Outbreak of *Cryptosporidium hominis* Associated with Swimming in a Motel Pool -- Salina, KS October 2008: Final Report

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Background

On October 30, 2008, the Kansas Department of Health and Environment, Office of Surveillance and Epidemiology (KDHE-OSE) was notified by a Nebraska resident that fourteen members of her extended family had stayed at the Super 8 Motel located at 120 East Diamond Dr, Salina, KS on October 10 – 12. Ten members subsequently became ill with gastrointestinal symptoms. The Kansas Department of Agriculture, Division of Food Safety and Lodging (KDA), the Salina-Saline County Health Department, and the Nebraska Department of Health and Human Services (NDHHS) were notified on October 30, 2008, and in conjunction with KDHE-OSE, began an outbreak investigation to determine the source of illness and to implement appropriate control measures.

Methods

Epidemiologic

Staff from NDHHS conducted preliminary interviews with the Nebraska residents who initially reported illness. The motel management provided the names and addresses of all persons who had motel reservations anytime from October 1 to October 12. A retrospective cohort study was conducted to characterize the outbreak and determine if illness was associated with swimming in the motel pool. An online survey was developed and launched using Perseus Survey Solutions (Perseus SurveySolutions Enterprise Version 7.0.042), and letters with the secure website address were mailed to motel patrons. Patrons were given the option of calling a tollfree number to have the survey conducted via a telephone interview.

A case was defined as an individual who stayed at the motel anytime from October 1 – October 12, 2008 and became ill with diarrhea (three or more loose stools within a 24-hour period) either during or after staying at the motel.

Responses received via the Internet and by phone were imported into Microsoft® Office Excel 2003 and analyzed using SAS® 9.1.3. Aggregate descriptive analyses were performed, and an odds ratio (OR) was calculated to assess the association between swimming in the motel pool and subsequent illness. The incubation period was calculated from the date of first exposure to the pool and the date of the onset of illness.

Laboratory

Two ill individuals submitted stool specimens through their healthcare providers. These specimens were tested at private laboratories and then forwarded to the Centers for Disease Control (CDC) for additional testing and subtyping.

Environment

An inspection of the motel and pool was conducted by KDA on October 30 and 31. The pool filter was back washed, and a water sample was collected and sent to CDC for testing.

Results

Epidemiologic

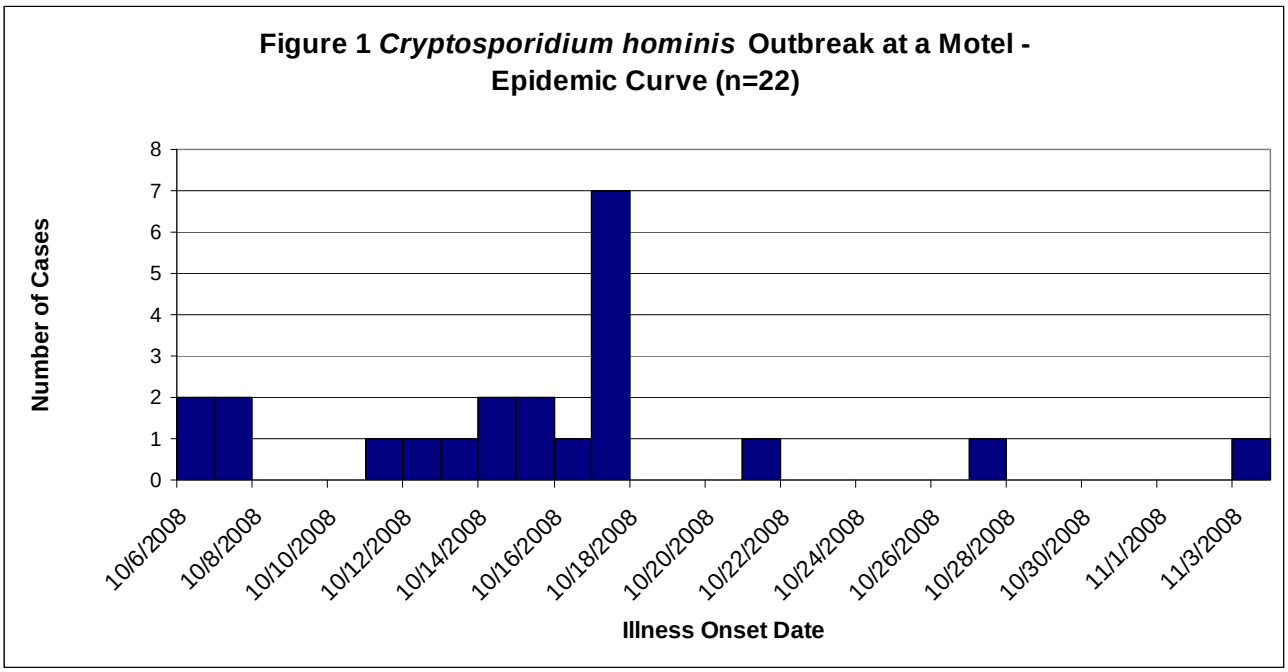
A total of 339 letters were mailed to motel patrons and of those, 29 were undeliverable. Of the 310 letters that were delivered to motel patrons, 53 (17%) responded to the survey. A total of 95 surveys were completed by patrons which includes an additional 42 that were guests of the 53 that received letters. Twenty-three (24%) respondents reported gastrointestinal illness. Of those reporting illness, 22 (96%) met the case definition. The 22 cases were residents of Colorado, Kansas, Massachusetts, Nebraska, and Oregon. Ages of the cases ranged from less than 1 year - 64 years (median = 28 years), and 11 (50%) of the cases were female.

