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Investigation Number 2013-2973 Summary

February 25, 2014

Summary of outbreak 2013-2973

Background:

On July 30, 2013, the Baker County Health Department (BCHD) notified the Oregon Health Authority (OHA) of three laboratory-confirmed cryptosporidiosis cases at St. Alphonsus Medical Center. Typically, Baker County reports a single case of cryptosporidiosis each year.

During 2009 – 2011, more than 200 cases of cryptosporidiosis were diagnosed in Oregon annually, for a rate of 5.6 – 5.9 cases/100,000 persons per year. This is higher than the national rate of 2.4 – 2.6/100,000 persons per year. In Baker County during 2002 – 2011 there were ≤1.0 case/100,000 persons per year. With three cryptosporidiosis cases reported on a single day, BCHD and OHA launched an investigation to find additional cases and determine the source of the illnesses.

Baker City, Oregon is a town of 9,828 located in eastern Oregon approximately 75 miles from the Idaho border. Baker City currently has one of Oregon's four municipal water systems meeting strict filtration exemption criteria and using unfiltered surface water. Two pipelines bring surface water from about nine intakes located within the Baker City watershed to a water treatment plant outside of Baker City. The water treatment plant chlorinates the water but does not perform filtration or ultraviolet (UV) disinfection before distribution.

During July 29 – 31, five lab-confirmed cases of cryptosporidiosis were reported with onset dates from July 17 through July 26, 2013. Staff from the Baker County Health Department also reported hearing many anecdotal reports of cryptosporidiosis-compatible illnesses throughout the community. Initial interviews of confirmed cases identified no common exposures, and no travel outside of the county was reported. The absence of common plausible alternatives suggested municipal drinking water as the likely source. The city issued a precautionary boil-water order on the morning of July 31, 2013. Two OHA staff traveled to Baker City on Wednesday, July 31, to assist with the investigation. Additional OHA staff was sent to Baker City Saturday, August 17.

Methods:

Three different investigations were conducted over the course of the outbreak: a phone survey and two door-to-door surveys — viz., a convenience sample of Baker City households and a multi-stage random sample of households. A confirmed case was a person with *Cryptosporidium* oocysts identified in a fecal specimen. A presumptive case was a person with exposure to Baker City water and diarrhea lasting three or more days on or after June 24, 2013. (The window of illness used in outbreak case definitions evolved as details of the outbreak emerged; but the final case definitions were applied to all respondents.)

Phone survey

In order to find additional cases and to explore the possibilities of common exposures to recreational water or other community-wide activities (e.g., Miner's Jubilee or Biker's rally) OHA interviewed a sample of Baker City residents using the Baker City phone book during the first week of August. Phone numbers were randomly selected, with a goal of contacting 100 households. Every other page of the phone book was photocopied, and every 10th number was called. Once the page was exhausted, every 5th number was called, then 3rd, and then 7th. Each number was called at least three times at different times of day. A standardized questionnaire was developed and used to interview households in Baker City. Data were entered and analyzed in a FilemakerPro® database. Residents who were actively symptomatic were asked whether they were willing to provide a stool specimen for testing at the state laboratory. Ten positive human stool samples were sent to the Centers for Disease Control and Prevention (CDC) for *Cryptosporidium* genotyping.

To estimate the background rate of diarrheal illness in a similar population we interviewed members from 100 households in La Grande, a neighboring city with a comparable demographic profile.

Door-to-door surveys

On August 4, 2013, we conducted a door-to-door survey of a convenience sample of Baker City households. We used the same questionnaire as the one used for the phone survey, and asked respondents who were actively ill whether they were willing to provide a stool specimen for testing.

During August 18–22, we performed a modified, retrospective cohort study using a door-to-door survey of Baker City residents. The primary objective of the survey was to determine the community attack rate of cryptosporidiosis, defining presumptive cases as any Baker City resident with self-reported acute diarrheal illness beginning on or after July 1 and lasting ≥3 days. Survey questions were divided into household- and individual-level questions. Housing units were sampled randomly using tax-lot data obtained from the Baker County Assessor.

Using an estimated attack rate of 20%, the sample size needed for alpha of 0.05 was 241 individuals. Individuals were sampled in a multi-stage randomization process. In stage one, multi-family dwellings were listed individually using the number of housing units per dwelling. A number was assigned to each of the 4,222 housing units using a random number generator; the dwelling list was then sorted by this random number. The first 314 housing units (sample size + estimated 30% non-response rate) were used in the initial stage of interviews. The second stage of sampling involved randomly selecting one person in a single housing unit. If the selected individual was <12 years of age, an adult proxy was asked to provide answers. Interview teams attempted to contact each household two times on separate days. Data were analyzed using Epi Info™ 7.2.1.0 and SAS® v9.3.

