

Section 4

Notable Outbreaks and Case Investigations

Notable Outbreaks and Case Investigations

In Florida, any disease outbreak in a community, hospital, or institution, and any grouping or clustering of patients having similar disease, symptoms, syndromes or etiological agents that may indicate the presence of an outbreak are reportable as per Florida Administrative Code Chapter 64D-3. Selected outbreaks and case investigations of public health importance that occurred in 2015 are briefly summarized in this section.

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Bacterial Diseases

Legionellosis Investigation Involving a Combined Assisted and Independent Living Retirement Facility, Duval County, June to September 2015

Authors

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Background

On July 6, 2015, the Epidemiology Program at the Florida Department of Health in Duval County (DOH-Duval) was notified by a local hospital infection control nurse of a positive *Legionella* antibody result on acute serum of an 87-year-old man. The man's address matched a combined assisted and independent living retirement facility where a legionellosis outbreak occurred in March 2014. Initially, it was reported that the man had not yet moved into the facility before his symptom onset of cough, fever, malaise, and shortness of breath on June 27.

On July 21, DOH-Duval Epidemiology received a report from a different hospital of an additional legionellosis case based on positive urine antigen testing in a 96-year-old man. This man had symptom onset on July 16 and lived in the same residential retirement facility during the entire exposure period.

In accordance with the DOH *Guidelines for the Surveillance, Investigation, and Control of Legionnaire's Disease in Florida*, a full epidemiological and environmental investigation was initiated by DOH-Duval and the regional environmental epidemiologist (REE). The Agency for Health Care Administration (AHCA), the Department of Business and Professional Regulation (DBPR), and the Department of Environmental Protection (DEP) were notified of the outbreak.

Methods

DOH-Duval Epidemiology staff obtained and reviewed medical records for the first two legionellosis patients and interviewed family members in lieu of the actual patients. Epidemiology staff conducted a retrospective medical record review with the facility health and wellness nurse for the previous year (June 2014 to July 2015). Epidemiology staff recommended urine antigen testing of all residents who developed fever, cough, shortness of breath, or pneumonia symptoms, and coordinated with local hospital infection control practitioners and laboratory directors to reinforce this recommendation for all cases identified during the investigation.

A confirmed case of Legionnaire's disease was defined as a person residing in the retirement community facility in the 14 days prior to onset of clinically compatible symptoms (i.e., fever, cough, shortness of breath, clinical or radiographic pneumonia, or myalgia) with confirmatory laboratory evidence of infection (i.e., positive culture or urine antigen test) between June 1 and September 30, 2015. A suspect case was defined as a person residing in the retirement community facility in the 14 days prior to onset of clinically compatible symptoms without confirmatory laboratory evidence of infection between June 1 and September 30, 2015.

A joint environmental assessment was conducted on July 23, 2015 with DBPR, DOH-Duval Environmental Health (EH) and Epidemiology staff, and the REE. EH staff reviewed facility engineering blueprint diagrams and visually inspected the facility plumbing on site for circulatory dead legs in design (i.e., areas of piping where water does not circulate or can become stagnant without routine flushing). Free chlorine levels, pH, and water temperature were also measured and recorded at each sample collection location. Investigators collected eight environmental samples (four bulk water and four swabs) from the facility maintenance/engineering room water piping and plumbing fixtures within residential rooms which were tested by the Bureau of Public Health Laboratories (BPHL). An industrial hygienist collected 75 environmental samples on July 30; 73 additional samples were collected on August 18 by the industrial hygienist after a hyperchlorination treatment of the premise plumbing system.

Results

Seven cases (three confirmed, four suspect) were associated with this 2015 residential retirement facility legionellosis outbreak. Ages ranged from 80 to 96 years old. Four cases were in women, and four cases were in assisted living (including one memory care) residents. The most common symptoms were fever, cough, and pneumonia. Onset times and symptom duration were difficult to assess among all cases; hospitalizations ranged from three to eight days. Of the seven infected people, two returned to the facility, two were transferred to different assisted living facilities, one moved into a family member's home, and two died. No other additional cases have been associated with this facility. One clinical sputum specimen analyzed by BPHL was culture positive for *Legionella pneumophila*.

Of the eight environmental samples tested by BPHL, all were negative for *Legionella* bacteria. Of the 75 environmental samples collected by the industrial hygienist on July 30, 20 (26.7%) tested positive for detectable levels of *Legionella* bacteria by a private laboratory. Of the 73 environmental samples collected by the industrial hygienist on August 18 after the hyperchlorination treatment of the premise plumbing system, two (2.7%) tested positive for detectable levels of *Legionella* bacteria. After consultation with the water safety company, plumbing modifications to the facility were completed on September 22 by a private plumbing contractor to incorporate a second chlorine dioxide injection point in the hot water recirculation loop.

Conclusions and Recommendations

A full epidemiological and environmental health assessment identified a total of seven legionellosis cases associated with a residential combined assisted and independent living facility. Water samples independently collected and tested by a private laboratory confirmed the presence of *Legionella* bacteria in the building premise plumbing. Post-disinfection water sampling results indicated nearly complete eradication of the bacteria (or reduction to undetectable levels) from the facility's premise plumbing system; however, the facility will continue to monitor for *Legionella* via monthly water testing through a private contractor.

Tattoo-Associated Nontuberculous Mycobacterial Skin Infections, Miami-Dade County, January to April 2015

Authors

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Background

On April 29, 2015, a local dermatologist reported three patients with skin infections to the Florida Department of Health in Miami-Dade County (DOH-Miami-Dade) Epidemiology, Disease Control, and Immunization Services (EDC-IS). All three patients reported receiving tattoos at Studio A from Artist A between February and March. Nontuberculous mycobacterial (NTM) infections were suspected based on clinical presentation and history. NTM bacteria are endemic in the environment, and found in high numbers in water, soil, and biofilms in drinking water systems. Cutaneous exposure to NTM produces a rash-like illness which often requires treatment with a combination of antibiotics for several months. In recent years, a number of NTM outbreaks associated with tattoo studios have been reported in the literature. These outbreaks have been associated with both poor infection control practices at tattoo studios and contamination of tattoo ink at the point of manufacture. DOH-Miami-Dade EDC-IS immediately initiated an epidemiological investigation and notified DOH-Miami-Dade Environmental Health (EH), the regulatory body for tattoo studios. EH informed EDC-IS that they had received a previous complaint of illness associated with the studio on April 7. The U.S. Food and Drug Administration (FDA) was subsequently notified.

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Methods

Epidemiologic Investigation

Epidemiology case definitions were based on characteristics of the first reported cases. A suspect case was defined as a person who received a tattoo at Studio A between December 1, 2014 and April 30, 2015 and developed a rash localized within the tattoo area or along its borders which lasted longer than two weeks. A probable case met the suspect case definition and also had histopathological or stain evidence of acid-fast organisms. A confirmed case met the suspect case definition and also had a positive NTM culture, immunohistochemical (IHC) stain, or polymerase chain reaction (PCR).