Diarrhea and abdominal cramps were the most commonly reported symptoms, followed by loss of appetite, nausea, weight loss, and fever (Table 1). Three people reported vomiting, and two people reported dehydration. Seven sought medical care for their illness, and one was hospitalized.

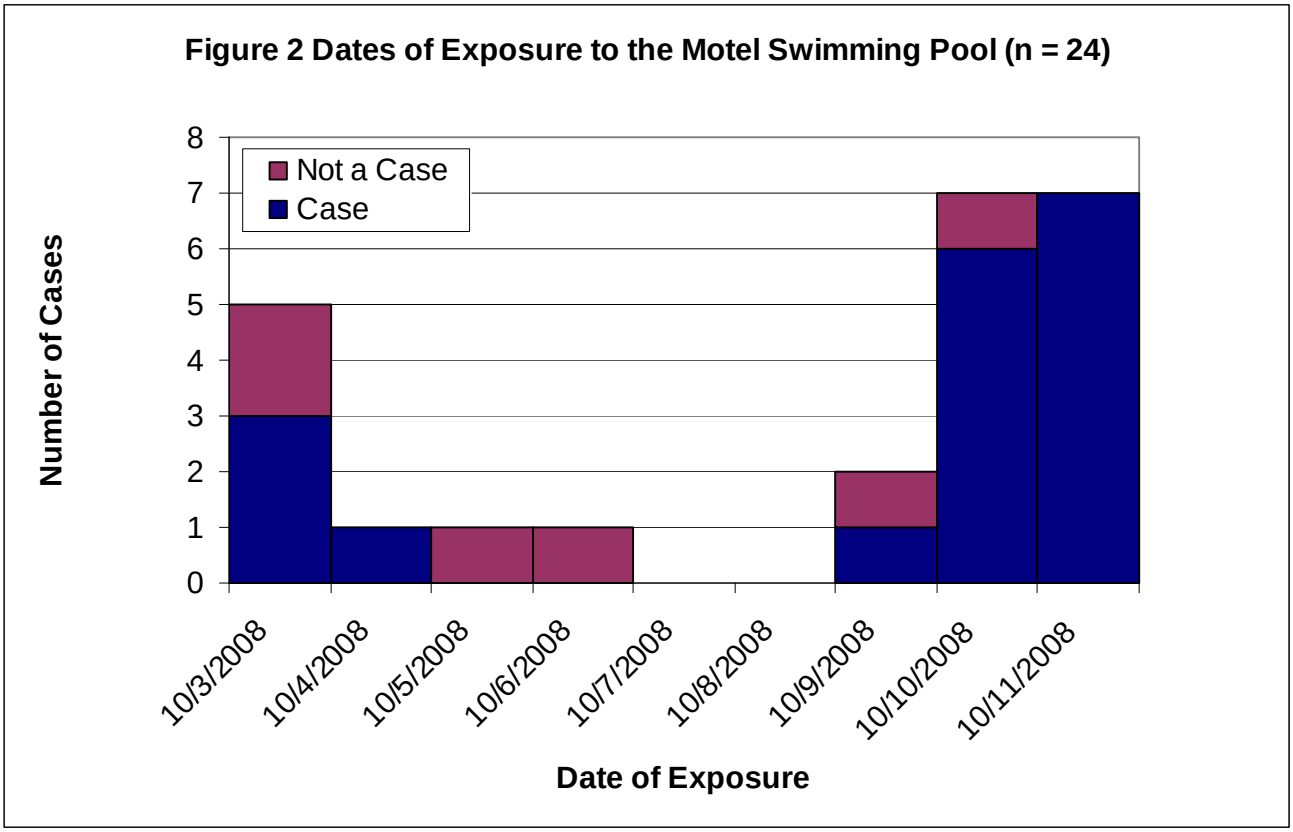
Table 1: Clinical Information of Cases (n=22)

Symptoms	# with symptom / total that responded (%)
Diarrhea	22/22 (100%)
Abdominal Cramps	22/22 (100%)
Loss of Appetite	20/22 (91%)
Nausea	18/20 (90%)
Weight Loss	7/18 (39%)
Fever	5/17 (29%)
Vomiting	3/21 (14%)
Dehydration	2/20 (10%)

Onset dates of illness ranged from October 6 – November 3, with a majority of individuals reporting illness from October 14 through October 17 (Figure 1).



