or humans carrying *Salmonella* at any stage of food production: produce harvesting or animal slaughter, packaging, transportation, kitchen preparation, or food service.

Many food items were present at the Chili/Chowder Cook-off. There were 11 vendors serving a total of nine chilis and five chowders, and another vendor, the CVFC, offering eight non-chili/chowder food items for purchase including hamburgers, sandwiches, chicken tenders, and french fries. While entry to the event was free, attendees could buy \$1 tickets to exchange for chili or chowder samples. Many attendees sampled multiple contest entries.

After learning of illness developing among so many event attendees, ACHD alerted the director of the Eastern Shore Health District (ESHD)—which includes the ACHD—and initiated a foodborne outbreak investigation. Staff from the Virginia Department of Health (VDH) Division of Surveillance and Investigation (DSI), VDH Office of Environmental Health Services, and Department of General Services Division of Consolidated Laboratory Services (DCLS) supported the investigation. The goals of this team were to assess the extent of the outbreak, determine the most likely source of exposure, and recommend steps to prevent similar outbreaks in the future.

# METHODS

# Epidemiologic investigation

#### Surveys:

The first people reporting illness to ACHD on October 3 were interviewed via phone using the VDH Enteric Case Report Form or the Centers for Disease Control and Prevention (CDC) Environmental Health Specialists Network Foodborne Illness Complaint Form (https://www.cdc.gov/nceh/ehs/ehsnet/docs/ehs-net\_foodborne\_illness\_complaint\_form.pdf). Due to the severity of illness reports, a team of public health nurses answered and returned all phone calls. After a press release was issued on October 4 requesting anyone who attended the cook-off to contact the ACHD to discuss their experience at the event, ACHD phone lines and staff were overwhelmed by incoming calls. Because of the scale of the outbreak, a report was posted on October 4 to Epi-X, a secure data-sharing system managed by CDC, to spread awareness of the outbreak to public health professionals in other states.

To reduce the burden of interviews on ACHD staff, the DSI Foodborne Disease Team created an online survey using REDCap electronic data capture tools<sup>2</sup> hosted at VDH. The survey had questions about GI illness and consumption of foods available at the cook-off. Any respondent who reported illness was asked when symptoms began, what symptoms were experienced, whether healthcare was sought, and whether a stool sample was submitted for testing. For each food item available at the cook-off, survey participants were asked whether they ate that food, with possible answers of "yes", "no", or "unsure."

The survey link was provided in a press release on October 5 and also published through the ESHD and CVFC websites and social media. All cook-off attendees were encouraged to take the survey whether they were ill or well. Data that were originally collected via paper form were entered into the online survey to standardize data for analysis. Within the first week of the investigation, VDH personnel communicated with health departments of other states where illness was being reported in the survey.

#### Statistical analysis:

Quality control, visualization, and analyses of data were performed in R<sup>3</sup> version 3.4.1.

<u>Quality control</u>: Incomplete surveys were removed from analysis. People who did not attend or eat food from the cook-off were excluded, as were people reporting illness onset prior to the cook-off or after the date they took the survey. Duplicate entries were removed—the first survey response was analyzed except when a respondent had taken the online survey after their paper case report information had been entered. In those instances, the more complete entry (the later online response) was kept. Any surveys with comments suggesting a secondary case of illness were removed: e.g., "My girl-friend fell ill Sunday mid-morning and I followed early Wednesday with Thursday being the worst."

One chili served at the festival was duplicated on the survey because it was entered under two different contestant names. An additional exposure variable was created to combine data for the two separate entries. If a respondent reported exposure to either chili, the person was considered exposed. If the respondent marked "unsure" for both chilis, the person was considered "unsure" for the overall exposure.

<u>Case definition</u>: The outbreak case definition included illness that occurred after consuming food from the Chili/Chowder Cook-off. Confirmed cases were positive for *Salmonella* by culture. Probable cases reported at least three episodes of diarrhea in a 24-hour period OR unquantified diarrhea and at least one other symptom (nausea, vomiting, fever, chills, abdominal cramps, or dehydration). Respondents who reported GI illness that did not meet the case definition were

excluded from analysis to avoid potential misclassification. All others who did not report GI illness were included in the "Not ill" group.

<u>Unstratified analysis</u>: For each food item served, the epitools<sup>4</sup> R package (version 0.5-9) was used to calculate attack rates among event attendees who were exposed and unexposed to that food. Risk differences and relative risks of illness were calculated by comparing the attack rates in exposed people to the unexposed. To determine which exposures were significantly associated with illness, 95% confidence intervals (CI) and *P* values were also calculated for relative risks using the epitools package.

<u>Single food exposure analysis</u>: Survey respondents who reported eating a single chili or chowder with no "unsure" answers were identified to calculate relative risks of illness for items eaten among this subgroup.

<u>Stratified analysis</u>: Because exposure to multiple food items was common at the cook-off, a stratified analysis was conducted. The unstratified and single food analyses indicated a particular food item was most strongly associated with illness, so Mantel-Haenzel adjusted relative risks were calculated to yield estimates of illness risk adjusted for exposure to the highest-risk food item.