Clinical Laboratory Investigation

Clinical isolates and biopsy specimens from 13 clients were forwarded to the Bureau of Public Health Laboratories (BPHL) and the Infectious Diseases Pathology Branch (IDPB) at the Centers for Disease Control and Prevention (CDC) for further evaluation. Laboratory analyses included culture and PCR of fresh tissues. PCR tests were completed by CDC and included *Mycobacterium* genus 16S rRNA, *Mycobacterium abscessus-chelonae* complex, and *Mycobacterium* genus groEL assays. Fixed tissues underwent histopathologic review at CDC using hematoxylin and eosin (HE) stain, Ziehl-Neelsen acid-fast stain (ZN AF stain), and *Mycobacterium* species immunohistochemical stain (IHC).

Environmental Investigation

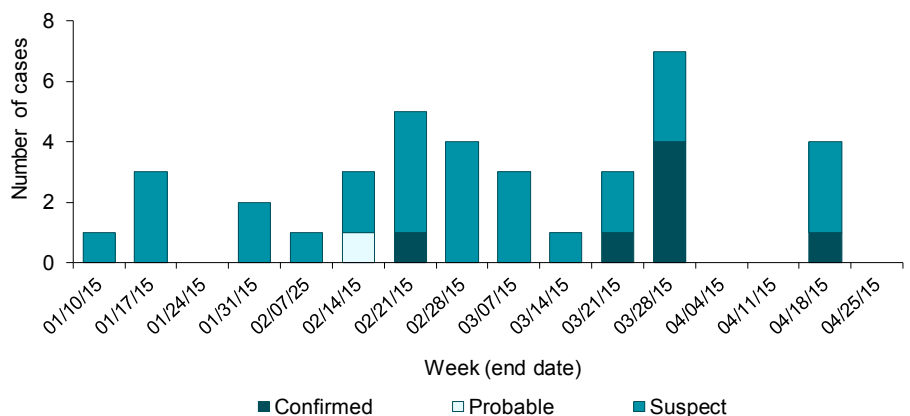
EH conducted an inspection of Studio A on April 8. Environmental samples collected from Studio A included an opened bottle of greywash ink (Ink A) used on clients, 10 samples of 100 milliliters (mL) of tap water, and two faucet swabs. No unopened bottles of Ink A were available for testing. Distilled water used for dilution was not available for testing. Environmental samples were submitted to FDA laboratories for microbiological testing and genome analysis. On April 30, EDC-IS interviewed the owner of Studio A. EH conducted a survey of 85 of 106 licensed tattoo studios in Miami-Dade County to identify studios using Ink A. Five unopened bottles of Ink A with the same lot number as the ink used at Studio A were obtained for testing.

Results

Epidemiologic Investigation

EDC-IS interviewed 246 clients (a response rate of 68.9%); 20 (8.1%) of 246 refused interview. Thirty-eight met the case definition (seven confirmed, one probable, and 30 suspect cases); 27 (71.0%) cases were in men and the median age was 28 years (range: 19 to 54 years). Implicated tattoo sessions occurred between early January and mid-April; symptom onsets fell between January 13 and April 23 (see Figure 1). All 38 cases reported nodules, 29 (76.3%) redness, 22 (57.9%) itching, 10 (26.3%) swelling, 10 (26.3%) pain, and 3 (7.9%) fever. On initial interview on May, 17 (44.7%) reported seeking medical attention; nine (52.9%) of those were prescribed antibiotics for NTM according to medical records and four (44.4%) of the nine reported taking the medication. Incubation periods ranged from 1 to 59 days. Duration of rash ranged from 15 days to 5 months. During follow-up interviews in September, 13 (61.9%) of 21 cases reported clinical resolution and 17 (44.7%) were lost to follow-up. Nine (64.3%) of 14 reported scarring and 3 (23.1%)

Figure 1. Number of Confirmed, Probable, and Suspect Cases of Tattoo-Associated Nontuberculous Mycobacterial Infections by Date of Tattoo Session at Studio A, Miami-Dade County, January to April 2015 (n=37)*



* One case did not have a known tattoo date and is excluded here.

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of 13 reported return of rash (one person was not asked about reoccurrence of rash). Of the 38 cases, 31 (81.6%) had tattoos done by Artist A (attack rate: 28.1%), 5 (13.2%) by Artist B (attack rate: 5.6%), and 2 (5.3%) by Artist C (attack rate: 8%). When controlling for individual tattoo artist and ink colors, logistic regression showed that being tattooed by a specific artist was not statistically significant; however, clients who reported grey ink were 8.24 times as likely to have a rash than those who did not report grey ink (odds ratio: 8.24, 95% confidence interval: 3.069-22.127).

Clinical Laboratory Investigation

Of the 13 clients with isolates and biopsy specimens submitted for testing, BPHL culture results were only available for nine cases. One probable case was positive for acid-fast bacteria by ZN AF only. Of seven confirmed NTM cases, six were positive for *M. abscessus* or *M. abscessus-chelonae* complex by culture (four cases) or PCR (three cases). The seventh case was culture- and PCR-positive for *M. fortuitum*.

Environmental Investigation

During the April 8 EH inspection of Studio A, the inspector noted that Artist A habitually diluted the greywash ink (Ink A) with distilled water and advised the studio to stop use of the greywash ink. On April 30, following an interview with the owner of Studio A, EDC-IS learned that Artist A purchased stolen items in January 2015, including opened and unopened heat-sealed bottles of greywash ink and tattoo machines that were reportedly used on symptomatic clients. The owner reported having three tattoo artists employed at the time the rashes occurred. Interviews with all three artists identified that Artist B used the greywash ink a “few times in the past six months,” and Artist C reported “never (having) used the greywash ink,” but both artists diluted ink using distilled water. The studio owner reported that the artists regularly used both distilled and tap water for dilution, and they “never had an issue in the past.” The studio reportedly stopped using Ink A following this site visit.

Environmental samples tested by the FDA grew multiple species of *Mycobacterium*. Tap water from Studio A grew *M. abscessus*, *M. phocaicum*, and *M. mucogenicum*. The open bottle of Ink A from Studio A grew *M. abscessus* and *M. fortuitum*. Five unopened Ink A bottles from Studios B and C of varying dilution levels grew *M. chelonae* and various mold species.

Conclusions and Recommendations

Cases of NTM skin infections following recent tattoos were only reported at Studio A despite a survey of more than 100 studios in the area with several reporting use of Ink A from the same lot. This observation prompted a closer look at artist practices at this studio and initially supported the idea that ink contaminated at the point of manufacture was a less likely source of this outbreak. Furthermore, when laboratory results were available, clinical specimens, tap water, and the opened bottle of Ink A from Studio A grew *M. abscessus*, suggesting that contamination of the opened bottle of Ink A with tap water at Studio A could be a source of the outbreak. This route of contamination is further supported by earlier reports from the owner that the artists regularly used both distilled and tap water to dilute greywash ink. Additionally, it is important to note that four additional cases were identified after the tattoo studio reportedly stopped the use of Ink A on April 7 (see Figure 1). Cases were identified among clients of all three artists; one case, a client of Artist A, was PCR-positive for *M. abscessus-chelonae* complex. These additional cases could be explained if periodic, subsequent contamination of ink or equipment by contact with tap water occurred through common practices at this tattoo studio. Despite negative results for faucet swabs and absence of biofilm samples, the NTM-positive tap water results may indicate the potential presence of a biofilm upstream. Characteristic properties of biofilms include a process of attachment, growth, and breaking off, a cycle which may increase levels of NTM typically found in tap water sources. The epidemic curve shows a pattern of peaks in cases which may reflect this cycle (see Figure 1).