Environmental samples

Water samples were collected by the Baker City Water Department and sent to a laboratory for testing by EPA Method 1623. This involved filtration, immunomagnetic separation of oocysts, staining, and enumeration of oocysts with contrast microscopy. Based on the recommendation of CDC, OHA epidemiologists also collected 100-liter samples of water in hollow-fiber filters, to concentrate and recover *Cryptosporidium* oocysts. Sodium thiosulfate was added to each container to achieve a final concentration of 40 mg/mL; a cooler containing the filters was then shipped to CDC for testing by EPA

Method 1623. These high-volume samples were collected at two sites in Baker City and at two sites in Goodrich reservoir (part of the Baker City watershed in the mountains above the city).

Before the outbreak, the only *Cryptosporidium*-specific water testing performed in Baker City occurred between April 2010 and March 2011: 24 samples were collected, and a total of three oocysts were detected. Since 1991, reports of daily turbidity and thrice-weekly *Escherichia coli* counts in water were sent to OHA Drinking Water Services (DWS) monthly. These turbidity and *E. coli* counts from the Baker City Water Department were reviewed retrospectively.

Epidemiologists from OHA collected additional environmental samples; goat and elk scat were collected near the Goodrich reservoir. Cattle scat and additional elk-scat samples were also collected near the Elk Creek intake. All environmental samples were shipped to the CDC for polymerase chain reaction (PCR) testing and microscopic evaluation.

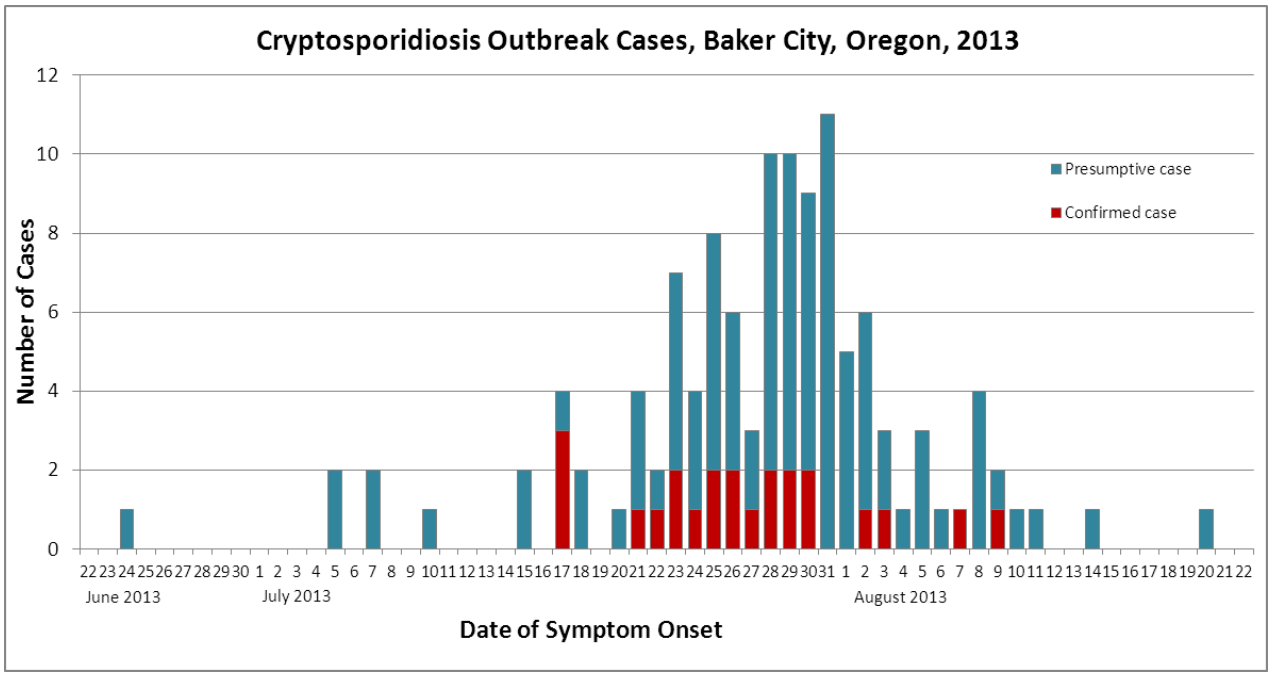
Results:

Overall, 119 cryptosporidiosis cases (23 confirmed and 96 presumptive) were identified as part of this outbreak. Age and sex distribution of cases are shown in Table 1. Eighty-seven percent of confirmed cases reported diarrhea, 74% cramps, 56% vomiting.

Table 1: Case demographic information, cryptosporidiosis outbreak, Baker County, Oregon, June – August 2013

Demographic	No (%) n=119
Sex	
Female	77 (65%)
Male	42 (35%)
Age (years)	
0 – 5	2 (2%)
6 – 17	19 (16%)
18 – 45	53 (45%)
46 – 65	32 (27%)
>65	13 (11%)

The epidemic curve of confirmed and presumptive cases is shown in the figure below.



Phone survey

Of 202 households selected from the Baker City phone directory, 74 (37%) completed interviews. Of 179 respondents in these households, 36 (20%) reported three or more days of diarrhea. One hundred households were surveyed in La Grande for comparison; two (1%) of 176 respondents reported diarrheal illness lasting three or more days.