# Environmental health investigation

Twelve food vendors competed in the Chili/Chowder Cook-off, including "professionals" (people who regularly receive pay to cook) and "amateurs." Seven amateur competitors applied for and received Temporary Food Establishment (TFE) permits, which are usually granted in temporary, outdoor settings. TFEs are inspected and permitted differently than other food establishments due to the short duration of service and limited operational capabilities. The CVFC also applied for and received a TFE permit to serve non-chili/chowder food items. Three of the professional competitors were from restaurants with a 2017 VDH food permit. One additional professional food vendor—a retail food store with a deli but no seating area—was governed by the Virginia Department of Agriculture and Consumer Services (VDACS) and exempt from TFE regulations.

Consistent with regulations, TFE permit holders were required to cook their food on-site on the day of the cook-off, while VDH-permitted or VDACS-inspected competitors were allowed to cook in their establishments. All but three contestants, two VDH-permitted and one VDACSinspected, opted to prepare their contest entries on-site, where ACHD EH staff ensured food was from approved sources and safe cooking practices were followed, including cooking chilis and chowders to appropriate temperatures. Cook-off setup started at 8:00 a.m., samples for contest judges were taken at 11:45 a.m., and the event began at noon with a target end time of 5:00 p.m. The EH inspector was at the cook-off for approximately 4 hours and the preparation process was completed with no violations. Because no violations were found for TFE permit holders the day of the event but permitted food establishments were not inspected, the EH components of the outbreak investigation focused on the professional competitors. As in the statistical analyses, preliminary evidence led EH to focus on one particular establishment.

On October 5, an EH specialist and foodborne illness investigation team member visited the establishment. The sanitary and physical conditions of the kitchen were assessed, including the cold storage unit and any cooking utensils used in food preparation. The food preparers were also interviewed about how the food items were prepared, stored, transported, heated and served, in addition to how leftovers were handled. The supplier for ingredients was verified, and shellfish record keeping and handling procedures were investigated. Kitchen staff were asked either in person or by phone about whether any GI symptoms were experienced. The food handlers were reinterviewed on October 13 to discuss food item handling procedures again and

create food preparation flow charts. EH also reinterviewed the event coordinator to discuss the layout of the event and availability of bathroom and handwashing facilities.

# Laboratory investigation

Stool samples collected from ill attendees were submitted to diagnostic laboratories. If possible, isolates were forwarded to public health laboratories within patients' states of residency for confirmation of organism identity, serotyping, molecular subtyping by PFGE, and, for Virginia samples, WGS. ACHD obtained three stool specimens from attendees and sent them directly to DCLS for analysis.

As soon as they were available, the outbreak-associated PFGE patterns were posted to the CDC PulseNet web-forum (referred to as SharePoint) to facilitate finding additional cases. Like Epi-X, PulseNet SharePoint is a secure system managed by CDC for data-sharing among state laboratories and health departments. The VDH outbreak identification number was provided to other states so any out-of-state specimens associated with the outbreak could be easily identified.

To test whether any asymptomatic food handlers might have been *Salmonella* carriers, an EH specialist delivered three stool collection kits to people at the restaurant involved in preparing or serving the primary food item of interest. One package of frozen, raw chopped surf clams—the same type but not the same package used in preparation of the food item—was obtained from the restaurant and sent to DCLS.

One attendee, after sampling several food items available at the cook-off including the main food item under investigation, used remaining tickets to purchase a take-home container of that food item. This person became ill after the cook-off and did not reopen or eat the purchased food. This uneaten sample was given to the ACHD and sent to DCLS for *Salmonella* testing.

# RESULTS

#### **Statistical analysis**

#### Survey participant characteristics

There were 528 entries in the REDCap survey. Of these entries, 57 were excluded because the surveys were incomplete, 3 were excluded because the person did not attend or eat food from the cook-off, 1 was excluded because the self-reported date of illness onset was prior to the cook-off, 15 were excluded because they were duplicate entries, 4 were excluded as secondary cases of illness, and 10 were excluded because the person reported illness not meeting the case definition. After applying these quality control procedures, 438 surveys were included in analysis.

Overall, 171 attendees (39% of survey respondents) experienced illness meeting the case definition. The epidemic curve, with number of cases of illness attributed to the cook-off by date of onset, is shown in Figure 1. The shape of the curve is consistent with a point-source outbreak. The earliest cases occurred within hours of the cook-off: 22 cases of illness (including 1 confirmed case) were reported the evening after the event on September 30. The majority (61%) of cases, 86 probable and 18 confirmed, occurred on October 1, the date following exposure. An additional 29 cases (17%) occurred on October 2, and 16 (9%) occurred more than two days after the event. Onset of symptoms in a confirmed case of illness was reported as late as October 7.