A much greater concern was that contamination of Ink A at the point of manufacture was a possible source of the outbreak as many more tattoo clients could have been exposed at other area tattoo parlors where Ink A was distributed. Because NTM identified in clinical specimens did not match NTM

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present in unopened bottles of ink, a definitive link between outbreak cases and contamination at the point of manufacture could not be made. Ink A as a possible source of the outbreak remained a concern because clinical specimens were only available for a fraction of cases and unopened bottles of Ink A tested positive for *M. chelonae* and other contaminants. *M. chelonae* has been linked to tattoo-associated outbreaks in the literature. Due to these concerns, FDA and the manufacturer of Ink A issued a national recall of the implicated lot number on July 22.

Investigation of current standards of practice for tattoo artists in Florida is currently being performed by DOH. It is imperative that clear recommendations be provided in order to prevent future outbreaks. Although CDC recommends that manufacturers ensure that ink is sterile and advises against dilution with non-sterile water, no FDA regulation exists requiring sterile tattoo inks. Instead, FDA delegates this responsibility to local government jurisdictions; regulations in Florida currently recommend following manufacturer guidelines for the dilution of tattoo inks, guidelines which did not exist for this particular greywash ink. Tattoo patrons should be made aware of the infection risks associated with tattooing, not only those that result from bloodborne pathogens, but also bacteria in contaminated inks and non-sterile water. The community would benefit from regulation of tattoo ink manufacturing, guidance on the dilution of tattoo ink, consumer-accessible documentation of sterile FDA-approved ink, and education on reporting adverse reactions and tattoo-related outbreaks to FDA and DOH, respectively.

Investigation of a Gastrointestinal Outbreak Associated With a Lifeguard Camp, Okaloosa County, June 2015

Authors

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Background

The Panhandle regional environmental epidemiologist (REE) was notified of a possible foodborne outbreak via a complaint that was submitted through the online foodborne complaint system on June 27, 2015. The complaint reported that 24 out of 25 children were ill with nausea and vomiting after consuming barbeque (BBQ) pork from a restaurant. Because of the potentially large number of children involved, the REE forwarded the complaint to the Florida Department of Health in Okaloosa County (DOH-Okaloosa) via the county's after-hours phone number and investigation was initiated on June 27.

Methods

DOH-Okaloosa staff attempted to interview the complainant and identify others in the group who were ill. Early in the investigation, it was noted that the children were attending a beach lifeguard camp; DOH-Okaloosa acquired the camp director's contact information and requested a line list of attendees. Initial interviews were conducted using the Tri-Agency Foodborne Illness Survey/ Complaint Form, but as more information was gathered, an outbreak-specific questionnaire was used. Data were collected and analyzed using Epi Info 7.

DOH-Okaloosa and the Department of Business and Professional Regulation (DBPR) conducted a joint assessment of the restaurant facility where food was prepared on June 29. DOH-Okaloosa spoke with camp staff to ascertain how food items were handled between picking them up from the restaurant and consumption at a local park. DOH-Okaloosa attempted to collect clinical specimens and leftover food items for pathogen analysis.

A case was defined as someone who attended the beach lifeguard camp meeting on June 26 and subsequently became ill with nausea and vomiting within six hours.

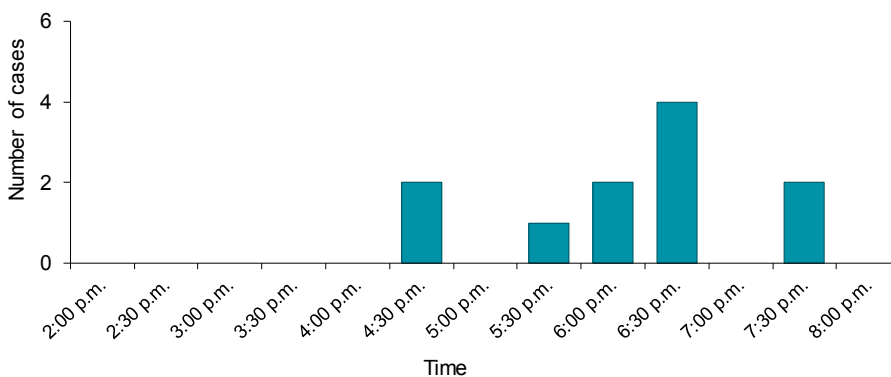
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Results

The camp that this group attended was a 2-week beach lifeguard training camp. There were no pool exposures. June 26 was the last day of the camp and the group met at a local park. The pork and the BBQ sauce were picked up by camp staff on June 25 and taken to the camp office (about a 10- to 15-minute drive from the restaurant). Nine pounds of pork pulled pork was stored in a disposable aluminum pan covered in aluminum foil. The pork and the sauce were put directly into the refrigerator. The next day, June 26, the pork was taken out of the refrigerator around 12:45 p.m. and was placed in the oven at 1 p.m. at 250°F for approximately one hour. The pork was removed from the oven around 2 p.m. and driven to the park (about a 5- to 10-minute drive). The temperature of the pork was not taken while reheating. The BBQ sauce was not heated. Food was served around 2:30 p.m.

DOH-Okaloosa was not able to get a line list of attendees from the camp director. All interview names were supplied by the original complainant or from other parents giving contact information. The total number of lunch attendees is unknown. DOH-Okaloosa interviewed 18 people, including both camp attendees and employees. Eleven people met the case definition. Eight of the 11 cases were in males. Ages ranged from 9 to 28 years old. The incubation period ranged from two to five hours with a median of four hours (see Figure 1). The duration of illness ranged from 30 minutes to 12.5 hours. All cases reported nausea and vomiting; other reported symptoms included abdominal cramps (seven cases), diarrhea (five cases), weakness (three cases), fatigue (three cases), chills (two cases), headache (one case), and dehydration (one case). No cases sought medical attention for their symptoms. No clinical specimens or leftover food items were available for pathogen analysis. Food items that were served at the lunch included pork, BBQ sauce, buns, chips, and lemonade. Statistical analysis of risk by food item was not meaningful for this outbreak due to the small sample size and all members of the group consuming the same food items.

Figure 1. Number of Gastrointestinal Outbreak Cases Associated With a Lifeguard Camp by Time of Onset, Okaloosa County, June 2015 (n=11)



DOH-Okaloosa and DBPR conducted a joint assessment of the restaurant facility on June 29. During the assessment, no employees were noted to be ill in the two weeks prior; the DBPR investigator noted two high-priority violations, three intermediate violations, and eight basic violations. One of the high-priority violations was potentially hazardous food (PHF) being cold-held at >41°F (chili at 48°F and coconut cream pie at 46°F) and a stop sale was issued on the chili for temperature abuse. One intermediate violation was ready-to-eat (RTE) PHF prepared onsite held >24 hours that was not properly date marked. The restaurant received a follow-up inspection on June 30 and three basic violation were noted. The restaurant met inspection standards upon the callback. Of note, this restaurant had an alternate operating procedure allowing staff to have bare hand contact with RTE foods.

