

Chapter 4: Development of the Final Report

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Overview of the Final Report Development

Introduction

When an investigation is complete, the final responsibility is to provide written documentation of events. This is necessary not only for large outbreaks involving many people but also for complaints of possible foodborne or waterborne illness. This chapter explains the importance of the report and its possible uses. Also included is a detailed explanation of a two workable formats for writing a report, what should be included in the report and who should receive it. Finally, samples of outbreak reports and after action reports are included as a guide.

While this chapter focuses on a report written for a more complex outbreak, even single complaints should be documented as completely as possible (on a complaint form). The single complaint must always be regarded as the possible first indication of a larger problem.

4.1 The Report

The report documents what happened in a foodborne or waterborne illness investigation. It is public record and must be objective, accurate, clear, and timely.

Detail in the document should reflect the complexity of the incident under investigation. A single complaint might result in a "complaint form" being completed with a list of action steps and any follow-up.

A more complicated occurrence (i.e., a large outbreak) might involve people outside your local jurisdiction and require a more comprehensive report. It may be necessary to enlist all involved parties when writing a final report.

4.2 Purpose of the Report

Whether the report is being written in response to an outbreak or a single complaint, complete documentation is important for the following reasons:

A document for action

In some cases, control and prevention measures will only be instituted in response to a written report. Until an outbreak is documented and summarized in a formal "outbreak report", it is easy for the implicated establishment operator to shift responsibility. The document contains the "official" findings. It should be used in refuting rumors and speculation.

A record of performance

A well-written report documents the magnitude of health problems and justifies program activities. A report clearly states events that occurred and the process that was followed. It should include all steps undertaken by everyone involved. The person writing the report will need to gather that information. The comprehensiveness of the outbreak report should reflect the complexity of the investigation. This accurately documents events and also clearly illustrates staffing resources required to undertake the investigations.

A document for potential legal issues

An investigative report written by health professionals must be written objectively, honestly and fairly. Information in these investigations is frequently used in legal actions. Thus, it is very important that a record exists that accurately documents events in a timely manner to aid in any legal investigations that might ensue.

An enhancement of the quality of the investigation

The process of writing a report and viewing the data in written form may result in new insights. It could precipitate new questions to be answered before a conclusion is reached. The more investigations and outbreaks one writes up, the better the understanding of process and results.

An instrument to present control and preventive measures

The primary reason to undertake an investigation is to control and prevent disease. The written report is an official medium to present control and preventive measures, and perform needs assessments. One may identify new trends, introduce new regulations or policies, identify training needs and reinforce existing regulations. When the report is presented to the owners and managers, encourage them to use it as a catalyst for change. This document is an educational tool and may help to prevent the same problems from reoccurring. (For example, operators who have been educated about the availability and safety of a pasteurized egg product will probably choose that over pooled whole, shell eggs.)

4.3 Outbreak Report Format

There are a variety of ways to compile the information obtained during an investigation into a professional, understandable and usable document. Below are outlines and examples of two outbreak report formats recommended by the Kentucky Department for Public Health (KDPH). The first is a scientific outbreak report format and the second is an after action report (AAR) format. KDPH recommends the use of the scientific outbreak format for any outbreak where a Department Operations Center (DOC) is not activated. An AAR should be written for any outbreak where the DOC is activated to manage the event. KDPH recommends these specific formats because they both logically describe the events that occur during an investigation. However for large outbreak investigations an AAR is necessary to document the activities of multiple

agencies/stakeholders, as well as to meet HSEEP (Homeland Security Exercise and Evaluation Program) requirements.

NOTE: This outbreak report format can be modified to reflect the complexity of the outbreak.

NOTE: Two outbreak report examples and an AAR example (4.1, 4.2, and 4.3) are provided at the end of this chapter.

Even if there is not the opportunity to compile a complex “outbreak report,” it would be helpful to be familiar with the following scientific outbreak report format and the after action report format and understand what information is contained in each section. It will then be easier to adopt any or all of the sections for use when responding to and documenting smaller scale incidents.

A foodborne or waterborne illness scientific outbreak report should include the following sections:

- I. Summary/Abstract**
- II. Background**
- III. Methods**
 - A) Epidemiologic**
 - B) Environmental**
 - C) Laboratory and Clinical**
- IV. Results**
 - A) Epidemiologic**
 - B) Environmental**
 - C) Laboratory and Clinical**
- V. Discussion**
- VI. Recommendations**
- VII. Acknowledgments**
- VIII. Supporting Documentation**

I. Summary/Abstract

The summary or abstract should consist of a paragraph or two that provide the reader with an overview of the main points of the investigation (i.e., the WHO, WHAT, WHERE and WHEN of the outbreak). It should describe what the investigation found, such as what caused the outbreak or what the final causal hypothesis was, based on the evidence.

II. Background

Background information is important and includes anything pertinent to understanding the outbreak or the investigation. This section identifies setting and the type of establishment involved in the outbreak (e.g., take-out restaurant, banquet facility, caterer, fast food establishment, retail store). If applicable, it could also include whether the establishment is part of a national chain, a commissary, a dormitory or a buffet where attendees are likely to eat multiple foods. Such things as previous problems at the same location or outbreaks with similar characteristics that might have added to understanding or guiding the current investigation should be explained and referenced. Any point that is relevant, even the weather in some cases, may be included in the Background section. The Background should also include the specific events that led to the investigation, such as how the outbreak was first reported, steps undertaken to confirm its existence, and all who assisted in the investigation.