As shown in Table 1, the most common symptom after diarrhea (which was required in the case definition) was abdominal cramps, reported by 83% of people. In addition, 65% of people reported nausea, 63% reported fever, 62% reported chills, 56% reported dehydration, and 33% reported vomiting. The median number of symptoms experienced in addition to diarrhea was 4. More than half of ill people sought health care: 32% reported visiting an urgent care or doctor's office and 21% reported visiting an emergency room. Of the 91 people who sought medical care for their illness, 57 (63%) reported submitting a stool specimen. Overall, 18 people (11% of survey respondents) reported being hospitalized at least overnight for illness.

The age distribution for ill and not ill respondents is shown in Figure 2. Age was not given in 2% of surveys (one ill and eight not ill people). The average age of ill respondents was 50 years (standard deviation [SD]: 17 years; range 5–87 years), while the average age of those who were not ill was 53 (SD: 15; range 6–81), a difference significant by t-test (two-sided *P* value = 0.04).

In addition to 52 Virginia residents, illness was reported by event attendees from six other states: Delaware (N = 13), Maryland (N = 50), North Carolina (N = 1), New Jersey (N = 16), Pennsylvania (N = 36), and West Virginia (N = 3). While Virginia residents comprised 30% of ill respondents, they accounted for the majority (59%) of not ill survey responses (shown in Figure 3).

#### Food item exposure analysis

Overall, nine chilis, five chowders, and eight other non-chili/chowder food items were available from vendors at the cook-off. Due to use of an early list of food items, one chili was included on the survey, but was not actually served at the cook-off (Chili C). One other chili entry was entered under two separate names (the restaurant's name and the restaurant bar's name) and was therefore duplicated on the survey as Chili E and Chili K. Regardless of whether separate variables or the combined Chili E and K variable was used, the median number of soups eaten was three overall, with two being the median number for the not ill subset, and four for the ill.

<u>Unstratified analysis</u>: Attack rates, relative risks, 95% CI, and *P* values for Chili/Chowder Cookoff exposures are shown in Table 2. All chowders and all but one chili consumed at the cookoff, Chili C. Chowder A was associated with the largest relative risk for illness, 8.9 (95% CI: 5.7– 13.7), which was three times greater than the next most strongly associated food, Chowder B, with an RR of 2.9 (95% CI: 2.2–3.7). The 66% difference in risk for people exposed to Chowder A compared to those who were not exposed was also 1.4–6.6 times greater than the risk difference for any other food item. The relative risk for the combined Chili E and K variable was 1.5 (95% CI: 1.1–1.9; p = 0.004), which was not greater than either chili considered individually. Some foods served by the Chincoteague Fire Department were significantly associated with reduced risk of illness, including french fries, pizza, hamburgers, and beverages. Because none of the food items served by the Chincoteague Fire Department was significantly associated with an increased risk of illness, these were not considered in further analyses.

<u>Single food exposure analysis</u>: Though most survey respondents reported tasting more than one chili or chowder at the cook-off, thirty-two people reported eating only one. As shown in Table 3, seven reported GI illness and of those, six identified Chowder A as their only exposure, resulting in a relative risk of illness of 13.2 (95% CI: 1.8–95.7). Only one ill person in this subset reported consuming a food other than Chowder A. In the survey open-ended comment section, she expressed certainty she ate a chowder, but thought it was Chowder B.

<u>Stratified analysis</u>: Attack rates for illness following exposure to the different chilis and chowders, stratified by whether the attendee also ate Chowder A, are shown in Table 4. For each food item analyzed, the attack rate was much greater among those who also ate Chowder A (from 70% to 86%) compared to attack rates among those who did not (from 5% to 27%). The number of total illnesses among people who did not eat Chowder A was also small: only 19 ill people did not report eating Chowder A.

Table 4 also includes the Mantel-Haenszel adjusted relative risks and 95% CI for other soups controlled for exposure to Chowder A. Five chilis and two chowders had CI that excluded 1, indicating increased risk for illness. However, as visualized in Figure 4, the relative risks were very small compared to the strength of association seen for Chowder A in the unstratified analysis. The adjusted RR for the Chili E and Chili K combined variable was 1.15 (95% CI: 0.94–1.4). Again, this estimate was not greater than either chili considered alone. There was no increased risk of illness associated with Chili C, the food item not served at the cook-off, in this stratified analysis.

# Environmental health investigation

The supplier for all ingredients of Chowder A was verified as a large, national restaurant supplier. Initially, the food preparer of Chowder A reported waking up early (approximately 5:00 a.m. the day of the cook-off) to cook the chowder. Bacon was sautéed, and in a separate pan, butter and flour were combined to form a roux. The cooked bacon was added to the roux along with diced potatoes, onions, carrots, and frozen raw clam strips (which had been thawed overnight in the walk-in refrigerator). Everything was then added to a large stock pot (Photo 1) with chicken broth and cream. The chef reported the chowder reached a temperature of 185 degrees, but that excessive cooking was avoided to



Photo 1. Stove and stock pot (center burner) like the ones used to make Chowder A.

prevent separation of the cream. The food preparer reported cooling the soup by placing it in several plastic trays set in metal trays (Photo 2) filled with ice, with fans (Photo 3) blowing at them. Then the chowder was moved to the walk-in refrigerator for storage until event time. Half of the chowder was devoted to the event, and half was kept to serve as a menu item in the restaurant. As needed, portions of the chowder were removed from the walk-in, reheated in pots on the



Photo 2 (left). Shallow plastic and metal trays used to cool Chowder A Photo 3 (right). One of two large fans used to assist in cooling

stove, and transported by truck approximately one mile to the cook-off in plastic containers (Photo 4).