Conclusions and Recommendations

In this investigation, no stool specimens or food samples were collected and analyzed to determine the pathogen. Given the short incubation times, symptoms, duration, and information gathered during the investigation, one possible cause of the outbreak is *Staphylococcus aureus*. *S. aureus* is a gram-positive bacterium that produces a highly heat-stable protein toxin. Staphylococcal food poisoning is caused by the enterotoxins produced by the bacterium. Onset of illness is generally rapid and ranges from 30 minutes up to eight hours. The most common symptoms are nausea, abdominal cramps,

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vomiting, and diarrhea. Illness typically lasts one or two days, but can last longer in severe cases. Foods that are frequently associated with staphylococcal food poisoning are meat and meat products, poultry and egg products, and foods that require considerable handling during preparation and are kept at elevated temperatures after preparation. Staphylococci can be found in the nasal passages, throats, and on the hair and skin of 50% or more of healthy individuals.

Overall, it is likely that the pork may have been contaminated during food preparation given that employees can have bare hand contact with RTE foods. The restaurant supplied the pork hot to camp staff. If the food had been consumed the same day, there may not have been opportunity for the bacteria to grow. However, since the food was supplied within the appropriate temperature range, put into a refrigerator to cool overnight, and reheated the next day, temperature abuse of the meat likely occurred and contributed to this outbreak. Future recommendations included distributing meat into smaller containers to allow the meat to cool faster and keeping it uncovered while cooling.

***Vibrio vulnificus* Outbreak Associated With Consuming Raw Oysters From a Restaurant/Market, Lee County, December 2015**

Authors

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Background

On December 9, 2015, the Florida Department of Health in Lee County (DOH-Lee) received a report from a local hospital of a positive *Vibrio vulnificus* laboratory result for a 76-year-old man who was admitted to the hospital on December 7 with an initial diagnosis of septic shock. DOH-Lee initiated an investigation upon notification of the laboratory report and conducted phone interviews with the man's daughter to gather information about potential exposures.

Methods

Interviews were conducted using the standard *V. vulnificus* data collection form. A confirmed case was defined as a person who consumed raw oysters purchased from the restaurant/market on December 6 and had a confirmed *V. vulnificus* laboratory result from a clinical specimen. A probable case was defined as a person with clinically compatible illness characterized by diarrhea, vomiting, or primary septicemia who was epidemiologically linked to a confirmed case. The index case's isolate was forwarded to the Bureau of Public Health Laboratories (BPHL) for confirmation.

On December 10, DOH-Lee notified the Florida Department of Business and Professional Regulation of the incident. DOH-Lee contacted the restaurant/market to obtain oyster tags.

Results

Two cases were identified; one met the confirmed case definition (76-year-old father) and the second was a probable case (36-year-old daughter). Both cases had an onset date of December 6 approximately five hours after consuming raw oysters. The daughter reported nausea, vomiting, and abdominal cramps lasting 30 hours and the father had fever and septic shock. The father had pre-existing health conditions and was undergoing chemotherapy for liver disease; he died on December 8. BPHL confirmed the isolate as *V. vulnificus* on December 22.

The oysters supplied to the restaurant/market were harvested in Florida from two different locations on November 29 and December 3. The restaurant/market did have the appropriate consumer warning of risks associated with consumption of raw and undercooked foods posted.

Conclusions and Recommendations

This was a confirmed outbreak of *V. vulnificus* associated with the consumption of raw oysters. The symptoms and type of shellfish consumed are commonly associated with *V. vulnificus* infection. *V. vulnificus* can cause particularly severe disease, with about 50% of bloodstream infections being

fatal. *V. vulnificus* is a bacterium that lives in brackish saltwater and seawater. It is present in higher concentrations in warmer waters. In people who are immunocompromised, particularly those with chronic liver disease, *V. vulnificus* can cause disease with potentially fatal complications after eating contaminated seafood or exposing an open wound to contaminated seawater. In healthy people, ingestion of this organism can cause gastroenteritis that generally remains localized and is self-limiting. Among susceptible people, the organism may cause primary septicemia (septic shock). Susceptible people include those with a predisposing condition; for example, those who are immunocompromised or have high serum iron levels (usually due to liver disease). More than 90% of *V. vulnificus* illnesses in the U.S. are associated with consumption of raw Gulf Coast oysters. Ingestion of clams and shrimp has also been associated with disease. Thorough cooking or freezing kills the organism, so illnesses usually occur from consumption of raw seafood or cooked seafood that has been contaminated with raw product.

The strengths of this investigation included the strong relationship between epidemiology and environmental health and the interagency partnership allowing for timely retrieval of oyster tags. The hospital laboratory reported illness as required and forwarded the specimen to BPHL for confirmation. Limitations included the inability to complete statistical analysis due to the limited number of cases, inability to interview other exposed family members and the man who died, limited food history recall from ill individuals, and lack of implicated foods available for analysis.

Local Listeriosis Cluster Linked to Retail Facility, Palm Beach, September 2013 to August 2015

Authors

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Background

In 2015, the Florida Department of Health (DOH) Food and Waterborne Disease Program (FWDP), the Florida Department of Agriculture and Consumer Services (FDACS), and the Centers for Disease Control and Prevention (CDC) investigated a local cluster of listeriosis cases in Palm Beach County occurring from September 2013 through August 2015. DOH routinely interviews all listeriosis cases with the National *Listeria* Initiative Questionnaire and forwards all information to CDC. *Listeria* isolates are required to be submitted to the Bureau of Public Health Laboratories (BPHL) for confirmatory testing and BPHL forwarded all *Listeria* isolates to CDC for whole genome sequencing (WGS).

Methods

DOH conducted multiple interviews with infected people or their proxies to determine common exposures. An outbreak-specific questionnaire was administered by DOH. Geospatial analysis was conducted to determine the proximity of the implicated facility to cases. FDACS conducted an environmental assessment and environmental sampling of the facility. FDACS analyzed the environmental samples. Additional samples were collected by a private contractor and positive samples were forwarded to BPHL and CDC for confirmation.

Results

Nine cases were associated with this outbreak; all required hospitalization and four deaths were attributed to listeriosis. Ages of the infected people ranged from 0 to 92 years old with a median of 80 years; and six were men. A single retail facility was identified by five of the nine cases/proxies as a location where items were purchased. Six infected people resided within a one-mile radius of the retail facility. Specimens from eight cases had WGS analysis and were highly related. The environmental assessment by FDACS found environments conducive to the growth and harborage of *Listeria* and environmental samples were positive for *Listeria*. WGS determined the environmental and clinical isolates were not closely related. FDACS recommended remediation and worked closely with the retail facility to ensure the environment was free of *Listeria*.

Conclusions and Recommendations

Despite not identifying the same closely related *Listeria* strain from clinical and environmental samples, available evidence suggests this retail facility was the likely source of the on-going listeriosis cluster in Palm Beach County. The facility had a fire in early August 2015 and some equipment was discarded and no longer available for analysis. No additional cases have been identified in this county since remediation of the facility. Environmental assessment and sampling were imperative for source identification. Consulting with subject matter experts was imperative to the successful identification and halting of transmission of *Listeria* in the community.