III. Methods

The Methods section records what procedures were followed to conduct the investigation. It is important to differentiate this from the Results section in that Methods should not include any findings of the investigation except in rare cases where it is crucial to determining or understanding the methods used. Three primary areas should be covered in most foodborne or waterborne outbreaks:

A. Epidemiologic

Explain how cases were defined. For example, are only laboratory confirmed cases included? Does a case have to experience diarrhea or is abdominal cramping sufficient? Also describe how cases were found or became identified. Include descriptions of interview techniques and copies of questionnaires or surveys if used. If an epidemiologic study, such as a case-control or cohort study is conducted, this should be described in detail, including how subjects were enrolled in the study, how the data were collected and how the analysis was performed.

B. Environmental

Clearly outline the number and kinds of environmental investigations that occurred and who conducted them. Was a Hazard Analysis and Critical Control Point (HACCP) risk assessment conducted of suspect foods as well as physical facility inspections? Were there any tracebacks of food products?

C. Laboratory and Clinical

It is important to note what kinds of and how many specimens were submitted for laboratory analysis. Was food available for testing? Did cases submit stool specimens or other clinical specimens for analysis? Were food handlers required to submit stool samples for testing? Note where the specimens were sent, what kinds of analyses were performed and who completed the testing. This could involve private, state or federal laboratories.

IV. Results

The previous section outlined steps taken to investigate the outbreak. The Results section informs the readers what was discovered. These results can be presented in tables, graphic figures and/or text:

A. Epidemiologic

- number of questionnaires mailed and returned
- number of people fitting the case definition
- symptoms experienced by cases
- duration of symptoms
- incubation period
- food or meal-specific attack rates
- statistical significance of foods eaten
- epidemic curve of the outbreak
- relationships among cases (if any)

B. Environmental

- the results of the physical facilities inspection (e.g., violations noted)
- the results of any food tracebacks

C. Laboratory and Clinical

- culture or other laboratory results on food handlers, patrons, or other individuals connected to the outbreak
- results on foods or water sources tested

V. Discussion

This section is where all aspects of the investigation are brought together and conclusions are drawn. Interpretation of the results and discussion of pertinent aspects of the investigation, such as reasons for unique associations not seen before as well as limitations to the investigation, are appropriate for the Discussion section.

NOTE: Not all outbreaks have a resolution. In fact, it is rare when everything comes together and a cause can be definitively determined. Do not be discouraged. In most cases, there will be enough evidence to present a plausible hypothesis. Be clear and present a detailed explanation on what has contributed to the conclusion.

VI. Recommendations

This is the opportunity to educate. Be detailed because these recommendations hopefully will be read by many people in the establishment that was investigated. The establishment has a vested interest in following the suggestions. If the outbreak has

been large and disruptive, the establishment will not want it to reoccur. In addition to listing general recommendations on good food handling procedures, include specific recommendations that address what might have been overlooked in the particular outbreak (e.g., attempting to transport food long distances at inadequate temperatures).

VII. Acknowledgments

In the spirit of cooperation, it is proper to thank those who assisted in the investigation. This might include health care personnel, the food handlers and/or management of the establishment or other local or state officials.

VIII. Supporting Documentation

When compiling the report, attach copies of all items that are relevant. These would include the following:

- inspection reports
- blank samples of the surveys or questionnaires
- letters to management
- menus
- copies of posted notices
- food testing results

4.4 After Action Report (AAR)

After Action Report outbreak report should include the following sections:

Handling Instructions

Contents

Executive Summary

Section 1: Event Overview

Event Details

Event Leadership

Participating Organizations

Section 2: Event Summary

Event Purpose

Objectives, Capabilities and Activities

Scenario Summary

Supporting Events or Event

Section 3: Analysis of Capabilities

Section 4: Conclusion

Appendix A: Improvement Plan

Appendix B: Lessons Learned (optional)

Appendix C: Participant Feedback Summary (optional)

Appendix D: Event Summary Table (optional)

Appendix E: Performance Ratings (optional)

Appendix F: Acronyms

Administrative Handling Instructions

This is a basic description of the document, which includes the title of the document, information handling instructions, and points of contact for the report.

Executive Summary

This includes an overall summary of the event and response, to include Major Strengths and Primary Areas for Improvement identified during the outbreak investigation process. In addition, this section provides a description of whether the response was successful or unsuccessful and should state areas where agencies or jurisdictions should focus to improve future outbreak investigation responses.

Section 1: Event Overview

This is a listing of pertinent event details: Event Name, Type of Event, Start Date, End Date, Duration, Location, Mission, Capabilities Scenario, Event Leadership (name, agency, and contact information), Participating Organizations, and Number of Participants.

Section 2: Event Summary

This is a detailed description of the Event Purpose and Design; Event Objectives, Capabilities, and Activities; a Scenario Summary: Supporting Event or Events.

Event Purpose and Design

This is a summation of why the event occurred, what participants hoped to learn, and a brief history of how/why the event was organized, designed, funded, etc.

Event Objectives, Capabilities, and Activities

This section should list the event objectives, which should be aligned with associated capabilities from the Target Capabilities List (TCL). For each TCL, there is an Event Evaluation Guide (EEG) which lists specific activities which must be performed to demonstrate a capability. In addition to the TCL capabilities, the EEG activities relevant to each objective should also be included in this section.

Scenario Summary

This is a basic summation of the scenario or situation as it was initially presented to participants, along with any subsequent key events during the outbreak investigation and the time in which they occurred.

Supporting Event and Events

This is the section where any previous events that supported the current response are listed.