At the cook-off, the chowder in the plastic containers was poured into metal chafing dishes (Photo 5), with lit methanol gel chafing fuel candles (Photo 6) underneath to maintain heat. Because this establishment had participated in the event for many years, they expected windy conditions that are common on the island, and wrapped aluminum foil around the base and candles to prevent the candles from being blown out. The food handler at the event reported she had no time to take temperatures during the event, but was sure the chowder was hot. However, the investigation team received several comments via the REDCap survey that Chowder A was lukewarm or cold.



Photo 4. Plastic container used to transport chowder from kitchen to cook-off via truck.

The food handler reported being very busy during the cook-off, and that all chowder was gone prior to the end of the event. Therefore, no leftovers were brought back to the restaurant and available for testing. Neither the food handlers directly involved in the event nor any other kitchen staff members reported GI symptoms or illness prior to, during, or after the event.



Photo 5 (left). Covered chafing dish used to serve chowder at the cook-off. Photo 6 (right). Gel chafing fuel "candles" used for Chowder A hot-holding.

During the October 13 reinterview of Chowder A food handlers, the establishment owners mentioned that chowder served at the event was actually from two different batches: one was cooked on the day preceding the event, September 29, and one the morning of the event, as previously described. The newly-made and previously-made batches of chowder were taken in two trips to be served at the cook-off. After the first containers of fresh-made chowder were finished by 2:00 p.m., three more trays of the chowder from the day before were taken out of the walk-in refrigerator, reheated in pots on the stove, and driven to the cook-off.

One restaurant employee who was not involved in food handling at the event, but who worked at the restaurant the following day (as waitstaff, not kitchen staff), reported illness after eating from the portion of Chowder A that was made the day of the event and kept at the restaurant.

During reinspections of the restaurant, EH noticed that a handwashing sink from the shellfish preparation room had been removed, though it was unknown whether this took place before or after the cook-off. Additionally, chowder that was being cooled in the walk-in refrigerator was not marked with the date of cooking.

The event coordinator provided a map of the event (shown in Figure 5) including the location of all vendors and available hand/utensil wash stations. Hand-washing stations were not accessible by the public, though hand sanitizer was available in porta potties on-site.

# Laboratory investigation

Out of 57 survey respondents who reported seeking medical care and submitting a stool sample for laboratory analysis, state public health laboratories received 23 isolates: 6 from Virginia respondents, 7 from Maryland respondents, and 10 from Pennsylvania respondents. Virginia and Maryland also each received one isolate for respondents who did not report they had submitted a sample for analysis at the time they took the survey. Organism confirmation and further characterization was performed for the 25 isolates by the respective state public health laboratory, and results were shared through the nationwide PulseNet SharePoint. The investigation team did not follow up to obtain healthcare provider and laboratory result information for the other 32 survey respondents who reported submitting a specimen.

In addition to the 25 laboratory-confirmed cases with survey responses, 12 other isolates received by state public health laboratories were linked to this outbreak by subtyping without survey data for analysis. Ten people did not complete the online survey, and one person reported illness onset date prior to the event date. Another person, a Virginia resident, did not attend or eat food from the event, but reported eating lunch on the day following the event at the restaurant where Chowder A was prepared. He was the only person to become ill among a party of six, and reported he was the only one in the party who ate steamed clams and steamed shrimp.

Of the 37 total isolates received by state laboratories, 14 were from Virginia, 11 were from Maryland, and 12 were from Pennsylvania. All tested positive for *Salmonella* serotype Javiana. By PFGE pattern type, 21 were JGGX01.0349, 15 were JGGX01.1197, and 1 was JGGX01.3103. Each of the three pattern types was linked to a previous Eastern Shore foodborne illness case in 2017—one in June and two in August. Despite multiple attempts, local health departments were unable to contact the person in these previous cases by phone, so their exposure histories could not be assessed.

Overall, 22 of the 25 survey respondents with lab-confirmed illness reported exposure to Chowder A; that chowder was the only exposure shared by more than half of the group. Of the three who did not report exposure, one person reported sampling many food items but not Chowder A, one person was unsure of her exposures, and one was the same person described in the single food analysis who definitely consumed chowder, but thought it was Chowder B. Two people with confirmed *Salmonella* serotype Javiana reported Chowder A was their only soup exposure.

All three stool collection kits given to the food handlers involved in preparing or serving Chowder A were returned and sent to DCLS for analysis. *Salmonella* was not identified in the food handler specimens, or in the specimen provided by the restaurant employee who reported illness following the event. Additionally, *Salmonella* was not identified in the package of frozen, sliced clams that was the same type as those used in Chowder A. However, the uneaten sample of Chowder A that had been taken home by an event attendee tested positive for *Salmonella* serotype Javiana, PFGE pattern type JGGX01.0349.