Parasitic Diseases

***Cryptosporidium* Recreational Waterborne Outbreak at a Large Water Park, Hillsborough County, July to August 2015**

Authors

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Background

During the past two decades, *Cryptosporidium* has become recognized as one of the leading causes of waterborne illness in the U.S. The parasite is found in every part of the U.S. and the world. *Cryptosporidium* is one of the leading causes of waterborne disease in the U.S.

In early August 2015, the Florida Department of Health in Hillsborough County (DOH-Hillsborough) began receiving case reports of residents testing positive for *Cryptosporidium*. Surveillance conducted on reported cryptosporidiosis cases by the Hillsborough Epidemiology office identified that many of the cases had visited a local water park in Tampa. This was the same large water park where a cryptosporidiosis outbreak was identified in the summer of 2014. A notice was posted on EpiCom, Florida's moderated web-based communication forum, and epidemiologists in several surrounding county health departments notified DOH-Hillsborough that some of their reported cryptosporidiosis cases had also visited the same water park. An investigation was initiated, including an environmental assessment of the identified water park, contact with park management, and active case finding.

Methods

DOH-Hillsborough conducted case investigations on reported cryptosporidiosis cases from physicians, health care clinics, and private citizens in Hillsborough County and received additional reports from surrounding county health departments. Active case finding was implemented, including posting to EpiCom and review of syndromic surveillance data. A confirmed case was defined as any person visiting the identified water park in Tampa in July or August 2015 with positive *Cryptosporidium* laboratory result. A probable case was defined as any person visiting the identified water park in Tampa in July or August 2015 who became symptomatic with diarrhea but lacked laboratory evidence of the illness.

On August 6, an environmental assessment of the water park was conducted by DOH-Hillsborough Environmental Health staff. Park management staff were notified of the reported cryptosporidiosis cases with possible exposure to the water park.

Results

Analysis of surveillance data identified nine confirmed and 13 probable cryptosporidiosis cases in water park attendees. In addition, three secondary cases with exposure to confirmed cases were also identified. Ages ranged from 1 to 68 years old. Onset dates of cases ranged from July 10 to August

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29. These cases represented approximately 35% of all reported cryptosporidiosis cases in the state during this period. The investigation identified that all reported cases had visited the park during the months of July and August. Cases visiting the park used various water slides, pools, and play areas throughout the water park. Cases were reported in residents of Hillsborough, Miami-Dade, Pinellas, and Pasco counties.

Results from the environmental assessment at the waterpark did not identify any significant violations of current Florida pool code. Water chemistry records were reviewed and all four fecal accidents reported during July were treated according to Centers for Disease Control and Prevention (CDC) recommendations for eliminating *Cryptosporidium*.

Conclusions and Recommendations

A recreational waterborne outbreak associated with attendance at a local water park in Hillsborough County occurred in July and August. Although no significant violations of current codes were identified during environmental assessments of the park, a secondary disinfection system was not used, potentially allowing *Cryptosporidium* oocysts to survive and circulate for extended periods of time. The investigation indicated that several confirmed cases attended the park while infectious and were likely the source of at least some of the reported cases. The facility was following CDC guidelines for pool disinfection after detection of fecal accidents. Unfortunately, the specific dates of the fecal accidents were not collected. Recommendations made to the management included educating park staff and visitors on established bathing rules, especially involving exclusion of symptomatic bathers, and to strongly consider use of more effective disinfection methods to reduce likelihood of transmission of *Cryptosporidium* at their facility.

Viral Diseases

Measles Outbreak, St. Lucie and Indian River Counties, April to May 2015

Authors

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Background

On April 13, 2015, a local provider notified the Florida Department of Health in St. Lucie County (DOH-St. Lucie) of a suspected case of measles in an unvaccinated 6-year-old girl with no known history of travel or exposure to persons with rash illness. Three days later, DOH in Indian River County (DOH-Indian River) received a call from a concerned mother stating that two of her adult children and a family friend had been clinically diagnosed with measles; none had a previous history of vaccination for measles. Measles is transmitted through inhalation of respiratory droplets generated when an infected person coughs, sneezes, or talks. Measles is a highly infectious disease, with >90% attack rate among susceptible contacts. The incubation period, prior to onset of prodrome, ranges from 7 to 21 days. No longer endemic in the U.S., measles cases in Florida residents are almost always reported in unvaccinated individuals who have traveled to an area experiencing an outbreak or contacts of unvaccinated ill travelers from areas with measles activity. DOH-St. Lucie and DOH-Indian River launched coordinated investigations due to concerns that these cases may be part of the same outbreak as they were clustered in space and time.

Methods

Epidemiological Investigation

In both counties, health care providers and other public health partners were alerted to be aware of measles, isolate and report suspected cases, and ensure persons were up-to-date on vaccines. All suspected cases were tested by serology or polymerase chain reaction (RT-PCR) at the Bureau of

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Public Health Laboratories (BPHL) within days of the initial reports. Specimens requested for all suspect measles cases included serum, urine, and nasopharyngeal/oropharyngeal swabs. Genotyping was completed at the Centers for Disease Control and Prevention (CDC) for two of the suspected cases.

Enhanced surveillance at area hospitals was conducted using daily queries of syndromic surveillance data for measles starting on April 17. A retrospective review of syndromic surveillance data back to March 1 was completed.

Contact Investigation

Movement histories were obtained for all cases during their contagious periods. For the purposes of these contact investigations, the contagious period was defined as four days prior to rash onset through four days after rash onset. Two serial incubation periods were used to establish the period of enhanced surveillance. Household settings and contacts were evaluated.

Results

Epidemiological Investigation

Upon investigation, all four initial suspected cases met the current suspect surveillance case definition for measles with fever and clinically compatible rash illness. Patients ranged in age from 6 to 23 years (see Table 1). The earliest reported onset dates were for the two Indian River women who recently returned from India with their church group on March 25; rash onsets for both were April 1. The 20-year-old brother of one of these travelers developed rash onset one week later on April 8; he had no history of recent travel and worked in the food court of the local mall and attended the area community college. The 6-year-old St. Lucie girl developed a rash around the same time with onset on April 7, 2015; her twin sister developed rash illness 11 days later. All five measles cases were confirmed by serology or PCR at BPHL within days of the initial reports. Genotyping completed at CDC for the initial patient in St. Lucie and the 20-year-old Indian River man demonstrated identical measles virus D8 sequences.

Table 1. Characteristics of Confirmed Measles Cases in Indian River and St. Lucie Counties, April to May 2015

County	Gender	Age	Onset date	Rash onset	Laboratory confirmation	One incubation period	Two incubation periods
St. Lucie	F	6	04/07/15	04/12/16	04/15/15	05/07/15	05/28/15
Indian River	F	23	04/01/15	04/02/16	04/18/15	04/27/15	05/18/15
Indian River	M	20	04/08/15	04/12/16	04/18/15	05/07/15	05/28/15
Indian River	F	17	04/01/15	04/04/16	04/21/15	04/29/15	05/20/15
St. Lucie	F	6	04/18/15	04/21/16	04/24/15	05/16/15	06/06/15

Retrospective review of syndromic surveillance data identified 30 emergency room visits that matched the measles query used. Additional information for these visits was requested from local hospital infection preventionists. Chart notes were reviewed and none met the case definition for persons under investigation (PUIs). Prospective daily review of syndromic surveillance data for suspicious rash illnesses or possible measles cases identified an additional 16 visits that were reviewed; no PUIs were identified.