Section 3: Analysis of Capabilities

This section is where the agency may review the performance of event capabilities, activities, and tasks. This section is organized by Capability, then Activity. This section should include the TCL Capability description and a description of how the capability

was performed during the event. The specific activities selected from the EEG should be identified below its associated capability. For each Activity, an Observation, References, Analysis, and Recommendations should be recorded. Observations may be either a “strength” or “area for improvement” and should be organized by capability and associated activities. References are a listing of plans, policies, procedures, laws, and/or regulations which may apply to each observation. The Analysis section should include a description of the behavior or action at the core of the observation, as well as a brief description of what happened and the consequences of the action or behavior. Recommendations apply to areas identified for improvement, and are generally ways that the response may be improved in the future (agency specific or multiple agencies).

Section 4: Conclusion

This is an overall summary of the report, which includes demonstrated capabilities, lessons learned, major recommendations, and a summary of what steps should be taken to address areas of improvement.

Appendix A: Improvement Plan

This appendix should include key recommendations and corrective actions identified in Section 3: Analysis of Capabilities, the After Action Conference, and the EEGs. These should be uploaded into the Corrective Action Program System (CAP) on the HSEEP website so that progress may be measured.

Appendix B: Lessons Learned (optional)

This appendix provides jurisdictions and organizations with an opportunity to nominate lessons learned from exercises for sharing on *LLIS.gov*. This includes Lessons Learned, Best Practices, Good Stories, and/or Practice Notes.

Appendix C: Participant Feedback Summary (optional)

This section provides a summary of the Participant Feedback Survey, if administered after the event is over.

Appendix D: Event Summary Table (optional)

This section should summarize what actually happened during the outbreak investigation in a timeline table format. Focus of this section is on what events occurred during the outbreak and what actions the investigation team took during the outbreak. Successful development of this section is aided by using a log or other method to record key events occurring during the outbreak investigation.

Appendix E: Performance Ratings (optional)

This section is used when a jurisdiction/organization elects to use performance ratings, or when initiatives require a rating within the AAR/IP. A qualitative performance rating is assigned to each activity demonstrated within its capability area. The performance rating is based on a systemic review by the investigation leader of outbreak investigation performance based on leader/team analysis of how well the participants

demonstrated the capability outcome. The performance rating categories refer to how well each activity was performed during the event. The results should be summarized within this appendix and should be based on the supporting narrative contained within the body of the AAR/IP.

Appendix F: Acronyms

Any acronym used in the AAR/IP should be recorded in this section, listed alphabetically and spelled out.

NOTE: Not all outbreaks have a resolution. In fact, it is rare when everything comes together and a cause can be definitively determined. Do not be discouraged. In most cases, there will be enough evidence to present a plausible hypothesis. Be clear and present a detailed explanation on what has contributed to the conclusion.

When compiling material, be aware of confidentiality issues.

Information that can lead to the identification of individual cases (e.g., test results that include personal identifiers), should not be included in the outbreak report or AAR/IP. The name of the facility or establishment under question is part of the public record and can be disclosed. Data that *cannot* be used to identify individuals can be presented. People cooperate in investigations on the basis of protected confidentiality, and this should be respected.

Distributing the Report

Copies of the report should be made available to all parties involved in the investigation. This would include, but not be limited to, the owner and/or managers of the establishment, the KDPH, and any other local or state agencies affected by or involved in the outbreak or the investigation.

Example 4.1 Outbreak Report

Hot Tub Folliculitis resulting from a stay in a rental unit at a Resort, March 2008

Education, proper maintenance, and regulation are keys to prevention
Jasie K. Logsdon, B.S., M.P.H., Regional Epidemiologist, Lake Cumberland District Health Department

Summary

On March 25, 2008 the environmentalist at the McCreary County Health Department received a phone call from a concerned parent whose daughter had spent the previous weekend in a cabin at a Resort on Lake Cumberland. Several cases of rash illness had developed among people who had spent time at the resort, including the daughter of the parent who contacted the health department. A total of 11 people were identified as having been at the suspect cabin during March 21 – 23, 2008. Jasie Logsdon, the Lake Cumberland District Health Department (LCDHD) epidemiologist began case finding on March 25, 2008. Through further telephone interviews using a standardized questionnaire, 8 total cases of folliculitis related to exposure to the resort's hot tubs were identified, ranging in age from 3 years old to 54 years old. Laboratory samples collected from three patients were positive for *Pseudomonas aeruginosa*. Environmental samples collected from the hot tub by the District Health Department's environmentalist also tested positive for this organism. On March 27, the Resort was asked to drain, thoroughly clean and sanitize all hot tubs. A follow-up inspection was made on April 1, 2008 to sample the hot tub after cleaning. Results of follow-up water sampling from April 1, were negative for *Pseudomonas aeruginosa* and *E. coli*, indicating that the hot tub was adequately cleaned and sanitized.

Background

Pseudomonas aeruginosa folliculitis (hot tub rash or hot tub folliculitis) is a well-recognized, community-acquired skin infection, which results from the bacterial colonization of hair follicles after exposure to contained, contaminated water (e.g. whirlpools, spas, swimming pools, water slides, bathtubs).¹ Diagnosis of hot tub folliculitis is usually made by visual examination and exposure history. However, a physician may obtain samples from the pus filled bumps for bacterial culture to confirm the diagnosis. Hot tub folliculitis first appears as itchy bumps and develops into dark red tender nodules and/or small pus-filled pimples. The eruptions typically involve the trunk and upper parts of the arms and legs. The rash can be extensive and may affect all areas of the body but is usually most severe under areas covered by a swimsuit. It may be accompanied by headache, nausea, vomiting, abdominal cramps, sore throat, rhinitis, sore eyes, and fever. In a one year period throughout the United States, eight

¹ Krivda, Stephen J. Pseudomonas Folliculitis. eMedicine from WebMD online. Available: <http://www.emedicine.com/DERM/topic356.htm>

confirmed and two suspected *Pseudomonas* water borne disease outbreaks were documented; five of these outbreaks involved spas, one involved a pool, and four involved both spas and pools². This report describes the outbreak investigation performed at a Resort in Lake Cumberland through a coordinated effort between environmentalists and epidemiologists.