WGS was performed for all isolates from Virginia-resident specimens and food associated with the outbreak investigation, using the LyveSET v1.1.4f pipeline with *Salmonella enterica* serotype Javiana str. CFSAN001992 as the reference strain for read mapping<sup>5</sup>. The 14 *Salmonella* isolates from event attendees and the uneaten Chowder A sample were determined to be highly genetically related with 0 single nucleotide polymorphism (SNP) differences among isolates in the genomic regions compared. *Salmonella* isolates from the three patients from the

Eastern Shore with illness onset during the summer preceding the event were also closely related to the outbreak clade, differing by 4–9 SNPs. The *Salmonella* isolate from the patient that visited the restaurant after the event and became ill had 0 SNPs different from the outbreak clade. The WGS analysis was performed for investigational purposes only.

#### DISCUSSION

Consumption of Chowder A at the Chincoteague Chili/Chowder Cook-off was associated with salmonellosis. Event attendees had the opportunity to sample multiple chilis and chowders, making it difficult to measure the risk of illness associated with eating each food item. Although relative risks were slightly elevated for a number of foods served, the risk of illness associated with Chowder A was more than three times greater than any other food item. When respondents who only ate one kind of chili or chowder were considered, seven reported illness, and of those, six reported Chowder A as the only soup they consumed. In an analysis stratified by exposure to Chowder A, attack rates were much lower in the group that did not eat Chowder A, and only 19 people in this group reported illness. Relative risks for other chilis and chowders adjusted for the effect of Chowder A were all less than 1.4. Additionally, *Salmonella* serotype Javiana was identified in an uneaten sample of Chowder A from the cook-off and was closely genetically related to clinical isolates from ill attendees.

Because many ingredients were combined in Chowder A, no individual ingredient could be separated out and identified as the source of contamination. More than half of outbreaks caused by *Salmonella* serotype Javiana involve plant-derived food commodities<sup>6</sup>, and Chowder A had several plant-derived ingredients including celery, carrots, potatoes, and onions. *Salmonella* can also be found in domestic and imported raw clams and other seafood<sup>7</sup>. A container of frozen raw surf clams of the same type used in Chowder A was tested for *Salmonella* but none was identified. While no raw local seafood was used in the chowder, opportunities for cross-contamination still existed in the restaurant kitchen. During a restaurant reinspection, it was noted that a sink used for handwashing had been removed from the shellfish preparation room. If this occurred prior to the cook-off, hygiene practices in the restaurant could have been affected.

The outbreak serotype of *Salmonella* was isolated from the stool of a person who did not attend or eat food from the cook-off, but ate at the restaurant that made Chowder A one day after the cook-off. This person was the only one in the party to become ill and also the only one who ate steamed clams and shrimp. In addition to the possibility raw clams could contain *Salmonella*, raw shrimp was the cause of a serotype Javiana salmonellosis outbreak in Arizona in 2016<sup>8</sup>.

*Salmonella* serotype Javiana has been identified as endemic to the environment of the Eastern Shore of Virginia. In one study of over 1,570 environmental samples, 8.4% tested positive for *Salmonella*, with the majority of positive samples being creek water and sediment. Javiana was one of the most common serotypes, identified in approximately 20% of *Salmonella*-positive samples<sup>9</sup>. *Salmonella* serotype Javiana has also been identified in animal farms such as poultry, dairy, or swine farms<sup>10</sup>, which are present on the Eastern Shore. Wetland areas like those common in the area correlate with incidence of serotype Javiana infections<sup>11</sup>. These areas have environmental conditions favorable to *Salmonella* survival and also support wildlife such as turtles, snakes, and avian species, in which multiple serotypes of *Salmonella*, including Javiana, have been found on the Virginia Eastern Shore<sup>12</sup>.

PFGE pattern JGGX01.1197, the second most common pattern in this outbreak, was identified in multiple environmental samples from the Eastern Shore in 2010 and 2011<sup>9</sup>. Additionally, all three outbreak PFGE patterns matched previous cases of illness in the Eastern Shore region, demonstrating endemic *Salmonella* has a direct impact on human health. Nationwide, Javiana is the fourth most common *Salmonella* serotype, whether measured in produce<sup>13</sup> or foodborne illness outbreaks in the United States<sup>14</sup>. In Foodborne Diseases Active Surveillance Network data, there was a significant 131% increase in *Salmonella* serotype Javiana infection incidence in 2014 compared to 2006–2008<sup>14</sup>. Better understanding of factors relating to presence and persistence of *Salmonella* in the Eastern Shore environment could be important for intervention efforts in the region as rates of infection continue to increase.