Contact Investigation – Indian River County

Additional household members of the Indian River family included parents who reported a history of measles vaccination and an unvaccinated, homeschooled 16-year-old sister who received her first measles vaccine on April 3.

In Indian River, 434 potentially exposed contacts were identified in 10 settings, including family homes, a mobile clinic, an urgent care, church, school, and a community college (see Table 2). One case attended a church musical that was open to the public during their infectious period. There were

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approximately 300 attendees, and none of these contacts could be individually identified for follow up; most were likely church attendees. The pastor notified all church members of the potential exposure by email, and asked them to notify DOH-Indian River if they developed symptoms. Of the 134 contacts for whom contact information was available, 122 (91.0%) were interviewed. No additional cases were identified by the completion of two incubation periods ending on May 28. Several symptomatic contacts were identified during the investigation and were isolated until ruled out or no longer considered infectious. All asymptomatic contacts were asked to monitor for symptoms of measles for 21 days following exposure and provided with guidelines on what to do should they develop symptoms during this time period.

Table 2. Measles Contact Investigation Summary by County, Indian River and St. Lucie Counties, April to May 2015

County	Potentially exposed identified	Exposed reached	Exposed not reached	Exposed with evidence of immunity	Exposed without immunity	Exposed with unknown immunity	Exposed with suspected measles
St. Lucie	1,126	1,052	74	1,032	58	36	1
Indian River	434	122	312	68	6	360	3
Total	1,560	1,174	386	1,100	64	396	4

Contact Investigation – St. Lucie County

Additional household members of the St. Lucie family included parents with a history of measles vaccination and an unvaccinated twin sister who did not receive chemoprophylaxis within the recommended window. All remaining household members were asymptomatic at the time of initial interview and were asked to monitor for symptoms for a period of 21 days from their last exposure. Quarantine at home was recommended for the twin sibling as the risk for measles was considered to be extremely high. She subsequently developed symptoms of measles, though her illness did not extend the period of enhanced surveillance because she was quarantined at the time of onset.

Additional high-priority settings for the rapid identification of susceptible contacts in St. Lucie included the twins' elementary school and their pediatrician's office (see Table 2). Vaccination records were reviewed for 694 students at the elementary school; only five students were recorded as not immune and required further individual follow-up by investigators. A school letter was sent out to notify parents that a child attending the school had been diagnosed with measles. One hundred eighty-five (90.7%) of 204 contacts at the pediatrician's office were contacted; 33 had no documented immunity to measles, many of whom were infants. Infants exposed within the last six days were offered post-exposure prophylaxis with immune globulin (IG) at the DOH clinic; eight infants received IG (one dose provided by a hospital). Other settings included a gym, restaurants, a civic center, and relatives' homes. A total of 11 settings and 1,126 contacts were identified as part of the contact investigation in St. Lucie County; 93.4% of contacts were reached as part of the investigation. Those who could not be reached by phone after three attempts on three different days and times were sent a letter. Sometimes vaccination records were available through review of medical records or Florida's voluntary statewide immunizations registry even if contacts could not be reached, allowing ascertainment of immune status. Home visits were conducted if there were concerns regarding no or unknown immunity to measles. For example, home visits were completed for households with unvaccinated infants when not reachable by phone. Only 93 (8.3%) contacts remained categorized with no or unknown immune status at the completion of the investigation.

Conclusions and Recommendations

Available epidemiological data suggest the outbreak originated with two imported measles cases in Indian River residents returning from an overseas mission to India. As a result of this investigation, DOH-Indian River identified faith-based and international aid organizations in the county and provided immunization recommendations for persons planning international travel.

Local transmission to the sibling in Indian River was likely a result of exposure to his sister in the household setting. Lack of travel history for the St. Lucie cases suggests measles was locally acquired from an unknown source case. It is possible that there was another generation of local transmission

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involving the twin since her onset of symptoms was 11 days after her sister, but it is also possible she was exposed at the same time and had a longer incubation period. Although definitive exposure of the St. Lucie cases to the Indian River cases was not identified, genotyping results suggest that all five cases share a common origin.

Despite extensive contact investigations in both counties involving more than 1,500 potentially exposed contacts in 20 settings, only one additional confirmed measles infection in the 6-year-old twin sister was identified by the end of the enhanced surveillance period on May 28. Given the time and resources involved in these types of contact investigations, further prioritization and investigation into more creative and efficient means for follow-up are needed.

Non-Infectious Agents

Foodborne Illness Outbreak Associated With a Convenience Store, Hernando County, September 2015

Authors

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Background

On September 24, 2015 the Florida Department of Health (DOH) Food and Waterborne Disease Program (FDWP) received a complaint from the Florida Department of Agriculture and Consumer Services (FDACS) regarding seven people from two different households experiencing vomiting 30 minutes after consuming beverages purchased at a local convenience store. In response to this complaint, an investigation was initiated by FDWP, FDACS, and DOH in Hernando County (DOH-Hernando).

Methods

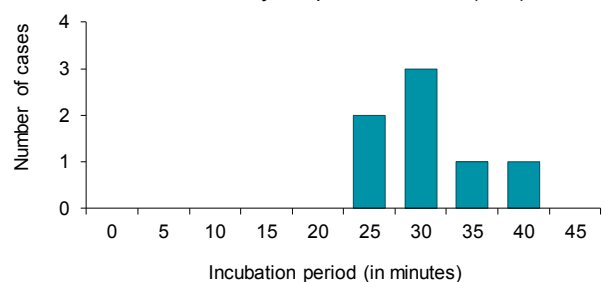
The Tri-Agency Foodborne Illness Survey/Complaint Form was used to elicit detailed information on clinical presentation and possible exposures. Florida's Environmental Health Surveillance (FLEHS) database was reviewed to identify any additional illness complaints related to the implicated product. A case was defined as a person who experienced vomiting following consumption of Rico Splash flavored drink purchased from convenience store A on September 23.

A joint environmental health assessment was conducted by the DOH-Hernando Environmental Health manager, the regional environmental epidemiologist and an FDACS inspector on September 29. Four 1-gallon Rico Splash samples were collected and submitted for analysis to the FDACS Bureau of Food Laboratories.

Results

Seven people from three households met the case definition. The only common exposure in the week prior to illness was consuming the Rico Splash flavored drink on September 23. Four cases were in women and ages ranged from 8 to 46 years old. The incubation period ranged from 25 to 40 minutes with a median of 30 minutes (see Figure 1). Duration of illness was two days. All seven people had nausea and vomiting; none sought medical attention for their illness. No stool specimens were collected for testing because all the cases symptoms had resolved. No other complaints were received and no other potential cases with similar symptoms or exposures were identified through surveillance efforts.