On March 25, 2008, the environmentalist at the McCreary County Health Department received a phone call from a concerned parent whose daughter had spent the previous weekend in a cabin at a Resort on Lake Cumberland. The daughter had subsequently developed a painful rash and swollen hands and feet, and reported that several others were exhibiting similar symptoms. The complainant, a physician's assistant and U.S. Public Health Service assignee to the United States Penitentiary in McCreary County, was concerned that his daughter had a *Staphylococcus aureus* infection. The complainant stated that approximately 30 people could have been exposed to the hot tub and potentially had symptoms. The LCDHD epidemiologist was contacted by another concerned parent stating that her daughter was sick. She was reported to have a rash, swollen hands and feet, and had been quarantined by the Marine Corps at a base in North Carolina.

Investigation Methods

The environmentalist in McCreary County, LCDHD Environmental Director, and LCDHD epidemiologist determined that an investigation must be conducted. LCDHD environmentalists contacted the Kentucky Department for Public Health (KDPH), Division of Public Health Protection and Safety on March 25, 2008 and were instructed to collect a 300 ml water sample from the suspect hot tub to be sent to a private laboratory for analysis. The LCDHD Epidemiologist contacted the KDPH, Division of Epidemiology and Health Planning to advise state officials and consult about the investigation.

Jasie Logsdon, the LCDHD epidemiologist began case finding on March 25, 2008. A case was defined as an individual who had visited the Lake Cumberland Resort over the weekend of March 21-23, 2008 who subsequently developed a rash within 24 hours of last exposure to the hot tub. Phone interviews were conducted by using a standardized questionnaire for the investigation. This questionnaire was developed by the LCDHD epidemiologist for outbreak investigations and contained questions about symptoms; medical treatment and diagnosis; lab testing; others with similar illness, including names and contact information; close contact with others; sharing of personal items; and exposure to pool, hot tub or sauna. Individuals were asked if they had shared any personal items or if they had other common exposures such as sleeping in

² Centers for Disease Control and Prevention. Surveillance for Waterborne Disease and Outbreaks Associated with Recreational Water --- United States, 2003—2004. MMWR 2006; 55(SS12);1-24 <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5512a1.htm>

the same bed. Based upon symptoms and exposure history, the hot tub was suspected as the source of the outbreak.

Results

The initial investigation revealed that the involved resort on Lake Cumberland rents and manages cabins that are privately owned homes. This rental program is not inspected or permitted by the health department because the cabins are considered individually owned homes. The hot tubs in these cabins are "home-grade" hot tubs and do not fall under health department regulation.

A total of 11 people were identified as having been at the suspect cabin during March 21-23, 2008. A description of the initial two cases follows.

Case 1

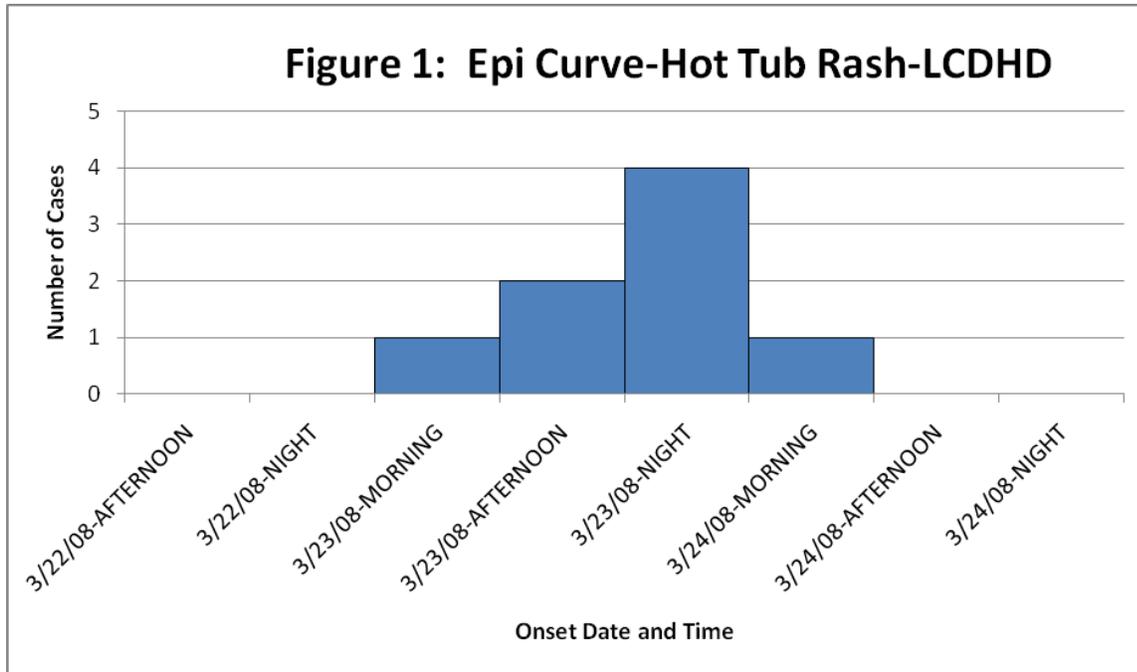
A 20 year old female had visited the resort over the weekend of March 21-23, 2008 and developed symptoms on March 23. She experienced painful swelling of lower extremities making it difficult to walk and a rash on her legs, stomach, thighs, back, and arms; she vomited all day after symptom onset. She sought medical attention on March 25 and was given the preliminary diagnosis of staph infection, from two physicians and one physician's assistant, scrapings of the rash were sent for laboratory testing.