Regardless of the initial source of contamination, once *Salmonella* was introduced into the chowder, there were several trips through the "danger zone" that could have contributed to bacterial growth. These included the initial cooking of ingredients, cooling the soup prior to refrigeration, and reheating prior to transport to the cook-off. The chowder should have been rapidly reheated to 165 degrees, then maintained at or above 135 degrees for safe food service, an especially difficult task considering the volume of chowder, the need for transport to the fairgrounds, and the windy conditions on the day of the cook-off. The Chowder A vendor used gel chafing fuel candles set underneath the serving trays, compared to propane burners used by many other competitors to maintain temperature. Chowder A temperatures were reportedly not taken during preparation or service. The food handlers reported the chowder was hot, but ACHD received at least a dozen survey comments that Chowder A was "lukewarm" or "cold" when tasted.

This foodborne disease outbreak highlights a 2017 VDH food policy change that allows current VDH food permit holders to operate at off-site events without an additional Temporary Food Establishment (TFE) permit. Inspection is instead optional. This policy change was intended to reduce redundant inspections and the burden of permitting. For example, on the Eastern Shore of Virginia there are four food inspectors covering the 70-mile-long peninsula and its associated islands. By October 2017, these inspectors had issued 234 regular permits for food establishments and an additional 80 TFE permits. The assumption underlying the policy change was that permit-holders had already shown their food preparation practices and facilities to comply with VDH Food Regulations. However, operating as a TFE is different from day-to-day operations in most restaurants. The larger quantities of food items required, necessity of transporting food items, and lack of access to typical restaurant cooking equipment on-site can present unique challenges. Coordinators of similar events in the future should consider requiring all participants to prepare food on-site, where EH specialists are present to ensure ingredients are properly sourced and that temperatures are reached and maintained for safe food service.

The findings of this investigation should be considered in light of a number of limitations. While it would be ideal to reach the entire population of 2,500 event attendees, there was no attendance list or contact information available for the event attendees. ACHD recruited as many people as possible to complete the survey, and all press releases reflected a desire to inform all attendees, whether they experienced illness or not. Analyzable surveys were ultimately received from 438 event attendees (approximately 18% of total attendees), with healthy people comprising 61% of respondents. A larger proportion of healthy respondents were from Virginia compared to ill. This is likely because of greater local interest in and publicity of the event.

There were difficulties gathering information because of the event's format. Most attendees tasted multiple chilis and chowders, with ill people reporting a median of four soup exposures (two more than not ill people). Exposures were therefore highly correlated and all but one chili was associated with illness. Residual confounding could explain the slightly increased risks of illness associated with other soups after controlling for Chowder A. The survey included an "unsure" option for each food item to prevent the need for guessing at exposures, but risk estimates could have been affected if attendees could not remember which samples they tasted. This is best illustrated by the 73 people who reported eating Chili C—a food item not served at the cook-off. However, the same restaurant that prepared Chowder A was the restaurant that had signed up to bring Chili C, so it is possible survey participants were reporting exposure to the restaurant itself. In the stratified analysis, only 11 people reported exposure to the chili and not the chowder from this restaurant, and there was no association between Chili C and illness. Two other chilis, E and K, were listed separately under two names though they were actually the same food item. When responses for the two were combined into one variable for the unstratified analyses, the relative risk of illness was not greater than the

estimates for each chili separately, indicating that a strong association with illness was not masked by separation of the two.

Data on laboratory confirmation of cases were also limited. While 57 people reported in the survey they had submitted a stool sample at a healthcare provider's office for analysis, lab results were received for only 23 (with an additional 2 confirmed results from people who did not report they had submitted a specimen at the time they took the survey). An additional 12 lab-confirmed *Salmonella* results matched into this outbreak but were not informative to our statistical analysis because there was no completed survey entry, the person did not attend or eat food from the cook-off, or the reported illness onset date was invalid. It was therefore not possible to determine if those people were event attendees, ate at the restaurant on a subsequent day, experienced secondary cases of illness, or were otherwise associated with the cook-off.

This outbreak raised important points about the potential risk of serious and widespread illness that can result if a contaminated food item is present at a large event. Some of the many challenges to food service at temporary events include the requirement for large food quantities in relatively short time periods, necessity of transporting food to the event, and vulnerability to environmental conditions. On-site expertise, oversight, and inspection from EH specialists is an important tool in preventing unsafe food service situations. Recommendations from the lessons learned in this outbreak should be implemented to ensure cook-offs and other events can be enjoyed with greater assurance of food safety in the future.

# RECOMMENDATIONS

For event organizers:

- Require all competitors to prepare their food items on-site where the process can be monitored by EH specialists.
- Ensure all competitors have sufficient heating equipment (such as propane gas burners) that will withstand consistently windy conditions for the duration of food service.
- Provide easy access to hand-washing stations for both food handlers and attendees.
- Clearly identify vendors with signs to facilitate attendee recall of foods eaten, in case a similar event occurs in the future.
- The event coordinator should seek an accredited program for training as a Certified Food Protection Manager, as added oversight of food preparation and serving at events.