Figure 1. Number of Outbreak Cases Associated with Rico Splash Flavored Drink By Incubation Period, Hernando County, September 2015 (n=7)



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During the environmental health assessment, inspectors observed that gallon bottles at the store had different volumes and varying color shades. Orange-flavored drink bottles also had a cloudy residue floating on top. FDACS stopped sales on all of the Rico Splash bottles at the store citing “unknown source” because the label did not have a manufacturer’s address or phone number listed. Out of the four Rico Splash samples collected during the environmental health assessment, the orange-flavored drink sample contained 14.6 parts per billion (ppb) of benzene.

Further investigation by FDACS identified that the product was produced by Spring Lake Water of Brooksville. On November 2, an FDACS inspector visited Spring Lake Water and collected two samples of Rico Splash orange-flavored drink. On November 10, the FDACS Bureau of Food Laboratories reported that one sample contained 9.8 ppb of benzene and the other sample contained 14.4 ppb, resulting in FDACS inspectors immediately stopping sales of the 459 gallons remaining at Spring Lake Water. The food entity issued a recall notice and provided FDACS with a list of all customers who received the implicated product for effectiveness checks. The food entity provided FDACS with traceback information on the beverage bases and ingredients used to produce the implicated product.

Conclusions and Recommendations

These illnesses appeared to be associated with the consumption of Rico Splash orange-flavored drink on September 23. The flavored drink was confirmed to be adulterated with benzene. Symptoms described by the cases were consistent with other documented benzene poisonings. Because of the rapid coordinated investigation by FDACS and DOH, the food entity issued a recall notice and the adulterated product was removed from the market preventing any further illnesses from occurring. At the time of this report, the source of the benzene has not been identified, Spring Lake Water has stopped production of the flavored drink products, and the investigation is on-going.

Occupational Lead Poisoning Cluster at a Gun Range, Volusia County, December 2015

Authors

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Background

There is increasing evidence of the toxicity of lead for adults at low doses and its association with hypertension, adverse effects on renal function, cognitive dysfunction, and adverse female reproductive outcomes. In Florida, a blood lead level (BLL) ≥ 10 micrograms per deciliter ($\mu\text{g}/\text{dL}$) meets the surveillance case definition for lead poisoning. Adult lead poisoning is primarily caused by exposure to lead in the workplace or during certain hobbies where lead is used. Around 95% of BLLs ≥ 25 $\mu\text{g}/\text{dL}$ are from occupational exposure. Indoor firing ranges are a source of lead exposure, and elevated BLLs among employees, their families, and customers occurs despite public health outreach efforts and comprehensive guidelines for controlling occupational lead exposure. On December 23, 2015, the Florida Department of Health in Volusia County (DOH-Volusia) received laboratory results for six residents with BLLs ranging from 12 to 31 $\mu\text{g}/\text{dL}$.

Methods

DOH-Volusia initiated an investigation that included reviewing laboratory results, interviewing employees of the gun range, and assessing the work environment.

Results

Investigation by DOH-Volusia identified that the six men with elevated BLLs were aged 28 to 40 years and worked as gun testers at an indoor firing range and firearms retailer in Daytona Beach in Volusia County. All six employees had undergone medical surveillance as required by the Occupational Safety and Health Administration. The six men did not report any symptoms of lead poisoning. Follow-up

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testing indicated that BLLs for five of the six the employees steadily declined after the initial test. Additional attempts to contact the employee whose BLLs did not decrease were unsuccessful. All employees reportedly wore appropriate respirators and operated in a properly ventilated indoor firing range; however, it was unclear whether the range had proper functioning ventilation shafts at the time the workers were exposed. Gathering additional information about renovation dates, written range maintenance protocol, gun range cleaning methods, and other possible sources of lead exposure among the gun range employees was challenging and incomplete.

Conclusions and Recommendations

This investigation highlighted the risk for lead exposure at indoor firing ranges despite federal regulations and specific guidelines pertaining to range design and operation. Recommendations were made to minimize employee exposure to lead, and the point of contact from the facility was educated on risks to employees and customers from airborne and surface lead exposure. Employees were advised to send family members for blood lead testing because of the potential for take-home lead exposures. DOH-Volusia additionally recommended the use of jacketed or lead-free bullets, use of a separate ventilation system for firing lanes, proper hygiene, a written protocol for range maintenance, and cleaning practices such as the use of wet mopping or high-efficiency particulate air (HEPA) vacuuming instead of dry sweeping to remove dust.

Elemental Mercury Poisoning Cluster in a Daycare, Hillsborough County, November 2015

Authors

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Background

On October 9, a 3-year-old boy (case 1) presented to an emergency department with a history of three weeks of anorexia, weight loss (about 2.7 kilograms), decreased activity, and abdominal and leg pain. During his hospital stay, he developed a maculopapular rash, tachycardia, hypertension, altered mental status, weakness, sweating, hand skin pilling, and swelling of the hands and feet. Several routine blood and urine laboratory tests were conducted including brain imaging studies with no significant findings. After excluding an initial diagnosis of rabies, heavy metal toxicity was suspected and laboratory tests were ordered after about four weeks. On November 11, urine mercury levels for case 1 were reported as 29.5 micrograms per liter ($\mu\text{g/L}$). On November 12, 2015, the Florida Department of Health in Hillsborough County (DOH-Hillsborough) was notified of the case by the Florida Poison Information Center Network. Children are at higher risk of mercury poisoning; therefore, it is important to investigate reports of mercury poisoning and identify sources of exposure.

Methods

The Florida Department of Environmental Protection (DEP) tested the home of case 1 on November 13 and the home daycare of case 1 on November 18. To identify additional cases, DOH-Hillsborough reviewed medical records; assessed the daycare in collaboration with other agencies; and conducted phone interviews with the daycare workers, visitors, and parents of the children. Additional children and adults were tested for mercury poisoning as part of the investigation.

Results

Subsequent investigation determined that the daycare owner had purchased an antique blood pressure cuff in early July 2015 as a toy for the children. Approximately three weeks later it was removed from the play area after the children pulled the device apart. The daycare owner was not aware of dangers of mercury used in a blood pressure cuff. Environmental assessment of the daycare identified high mercury vapor levels ranging from 50 to 87 micrograms per cubic meter ($\mu\text{g/m}^3$) in different areas of the daycare.

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Remediation was completed on November 20 by the U.S. Environmental Protection Agency (EPA) by removing visible mercury, carpet, carpet pads, and other household items contaminated with mercury. Very little mercury was left in the broken blood pressure cuff. It was obtained during cleanup and sealed in a plastic bag to avoid further contamination. The floor was cleaned with an Epsom salt wash, and the daycare was ventilated after heating to remove any vapors of mercury. The daycare was opened after mercury levels dropped to recommended levels for residential cleanup ($1 \mu\text{g}/\text{m}^3$).

DOH-Hillsborough contacted parents of the children who attended or visited the daycare since July 2015, provided information about the mercury spill, and recommended mercury testing through their own health care provider. As children may have carried mercury out of the daycare on their shoes or clothes, parents were asked to bring their cars for mercury testing. No mercury was detected in any of these cars so no further testing of their homes was conducted.