Case 2

A 19 year old female Marine stationed in North Carolina who had visited the resort over the weekend of March 21-23, 2008, returned to North Carolina on March 24. She began exhibiting symptoms on March 24 during her drive back to North Carolina. She stated she had a rash on her legs, felt "funny", and her toes and hands were aching. She sought medical attention at the infirmary where she was immediately quarantined her to her room with a preliminary diagnosis of a Staph infection. Blood work was done, but the LCDHD was unable to gain contact with anyone in the infirmary at the base. Both individuals had spent time in a hot tub at the cabin.

Through further telephone interviews, 8 total cases of hot tub folliculitis were identified, ranging in age from 3 years old to 54 years old, who met the case definition. All of the cases sought medical treatment, four cases had samples collected for laboratory confirmation. Of the four laboratory samples, three were positive for *Pseudomonas aeruginosa* and the fourth was identified as "mixed skin flora."

The mean age of cases was 20 years and 88% were female. Of the 11 individuals who were present at the cabin over the weekend of March 21-23, 2008, 73% spent time in the hot tub. The epidemiologic curve identifying the number of cases and timeline in which they reported illness is shown in Figure 1.



The water sample collected from the hot tub was identified as positive for *Pseudomonas aeruginosa* by Lab Corp. On March 27, the Resort was asked to drain, thoroughly clean and sanitize all hot tubs. A follow-up inspection was made on April 1, 2008 to sample the hot tub after cleaning. Results of follow-up water sampling from April 1, were negative for *Pseudomonas aeruginosa* and *E. coli*, indicating that the hot tub was adequately cleaned and sanitized.

Discussion

Hot tub folliculitis has an incubation period of up to 48 hours after exposure to contaminated water. The rash usually clears on its own within 2-10 days, as it is a self-limiting infection. Usually no treatment is necessary for the infection, with the exception of the use of "anti-itch" medications while severe infections may be treated by ciprofloxacin. Laboratory testing usually isn't necessary; however, to rule out Staph infections and confirm a hot tub folliculitis outbreak by exposure to contaminated water, cultures were done. Morehead State Laboratory has the ability to perform specialized water testing. In order to submit specimens to the Morehead State Laboratory, (3) 120mL water samples should be taken and must arrive at the lab within 30 hours. It is important to note that the Morehead State Laboratory will charge \$50 per organism tested. For more information, visit their website at <http://www.morehead-st.edu/wtl/>. The State Public Health Laboratory does have the ability to test water for *Pseudomonas aeruginosa*, the most common cause of hot tub folliculitis. In order to submit water for testing for other organisms to the State Public Health Laboratory, (2) 100mL water samples must be collected from a hot tub/spa. For pool or beach samples, (1) 100 mL water sample is required. These samples must also arrive at the lab within 20 hours of collection.

The environmental investigation posed some unique challenges for the Environmentalists as well as the KDPH Division of Public Health Protection and Safety. Since this type of resort is not permitted by the health department as a regulated hotel or recreational water facility, new issues arose with regard to the handling the inspection and recommendations given to the facility. This is an area that the State has not yet addressed because ultimately these are private residences that are “rented.”

An educational pamphlet for hot tub folliculitis describing the signs and symptoms, causes, and prevention methods, as well as recommendations for hot tub care and maintenance was created and made available to the Resort. The staff at the resort were educated on proper hot tub care and maintenance, and the cases were all educated on hot tub rash causes, symptoms, and prevention. The Centers for Disease Control and Prevention recommends maintaining a free chlorine or bromine concentration of 2 to 5 parts per million, pH of 7.2-7.8 and lists other important health and safety guidelines for public spas or hot tubs on their website.³ Individuals are recommended to take precautions such as heeding hot tub safety rules, observing the hot tub and its surroundings and talking with staff and other hot tub users when choosing to enjoy a hot tub in the future⁴.

Closing Notes

The outbreak investigation at the Resort in Lake Cumberland demonstrated the need for a coordinated effort between LHD environmentalists and epidemiologists during outbreak investigations. In addition, further guidelines may need to be developed for facilities available for public use that are privately owned and rented. The issue remains as to when this is a private agreement between parties or when this is a public place that should fall under health department regulation. This will have to be addressed at the state level and the policy/procedure passed down to the local level.

³ http://www.cdc.gov/healthyswimming/pdf/spa_operation.pdf

⁴ http://www.cdc.gov/healthyswimming/pdf/spa_user_tips.pdf

Example 4.2 Outbreak Report

E. coli O157:H7 Outbreak Associated with Spinach in Kentucky – September 2006

Kentucky Cabinet for Health and Family Services
Department for Public Health
Division of Epidemiology and Health Planning
Epidemiologic Notes & Reports
Volume 42 Number 1 January/February 2007

Summary

In September 2006, public health officials in Wisconsin and Oregon reported that an outbreak of *E. coli* O157:H7 associated with the consumption of raw spinach was occurring in their region. Officials in New Mexico reported seeing similar cases in their area later that same month. CDC created a one-page questionnaire to be administered to cases which focused on spinach consumption. On September 15, 2006, Kentucky Department for Public Health (KDPH) laboratorians and epidemiologists confirmed that their first case-patient's clinical specimen matched the national outbreak strain. Three additional outbreak cases in Kentucky residents were confirmed later that day. By the end of the month, the Kentucky outbreak included 8 cases, of which 4 required hospitalization, with 2 developing hemolytic-uremic syndrome. Nationwide, 199 cases were associated with the outbreak. The outbreak was eventually traced to four fields in California that were contaminated with pig and cattle feces.