# For chili/chowder cooks and other food preparers:

- Closely follow all recommended hand hygiene practices as well as surface cleaning practices to prevent any cross-contamination between foods.
- Monitor food temperatures throughout preparation and service to ensure the thresholds required to kill harmful bacteria are met. According to VDH Food Regulations 12VAC5-421 et seq.:
  - Fresh chowder and chili (considered to be "comminuted" foods) must be cooked to at least 155 degrees for 15 seconds and held at 135 degrees or above.
  - Previously cooked chowder or chili must be rapidly reheated to 165 degrees and maintained at 135 degrees or above.
  - For all food preparation, avoid repeated trips through the "danger zone" for bacterial growth (between 41 and 135 degrees).
- Though in this case no ill employees were reported to be involved in food preparation or service, all contestants should be aware of symptoms of GI illness and prevent any ill people from assisting with food handling.

Table 1. Salmonellosis symptoms reported in 171 cases of illness — Chincoteague Chili/Chowder Cook-off, 2017

	People reporting			
Symptom	Number	Percent		
Diarrhea*	171	100		
Abdominal Cramps	142	83		
Nausea	111	65		
Fever	108	63		
Chills	106	62		
Dehydration	95	56		
Vomiting	56	33		

\*symptom required for probable case definition

	EXPOSED					U	NEXPO	SED		
Label		Well	Total	Attack Rate		Well	Total	Attack Rate	Relative Risk (95% CI)	P value
Chowder A	134	47	181	74%	19	208	227	8%	8.85 (5.7, 13.72)	2E-45
Chowder B	60	26	86	70%	69	214	283	24%	2.86 (2.23, 3.67)	4E-14
Chowder C	45	17	62	73%	80	222	302	26%	2.74 (2.15, 3.49)	2E-11
Chowder D	60	37	97	62%	83	220	303	27%	2.26 (1.77, 2.87)	2E-09
Chowder E	78	64	142	55%	74	194	268	28%	1.99 (1.56, 2.54)	1E-07
Chili A	60	43	103	58%	74	189	263	28%	2.07 (1.61, 2.67)	1E-07
Chili B	40	30	70	57%	83	198	281	30%	1.93 (1.47, 2.54)	4E-05
Chili C*	35	24	59	59%	100	220	320	31%	1.90 (1.45, 2.48)	6E-05
Chili D	66	59	125	53%	80	190	270	30%	1.78 (1.39, 2.28)	1E-05
Chili E^	40	33	73	55%	98	217	315	31%	1.76 (1.35, 2.30)	2E-04
Chili F	59	68	127	46%	78	187	265	29%	1.58 (1.21, 2.05)	0.001
Chili G	42	40	82	51%	97	201	298	33%	1.57 (1.20, 2.06)	0.003
Chili H	32	33	65	49%	91	196	287	32%	1.55 (1.15, 2.10)	0.009
Chili I	62	67	129	48%	86	187	273	32%	1.53 (1.19, 1.96)	0.002
Chili J	52	60	112	46%	85	179	264	32%	1.44 (1.11, 1.88)	0.01
Chili K <sup>^</sup>	52	71	123	42%	85	184	269	32%	1.34 (1.02, 1.75)	0.05
Clam sandwich	14	19	33	42%	141	247	388	36%	1.17 (0.77, 1.77)	0.6
Oyster sandwich	18	30	48	38%	137	237	374	37%	1.02 (0.69, 1.51)	1
Ice cream	22	38	60	37%	132	229	361	37%	1.00 (0.70, 1.44)	1
Chicken	7	14	21	33%	148	253	401	37%	0.90 (0.49, 1.68)	0.8
French fries	43	105	148	29%	114	162	276	41%	0.70 (0.53, 0.94)	0.02
Hot dog	7	20	27	26%	148	247	395	37%	0.69 (0.36, 1.33)	0.3
Pizza	13	50	63	21%	140	217	357	39%	0.53 (0.32, 0.87)	0.004
Hamburger	1	21	22	5%	153	246	399	38%	0.12 (0.02, 0.81)	9E-04
Other food	9	17	26	35%	141	249	390	36%	0.96 (0.56, 1.65)	1
Beverage	83	181	264	31%	71	85	156	46%	0.69 (0.54, 0.88)	0.005
Ice in beverage	1	14	15	7%	82	167	249	33%	0.20 (0.03, 1.36)	0.04

Table 2. Attack rate table for all cook-off food items — Chincoteague Chili/Chowder Cook-off, 2017

Exposures with significantly increased risks for illness are highlighted in red; exposures with significantly decreased risks are highlighted in blue. Scientific notation is used for *P* values less than 0.001

\*food that was included on the survey but not present at the cook-off

^two chilis listed separately on the survey which are the same food item

 Table 3. Attack rate table for survey participants who reported eating only a single chili or chowder — Chincoteague