Door-to-door surveys

Twenty-one households were surveyed in the door-to-door convenience sample; 16 26% of 62 respondents reported diarrhea lasting for three or more days.

The overall community attack rate in Baker City based on the retrospective door-to-door study was 28%, indicating (based on 2012 U.S. census data) that approximately 2,781 individuals were ill. Presumptive cases were 54% female with median age 49 (range 2 – 89) years. Based on survey data, there was a lag of approximately four weeks between earliest identified symptoms and the date of the first positive laboratory result.

*Environmental sample*s

The standard for fecal bacteria count in the water supply is 20 per 100-mL sample; there was no significant spike in either the turbidity or the raw bacteria counts in the weeks leading up to the outbreak. However, during this outbreak it was discovered that the sample point for these tests captured water from only one of two (of up to 9 total) transmission lines carrying water to Baker City's water treatment facility. Moreover, water samples were analyzed not for fecal coliforms, but for *E. coli*, for which no standard exists.

Water samples obtained on July 31 and August 4, 2013, from multiple watershed intakes and from within Baker City tested positive for *Cryptosporidium* oocysts. A high-volume water sample collected at the end of the municipal water line in Baker City on July 31, 2013, tested positive for *Cryptosporidium* at CDC. Two high-volume water samples collected at the Goodrich reservoir on August 3 and a high-volume sample collected at the Sun Ridge Hotel in Baker City on August 4 tested negative for *Cryptosporidium* at CDC. The results of all water testing are summarized in Table 2.

Table 2: Baker County water sample results, by collection location, Baker City, Oregon, July – August 2013

Location of water samples	**# locations with oocysts detected / total locations tested**
Raw watershed intakes	5/13 (38%)
City water faucets	6/9 (67%)

Microbiology

One of 81 goat-scat samples tested from near Goodrich reservoir was positive for *C. ubiquitum*. Of 64 elk-scat samples tested, one was positive with species still unknown, but negative by *C. parvum*- and *C. hominis*-specific PCR. Four cattle specimens from the Elk Creek watershed were all negative.

All samples from confirmed human cases tested positive for *C. parvum* IIaA15G2R1 at CDC.

Discussion:

This is the first outbreak of cryptosporidiosis caused by a contaminated public water supply in the United States since Las Vegas in 1993. *Cryptosporidium* caused illness in approximately 28% (2,781) of Baker City residents. Different methodologies used to ascertain an attack rate yielded similar estimates.

The means of contamination of the Baker City water supply remains unknown. The Goodrich reservoir intake (the northernmost intake in the Baker City watershed) was turned on two weeks before the outbreak was detected, and a recent storm could have caused runoff of *Cryptosporidium*-containing animal feces into the stream. While collecting water samples, residents of Baker City told OHA epidemiologists they had seen a goat herd near this reservoir in the weeks leading up to the outbreak. While obtaining water samples from the Goodrich reservoir, OHA staff also noticed goats on the hills around the reservoir, prompting collection of goat scat from areas surrounding the reservoir. However, none of the samples of goat scat were found to contain *C. parvum*.

Livestock are a known reservoir for *Cryptosporidium*. The Elk Creek intake was taken offline because it had the highest reported oocyst count; a search of the area surrounding Elk Creek revealed no dead animals or signs of cattle entry into the watershed. Although there were no positive specimens from cattle, bovine contamination of the watershed seems to be the most plausible cause of the outbreak, given that *C. parvum* was identified from human samples and that cattle-grazing lands almost completely encircle the Elk Creek watershed.

On August 8, DWS advised Baker City officials to test all water intakes twice weekly and to let the boil-water advisory remain in effect until each intake was negative for *Cryptosporidium* on two consecutive samples. The boil-water advisory was lifted on August 20 after water samples from each intake (except from Elk Creek, which remained off-line) tested negative for *Cryptosporidium* oocysts at an approved laboratory.

After learning that the sample point for *E. coli* and turbidity testing was capturing water from only one of two transmission lines carrying water to Baker City's water treatment facility, the Baker City Water Department changed sampling locations to get a blend of all water sources and began coliform testing, as recommended by DWS. The Department will continue twice weekly water testing for *Cryptosporidium* until a new UV disinfection treatment facility is operational. The anticipated completion date for a temporary treatment facility is spring 2014, with the permanent facility being completed by the end of 2014.

Conclusion:

Contaminated public drinking water caused an outbreak of cryptosporidiosis in Baker City, Oregon during the summer of 2013. County public health officials recognized the outbreak promptly and quickly respond with a boil-water alert, curtailing additional illnesses. No definite source of the *Cryptosporidium* contamination was identified, but contamination of the watershed by cattle is most plausible: the outbreak species is most commonly found in cattle. This outbreak in a municipal water system highlights the importance of strengthening watershed protection – especially of sources not destined for filtration, adhering to drinking water standards, and continuous monitoring of drinking water sources and treatment systems.