Background

Escherichia coli O157:H7 is a gram negative bacterium that causes an average of 70,000 cases of disease, 20,000 hospitalizations, and 60 deaths yearly in the United States. It is also a frequent cause of hemolytic-uremic syndrome (HUS), a triad of renal insufficiency, anemia, and thrombocytopenia (lowered platelet count) that can lead to permanent need for dialysis and even death. It is one of several hundred types of *E. coli* bacteria and is found in the intestines of cattle, sheep, and goats. It is a common cause of foodborne illness, although the Centers for Disease Control and Prevention (CDC) reports that the incidence of *E. coli* O157:H7 is decreasing. On September 13, 2006, CDC was alerted to an *E. coli* O157:H7 outbreak likely caused by bagged spinach in Wisconsin and Oregon. On the same date, Kentucky epidemiologists were notified of several residents who were infected with *E. coli* O157:H7. This article describes the investigation and events related to this outbreak in Kentucky and the national investigation of this outbreak.

Investigation Methods

On September 8, 2006, Wisconsin officials reported to CDC that they had multiple cases of *E. coli* O157:H7 in their state. On September 12, CDC reported to Wisconsin that the pulsed-field gel electrophoresis (PFGE) patterns were matching in their cases. Public

health officials in Wisconsin and Oregon conducted a survey of patients' eating habits prior to illness which showed a strong association between disease and raw spinach consumption in patients infected with *E. coli*. State officials in Wisconsin and Oregon notified CDC of their findings on September 13th. New Mexico epidemiologists contacted Wisconsin and Oregon officials on the same date regarding an *E. coli* O157:H7 outbreak in their state which also appeared to be related to the consumption of fresh spinach. State officials and CDC determined that a multi-state outbreak of *E. coli* was in progress. CDC created a one-page questionnaire to be administered to cases which focused on spinach consumption. A case was defined as any person with a lab-confirmed *E. coli* O157:H7 infection which matched the outbreak strain identified in Wisconsin and Oregon by PFGE pattern. On September 15, 2006, KDPH laboratorians and epidemiologists confirmed that their first *E. coli* O157:H7 case-patient's clinical specimen matched the national outbreak strain. Three additional outbreak cases in Kentucky residents were confirmed later that day. Using the CDC spinach questionnaire, Kentucky case patients were questioned by local health department epidemiologists about timing of spinach consumption, location where the spinach was purchased, and if spinach packaging with universal product code (UPC) and lot numbers was available. Data regarding need for hospitalization and development of HUS were obtained on the questionnaire. This questionnaire was used both with Kentucky case patients as well as patients throughout the country during the outbreak. Across the U.S., a confirmed case was defined as a patient with an illness onset date of August 1, 2006-September 18, 2006 or if onset was unknown, a patient with an *E. coli* O157:H7 isolate from August 15, 2006-September 18, 2006 matching the outbreak strain of *E. coli* and from the U.S. By September 22, 2006, a total of eight Kentucky residents were ultimately identified as part of the outbreak.

Regional epidemiologists interviewed seven of the patients by phone or in person and completed the CDC spinach questionnaire. Several patients also completed the general foodborne illness questionnaire to identify other potential exposures. Epidemiologists and environmentalists worked with the state lab and CDC to obtain spinach samples in order to attempt to isolate *E. coli* in the spinach or packaging. Spinach specimens provided by case patients were tested in the state lab for the presence of *E. coli* O157:H7.

Results

National

Ultimately, 199 cases nationwide were confirmed positive for the *E. coli* outbreak strain associated with the outbreak. States reporting the greatest number of confirmed cases were Wisconsin (49), Ohio (25), and Utah (19). Ninety-five percent of patients reported spinach consumption prior to onset of illness. Ninety-eight people required hospitalization, and three people died. Thirty cases of HUS occurred nationally among those infected.

Kentucky

Six Kentucky *E. coli* O157 case patients (75%) were female. Two patients (25%) developed HUS. Four Kentucky patients (50%) required hospitalization. There were no Kentucky fatalities. Of the seven patients who completed interviews detailing their exposures, six (85.7%) recalled eating spinach in the appropriate time frame prior to illness. One patient could not recall whether spinach was consumed prior to illness onset. The ability of the regional epidemiologists and local environmentalists to work throughout the state to interview patients, ship samples to the state lab, and provide state epidemiologists with the spinach questionnaire responses played a critical role in Kentucky's response to the outbreak. State and regional epidemiologists worked in concert to inform the state lab when environmental and patient specimens would be arriving. Regional epidemiologists also quickly provided state epidemiologists with completed questionnaires, thereby enabling state epidemiologists to share information with CDC and the U.S. Food and Drug Administration (FDA). The Public Health Protection and Safety team also was crucial to the success of the state investigation. The local environmentalists collected spinach samples from individuals involved in the outbreak, and worked with epidemiologists at the state level to coordinate testing at the state laboratory. They fielded questions from Kentucky residents about spinach safety. State food safety experts also worked with the laboratory and epidemiologists to arrange for local environmentalist services, and updated local health departments on FDA updates and the number of state residents who were part of the outbreak. The CDC and the FDA used information including lot numbers, lab testing, and spinach brands provided by Kentucky and other involved states to trace the outbreak to four fields in California. Testing performed at these fields revealed that the fields contained pig and cattle feces contaminated with *E. coli* O157:H7 matching the outbreak strain. Investigators also found evidence that wild pigs had been present in the implicated farms.