 Chili/Chowder Cook-off, 2017

	EXPOSED					U	NEXPC	OSED		
Label	III	Well	Total	Attack Rate	III	Well	Total	Attack Rate	Relative Risk (95% CI)	P value
Chowder A	6	4	10	60%	1	21	22	5%	13.2 (1.82, 95.67)	0.001
Chowder B	1	1	2	50%	6	24	30	20%	2.50 (0.53, 11.89)	0.4
Chowder C	0	0	0	—	7	25	32	22%	-	1
Chowder D	0	2	2	0%	7	23	30	23%	0 (0, —)	1
Chowder E	0	3	3	0%	7	22	29	24%	0 (0, —)	1
Chili A	0	0	0	—	7	25	32	22%		1
Chili B	0	0	0	_	7	25	32	22%	_	1
Chili C*	0	1	1	0%	7	24	31	23%	0 (0, —)	1
Chili D	0	1	1	0%	7	24	31	23%	0 (0, —)	1
Chili E^	0	0	0	_	7	25	32	22%	_	1
Chili F	0	3	3	0%	7	22	29	24%	0 (0, —)	1
Chili G	0	0	0	—	7	25	32	22%	-	1
Chili H	0	1	1	0%	7	24	31	23%	0 (0, —)	1
Chili I	0	2	2	0%	7	23	30	23%	0 (0, —)	1
Chili J	0	2	2	0%	7	23	30	23%	0 (0, —)	1
Chili K <sup>^</sup>	0	5	5	0%	7	20	27	26%	0 (0, —)	0.6

Exposures with significantly increased risks for illness are highlighted in red

The horizontal bar (—) indicates an undefined number (a number divided by zero)

\*food that was included on the survey but not present at the cook-off

^two chilis listed separately on the survey which are the same food item

Table 4. Mantel-Haenszel adjusted relative risks for all chili and chowder food items, stratified by exposure to Chowder A — Chincoteague Chili/Chowder Cook-off, 2017

	Å	ALSO A	ATE CH	OWDER A	D	D NOT	EAT C	HOWDER A	
Label	III	Well	Total	Attack Rate	III	Well	Total	Attack Rate	Mantel-Haenszel adjusted Relative Risk (95% CI)
Chowder B	56	15	71	79%	4	11	15	27%	1.23 (1.02, 1.47)
Chowder C	43	8	51	84%	2	9	11	18%	1.29 (1.07, 1.55)
Chowder D	53	17	70	76%	4	17	21	19%	1.15 (0.96, 1.39)
Chowder E	74	19	93	80%	2	41	43	5%	1.13 (0.93, 1.37)
Chili A	55	13	68	81%	5	27	32	16%	1.28 (1.06, 1.55)
Chili B	38	10	48	79%	2	19	21	10%	1.18 (0.96, 1.46)
Chili C*	33	14	47	70%	2	9	11	18%	1.01 (0.82, 1.26)
Chili D	55	15	70	79%	8	41	49	16%	1.28 (1.06, 1.54)
Chili E <sup>^</sup>	35	7	42	83%	4	24	28	14%	1.29 (1.06, 1.56)
Chili F	53	18	71	75%	6	48	54	11%	1.15 (0.94, 1.40)
Chili G	36	6	42	86%	5	31	36	14%	1.33 (1.10, 1.60)
Chili H	29	10	39	74%	2	22	24	8%	1.06 (0.84, 1.34)
Chili I	52	12	64	81%	8	52	60	13%	1.30 (1.07, 1.56)
Chili J	45	12	57	79%	5	45	50	10%	1.15 (0.94, 1.40)
Chili K <sup>^</sup>	45	16	61	74%	5	51	56	9%	1.09 (0.88, 1.35)

Adjusted relative risks for illness with confidence intervals that do not include one are highlighted in red.

\*food that was included on the survey but not present at the cook-off

^two chilis listed separately on the survey which are the same food item



Figure 1. Number of salmonellosis cases by illness onset date and case status — Chincoteague Chili/Chowder Cook-off, 2017

The outbreak case definition included illness that occurred after consuming food from the Chili/Chowder Cook-off. Confirmed cases were positive for *Salmonella* by culture. Probable cases reported at least three episodes of diarrhea in a 24-hour period OR unquantified diarrhea and at least one other symptom (nausea, vomiting, fever, chills, abdominal cramps, or dehydration).



Figure 2. Number of survey participants by illness and age group — Chincoteague Chili/Chowder Cook-off, 2017

Figure 3. Number of survey participants by illness and state of residence — Chincoteague Chili/Chowder Cook-off, 2017



"Other" includes any state with fewer than 10 respondents: West Virginia (3 ill and 3 not), North Carolina (1 ill and 1 not), New York (2 not ill), Ohio (2 not ill), and Florida (1 not ill).

Figure 4. Mantel-Haenszel adjusted relative risks of illness (stratified by Chowder A exposure) compared to the Chowder A unadjusted relative risk — Chincoteague Chili/Chowder Cook-off, 2017



The dashed line marks a relative risk of 1, indicating no increased or decreased risk of illness. \*food that was included on the survey but not present at the cook-off ^two chilis listed separately on the survey which are the same food item Figure 5. Event layout for the Chili/Chowder Cook-off in Chincoteague, Virginia, on September 30, 2017

Hand Chili E^ and **Chowder B Chowder C** Chili D Chili K<sup>^</sup> **Chowder A** utensil wash **Chowder D** station Walk-through area Utensils Walk-through area Hand and Chili I Chili G Chili B Chili H Chili F Chili A utensil Chowder E Chili J wash station

East

North



^two chilis listed separately on the survey which are the same food item

West

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