Including case 1, 23 individuals were tested for mercury. Sixteen people (10 children, 3 visitors, and 3 workers) had elevated blood or urine mercury levels ($\geq 10 \mu\text{g}/\text{L}$). Thirteen met the DOH surveillance case definition (12 confirmed and 1 probable) based on elevated mercury levels and illness consistent with mercury poisoning. Ages of cases ranged from <1 to 71 years with a mean of 14.4 years. The majority were male ($n=7$, 53.8%), non-Hispanic white ($n=13$, 100%), and residents of Hillsborough County ($n=11$, 84.6%). Two cases (15.4%) were in residents of Pasco County. Nine people (69.2%) received chelation therapy with only one dose of oral succimer to increase removal of mercury from the body. Following treatment, five people's urine mercury levels remained above the reference range. No one was chelated more than once.

Conclusion and Recommendations

Based on laboratory criteria (blood or urine level $\geq 10 \mu\text{g}/\text{L}$) and clinical compatibility, 13 people met the DOH surveillance case definition for mercury poisoning. Blood pressure cuffs contain about 80 to 100 grams of elemental mercury per unit which volatilizes slowly at room temperature and exposure can occur by inhalation. Children are at higher risk of such exposure and health effects from mercury poisoning depending on magnitude, dose, and duration of exposure. DOH investigation of the index case's daycare identified mercury levels above the Agency for Toxic Substances and Disease Registry suggested action level for mercury vapors in residential settings ($1 \mu\text{g}/\text{m}^3$). This finding was crucial to identifying and eliminating the source of exposure. As identified in case 1, a diagnosis of mercury poisoning should be considered by health care providers in cases of non-specific symptoms involving behavioral changes and several organ systems (e.g., gastrointestinal, neurological, dermal). It is also important to identify and eliminate the source of mercury exposure, which helps identify additional people with exposure and informs remediation efforts. Prevention is the key to reducing mercury poisoning. DOH has developed a fact sheet to educate daycare owners and others about the dangers of mercury in daycares (available at www.floridahealth.gov/environmental-health/mercury-spills/_documents/liquid-mercury-daycares.pdf).

Acute Sulfuryl Fluoride Poisoning in a Family, Martin County, August 2015

Authors

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Background

On August 19, 2015, the Florida Department of Health in Martin County (DOH-Martin) was notified by the Florida Poison Information Center Network and a local hospital of possible sulfuryl fluoride poisonings affecting a family in Martin County. Sulfuryl fluoride is a highly toxic gas fumigant used for termite control in homes and buildings. The U.S. Environmental Protection Agency (EPA) has classified sulfuryl fluoride as a restricted-use pesticide that can only be used by certified pest control

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operators. The structure to be fumigated is usually covered with a tarp or tent and sealed completely before releasing the gas. Chloropicrin, a colorless liquid lacrimating agent with a strong odor, is added to the gas fumigant as a warning agent to deter people from entering or remaining in an area that has been fumigated. Applicators post warning signs around the building. After fumigating for 2–72 hours, the tarp is removed and the structure is aerated using fans.

Methods

DOH-Martin initiated an investigation into exposure to sulfuryl fluoride associated with a house fumigation. The Florida Department of Agriculture and Consumer Services (FDACS) and the EPA Criminal Investigation Division also conducted an investigation after being notified of the incident by DOH. Medical records were reviewed and the father of the household was interviewed by DOH.

Results

On August 14, the house of a family of five (a grandmother, mother, father, son, and daughter) was fumigated with sulfuryl fluoride to eradicate a dry-wood termite infestation. At 4:00 p.m. on August 16, approximately 48 hours after the fumigation began, the family was permitted to reenter the house. That evening, the mother and son developed nausea and vomiting. By 6:00 a.m. the next morning, all family members had similar symptoms, prompting all family members except the father to visit a hospital emergency department. The grandmother, mother, and daughter were released the same day with diagnoses of chemical inhalation. The son, a previously healthy 9-year-old boy, had altered mental status, dysarthria, dystonia, rigidity, and hyperreflexia, but was alert and answering questions. He was treated with calcium gluconate to correct hypocalcemia; other laboratory tests were normal, and a urinary toxicology profile was negative. He was admitted to the pediatric intensive care unit and was intubated for the first two days of hospitalization for airway protection from aspiration. Computerized tomography scan of the brain showed no cerebral edema or evidence of bleeding. On August 18, he developed choreoathetosis that progressed to involve both arms, legs, and both sides of his face; a brain magnetic resonance imaging study was consistent with basal ganglia injury. He underwent two rounds of hemodialysis to assist with fluoride ion removal, although documentation of his serum fluoride concentration was not found in the medical record. After excluding carbon monoxide and heavy metal poisoning, anoxic brain injury, and metabolic disorders, the treating physicians attributed his neurologic findings to sulfuryl fluoride poisoning, manifested by basal ganglia necrosis. Because there is no specific antidote for sulfuryl fluoride poisoning, his management was supportive. Symptoms improved slightly during hospitalization, although dysarthria and choreoathetosis continued. On September 4, he was transferred to a rehabilitation facility where he experienced some additional improvement, but continued to have expressive aphasia and choreoathetoid movements of the face, trunk, and extremities. He was released on September 25.

On August 20, 2015, FDACS initiated an investigation and identified multiple violations related to the fumigation of the family's home, including failure to have functioning devices to measure sulfuryl fluoride concentrations and failure of the pest control operator to participate in the sulfuryl fluoride manufacturer's training and stewardship plan. Pest control operators are required to measure the level of sulfuryl fluoride remaining in each room of the fumigated space until all measurements are below the EPA-approved concentration of ≤ 1 parts per million before buildings are cleared for reentry. On September 29, FDACS revoked both the business license of the pest control company and certification of the pest control operator who conducted the fumigation. On March 10, 2016, the pest control company and two of its pest control operators pled guilty in federal court to the above-mentioned violations and others.

DOH determined that sulfuryl fluoride exposure was the most likely cause of illness among these five family members. According to the Florida surveillance case definition, four family members (grandmother, mother, daughter, and son) were classified as confirmed cases of pesticide-related illness, and the father was classified as a probable case.

Conclusions and Recommendations

Although sulfuryl fluoride is highly toxic and can cause severe injury if recommended safety measures are not followed, severe poisoning and death caused by sulfuryl fluoride are uncommon. Since 2010, only one other such case has been reported in Florida. Signs and symptoms of sulfuryl fluoride poisoning include irritation of the nose, eyes, and respiratory tract; dyspnea; numbness; weakness; nausea; vomiting; abdominal pain; slowed speech or motor movements; cough; restlessness; muscle twitching; seizures; and pulmonary edema.

The findings in this report are subject to limitations. Concentrations of sulfuryl fluoride were not measured at the house at the time of the incident and no laboratory tests were available to confirm exposure to sulfuryl fluoride. It is not known why only the son developed high-severity illness. It is possible he spent more time in less-ventilated parts of the house with higher sulfuryl fluoride concentrations or had higher susceptibility.

Although sulfuryl fluoride has been observed to cause basal ganglia injury in animals, this is the first report of basal ganglia injury in humans resulting from systemic sulfuryl fluoride poisoning. This exposure underscores the importance of strict compliance with pesticide label requirements. The EPA subsequently proposed revised rules for enhanced training and certification of pesticide applicators.