Discussion

E. coli O157:H7 is a virulent strain of *E. coli* that produces Shiga toxin. It may cause acute watery or bloody diarrhea due to its ability to invade the intestinal wall. It is diagnosed by a clinical stool specimen taken from the patient. The incubation period ranges from 1-8 days following ingestion, but most commonly symptoms begin 3-4 days after ingestion. *E. coli* O157:H7 is transmitted by ingestion of food or liquid contaminated with feces of an infected or asymptomatic carrier. Foods previously implicated in transmission of *E. coli* O157:H7 include raw milk, unpasteurized apple juice, ground beef, uncooked fruits, and vegetables. Petting zoos have also been the source of previous outbreaks. According to the FDA, 18 previous outbreaks have been caused by spinach in the last 10 years, including an outbreak in 2005 in which spinach was implicated. Lettuce or spinach may become contaminated via multiple mechanisms from the farm to consumption (by manure from an infected animal such as a cow; from contaminated irrigation water; from contamination during packaging and processing; or through individual contamination at restaurants or grocery stores). Infection may also result in HUS, or renal insufficiency, anemia, and thrombocytopenia. Children aged

younger than five years are most likely to contract HUS, which most commonly occurs around two weeks after infection with *E. coli* O157; approximately 8% of children infected with *E. coli* O157:H7 subsequently develop HUS. Half of the children diagnosed with HUS ultimately require short- or long-term dialysis, and approximately 4% die. Antibiotics have not proven beneficial in the prevention of HUS.

Normally, transmission of *E. coli* infection is prevented by cooking ground beef until no longer pink, avoiding raw milk and unpasteurized products, and good hand hygiene. In this outbreak, the FDA also stated that cooking spinach for 15 seconds at a temperature of 160 degrees Fahrenheit would kill any *E. coli* present, therefore making the spinach safe to eat. It should be noted that meticulous attention to food preparation helps to prevent any foodborne illness. Cooks should be careful to avoid contamination of raw fruits and vegetables with items which have touched uncooked meat. In addition, refrigerating spinach will also prevent the growth of *E. coli* and other types of bacteria. In the present outbreak, however, the product was advertised as "pre-washed". Bagged raw spinach is usually used for salad and is therefore not cooked. The FDA did not recommend rewashing pre-washed spinach, as the *E. coli* often is incorporated into the interior of the spinach leaf and therefore can't be removed by washing at home. Thus, prevention strategies for this type of transmission rely primarily on identification of sources of contamination prior to distribution and prevention of subsequent outbreaks via the same or similar mechanism.

Closing Notes

Ultimately, the outbreak strain was not isolated from spinach supplied by Kentucky patients to the state lab. However, the implicated strain of *E. coli* was isolated from several spinach bags provided by ill patients in other states (New Mexico, Pennsylvania, Utah, and Nebraska). The FDA traced the infection to a spinach processing company by combining the epidemiologic information obtained from the spinach questionnaire with the laboratory testing performed on the implicated bags of spinach. The outbreak was halted by recalls of spinach and spinach products from the implicated companies and FDA advice to consumers to avoid eating raw spinach until the source of the outbreak could be determined. Future plans include development of an industry-wide plan with steps to prevent contamination, thereby reducing the risk of another outbreak.

References

Bryan, F. *Guide for Investigating Foodborne Disease Outbreaks and Surveillance Data*, U.S. Department of Health and Human Services, CDC. Atlanta, Georgia, 1981.

Holland, W. et al. *Oxford Textbook of Public Health*, Oxford University Press, 1985; 3:284-289.

Example 4.3 Outbreak After Action Report



Kentucky Public Health
Prevent. Promote. Protect.

EVENT NAME

After-Action Report/Improvement Plan
[Date]

EXECUTIVE SUMMARY

[When writing the Executive Summary, keep in mind that this section may be the only part of the AAR/IP that some people will read. Introduce this section by stating the full name of the event and providing a brief overview. This brief overview should discuss what occurred and the capabilities that were address i.e., Core Capabilities, HPP Capabilities, and/or PHEP Capabilities and the purpose of the exercise/event. In addition, the Executive Summary may be used to summarize any high-level observations that cut across multiple capabilities.]

Purpose

The purpose of this exercise was to

This report will analyze the results of the exercise and identify strengths and potential areas for further improvement to support the development of improvement plans and associated corrective actions for the [Your Agency].

Major Strengths

The major strengths identified by [Your Agency] during the [Name of Exercise] are as follows:

- [List Strength - Use complete sentences to describe each major strength.]
- [List Strength - Use complete sentences to describe each major strength.]
- [List Strength - Use complete sentences to describe each major strength.]

Primary Areas for Improvement

Throughout the response to the [Name of Exercise], several opportunities for improvement in the [Your Agency] ability to respond were identified. The primary areas for improvement are listed below. These areas for improvement, along with recommendations and corrective actions, are listed in the Improvement Plan; Appendix A.

- [List Area for Improvement - Use complete sentences to state each primary area for improvement.]
- List Area for Improvement - Use complete sentences to state each primary area for improvement.]
- List Area for Improvement - Use complete sentences to state each primary area for improvement.]

Conclusion *[End this section by describing the overall response as successful or unsuccessful, and briefly state the areas in which organizations should focus on (exercise, training, equipment, etc.) to prepare for future responses.]*

EVENT OVERVIEW

Event Name	[Insert the formal name of exercise, which should match the name in the document header]
Event Dates	[Indicate the start and end dates of the exercise]
Scope	This exercise was a [exercise type], planned for [exercise duration] at [exercise location]. Exercise play was limited to [exercise parameters].
Mission Area(s)	[Prevention, Protection, Mitigation, Response, and/or Recovery]
Core Capabilities	[List the core capabilities being exercised]
HPP/PHEP Capabilities	[List the HPP/PHEP capabilities being exercised]
Objectives	[List exercise objectives]
Threat or Hazard	[List the threat or hazard (e.g. natural/hurricane, i.e., technological/radiological release)]
Scenario	[Insert a brief overview of the exercise scenario, including scenario impacts (2-3 sentences)]
Sponsor	[Insert the name of the sponsor organization, as well as any grant programs being utilized, if applicable]
Participating Organizations	[Insert a brief summary of the total number of participants and agency level (i.e., federal, state, local, private). List the participating agencies in Appendix B. List the exercise participants in Appendix C (Optional)]
Point of Contact	[Insert the name, title, agency, address, phone number, and email address of the primary exercise POC (e.g., exercise director or exercise sponsor)]

ANALYSIS OF CAPABILITIES

Aligning exercise objectives and core capabilities provides a consistent taxonomy for evaluation that transcends individual exercises to support preparedness reporting and trend analysis. Table 1 includes the exercise objectives, aligned core capabilities, and performance ratings for each core capability as observed during the exercise and determined by the evaluation team.

Objective	Core Capability	HPP/PHEP Capabilities	Gaps Addressed	Rating
[Objective 1]	Choose from dropdown.	Choose from dropdown.		Choose from dropdown.
[Objective 2]	Choose from dropdown.	Choose from dropdown.		Choose from dropdown.
[Objective 3]	Choose from dropdown.	Choose from dropdown.		Choose from dropdown.
[Objective 4]	Choose from dropdown.	Choose from dropdown.		Choose from dropdown.

Ratings Definitions:

- Performed without Challenges (P): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s) and did not negatively impact the performance of other activities. Performance of this activity did not contribute to additional health and/or safety risks for the public or for emergency workers, and it was conducted in accordance with applicable plans, policies, procedures, regulations, and laws.
- Performed with Some Challenges (S): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s) and did not negatively impact the performance of other activities. Performance of this activity did not contribute to additional health and/or safety risks for the public or for emergency workers, and it was conducted in accordance with applicable plans, policies, procedures, regulations, and laws. However, opportunities to enhance effectiveness and/or efficiency were identified.
- Performed with Major Challenges (M): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s), but some or all of the following were observed: demonstrated performance had a negative impact on the performance of other activities; contributed to additional health and/or safety risks for the public or for emergency workers; and/or was not conducted in accordance with applicable plans, policies, procedures, regulations, and laws.
- Unable to be Performed (U): The targets and critical tasks associated with the core capability were not performed in a manner that achieved the objective(s).

The following sections provide an overview of the performance related to each exercise objective and associated core capability, highlighting strengths and areas for improvement.

[Objective 1]

[Core Capability 1]

Strengths

- **Strength 1:** [Observation statement]
- **Strength 2:** [Observation statement]
- **Strength 3:** [Observation statement]

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1.1: [Observation statement. This should clearly state the problem or gap; it should not include a recommendation or corrective action, as those will be documented in the Improvement Plan.]

- **References:** [List any relevant plans, policies, procedures, regulations, or laws.]
- **Analysis:** [Provide a root cause analysis or summary of why the full capability level was not achieved.]

Area for Improvement 1.2: [Observation statement]

- **References:** [List any relevant plans, policies, procedures, regulations, or laws.]
- **Analysis:** [Provide a root cause analysis or summary of why the full capability level was not achieved.]

[Objective 2]

[Core Capability 2]

Strengths

- **Strength 1:** [Observation statement]
- **Strength 2:** [Observation statement]
- **Strength 3:** [Observation statement]

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 2.1: [Observation statement. This should clearly state the problem or gap; it should not include a recommendation or corrective action, as those will be documented in the Improvement Plan.]

- **References:** [List any relevant plans, policies, procedures, regulations, or laws.]
- **Analysis:** [Provide a root cause analysis or summary of why the full capability level was not achieved.]

Area for Improvement 2.2: [Observation statement. This should clearly state the problem or gap; it should not include a recommendation or corrective action, as those will be documented in the Improvement Plan.]

- **References:** [List any relevant plans, policies, procedures, regulations, or laws.]
- **Analysis:** [Provide a root cause analysis or summary of why the full capability level was not achieved.]

APPENDIX A: IMPROVEMENT PLAN

This Improvement Plan P has been developed specifically for [Organization or Jurisdiction] as a result of [Exercise Name] conducted on [date of exercise.]

Core Capability	HPP/PHEP Capability	Issue/Area for Improvement	Corrective Action Description	Capability Element	Primary Responsible Organization	Organization POC	Start Date	Completion Date
Core Capability 1: Choose from dropdown.	Capability 1: Choose from dropdown.	1. [Area for Improvement]		Choose from dropdown				
				Choose from dropdown				
				Choose from dropdown				
		2. [Area for Improvement]		Choose from dropdown				
	Choose from dropdown							
Core Capability 2: Choose from dropdown.	Capability 2: Choose from dropdown.	1. [Area for Improvement]		Choose from dropdown				
				Choose from dropdown				
				Choose from dropdown				
		2. [Area for Improvement]		Choose from dropdown				
	Choose from dropdown							