The incubation period ranged from two to sixteen days with a median of six days. Duration of illness ranged from one to 26 days with a median of eight days. Of the 22 cases, 18 (82%) reported swimming during their stay at the motel. An additional six individuals also reported swimming, but did not report illness. Most of the cases reported swimming either the first or the second weekend in October (Figure 2). Statistical analysis demonstrated that swimming in the motel pool was significantly associated with illness (OR = 50.25; 95% confidence interval=12.79 – 197.35).



Laboratory

Two stool specimens tested positive for *Cryptosporidium spp*. One was sub-typed as *Cryptosporidium hominis.* The second specimen could not be typed because it had been collected in formalin, which can interfere with the assay used to type *Cryptosporidium*. *Cryptosporidium spp.* was not detected in the water sample that was collected from the filter backwash.

Environment

KDA conducted an inspection of the pool on October 30. Three violations were noted during the inspection: 1) failure to discontinue operations of the pool after management was notified of a potential waterborne outnreak 2) failure to notify the regulatory authority within 12 hours of notification of a possible outbreak; and 3) chlorine levels were not recorded on the pool log. During the inspection, the chlorine level in the pool was > 5ppm, and in addition to the violations noted, the pool log indicated an elevated pH level of 8.2 on 10/03 – 10/07 and 10/09 – 10/12. The pool was closed on October 30, and a

private company was hired to treat the pool. The pool was hyperchlorinated at a contact time (CT) inactivation value of 15,300 on October 31 and reopened on November 3. (CT inactivation value refers to the concentration of free chlorine in parts per million (ppm) multiplied by time in minutes at a specific pH and temperature) [i].

Discussion

This outbreak of *C. hominis* was associated with swimming at a motel pool. The odds of becoming ill were 50 times higher among those who swam in the pool compared to those who did not swim in the pool, and this finding was statistically significant. Two clinical specimens tested positive for C*ryptosporidium spp.*, and one was sub-typed as *C. hominis*. The water sample tested negative for C*ryptosporidium*, most likely because of the delay in notification and sample collection. KDHE-OSE was notified of the outbreak 18 days after the last ill person had swum in the pool. During those 18 days, the chlorine levels measured 5 ppm or higher. With a CT inactivation value of 15,300, *Cryptosporidium* would have been inactivated within 51 hours at that chlorine level.

Cryptosporidiosis is a gastrointestinal illness that is caused by protozoa in the genus *Cryptoporidium*. *Cryptosporidium hominis* primarily infects humans. In otherwise healthy individuals, clinical illness is characterized by watery diarrhea often accompanied by abdominal cramps, loss of appetite, low grade fever, nausea, vomiting, and weight loss. Disease can be more debilitating and sometimes fatal among immunocomprised individuals.

Cryptosporidiosis is transmitted by the fecal-oral route and results from the ingestion of *Cryptosporidium* oocysts. Infectious dose is low; only 10-30 oocysts [ii] are necessary for infection, and infected persons can shed $10^8 – 10^9$ oocysts in a single bowel movement. Ill individuals can continue to excrete oocysts for up to 50 days after diarrhea has ended[iii]. *Cryptosporidium* has emerged as the most frequently recognized cause of recreational water-associated outbreaks of gastroenteritis, especially in chlorinated venues because of its small size, low infectious dose[i], and high tolerance to chlorine[iv], which is the major disinfectant used in swimming pools.

Individuals can protect themselves from cryptosporidiosis by practicing healthy swimming behaviors, including not swimming when experiencing diarrhea, not swallowing pool water, and practicing good hygiene.

Attachments

Appendix A – Super 8 *Cryptosporidium* Questionnaire

Acknowledgements

Salina-Saline County Health Department
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Nebraska Department of Health and Human Services

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Our Vision and Mission

As the state's environmental protection and public health agency, KDHE promotes responsible choices to protect the health and environment for all Kansans.
Through education, direct services, and the assessment of data and trends, coupled with policy development and enforcement, KDHE will improve health and quality of life. We prevent injuries, illness, and foster a safe and sustainable environment for the people of Kansas.

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[i] Shields JM, Hill VR, Arrowood MJ, Beach MJ. Inactivation of *Cryptosporidium parvum* under chlorinated recreational water conditions. J Water Health 2008;6(3):513–20.

[ii] DuPont HL, Chappell CL, Sterling CR, Okhuysen PC, Rose JB, Jakubowski W. The infectivity of *Cryptosporidium parvum* in healthy volunteers. N Engl J Med 1995;332:855--9.

[iii] Chappell CL, Okhuysen PC, Sterling CR, DuPont HL. *Cryptosporidium parvum*: intensity of infection and oocyst excretion patterns in healthy volunteers. J Infect Dis 1996;173:232--6.

[iv] Korich DG, Mead JR, Madore MS, Sinclair NA, Sterling CR. Effects of ozone, chlorine dioxide, chlorine and monochloramine on Cryptosporidium parvum viability. Appl Environ Microbiol. 1990;56:1423–8.

APPENDIX A

Kansas Department of Health and Environment - Waterborne Illness Outbreak Investigation Survey

The Saline County Health Department and the Kansas Department of Health and Environment are investigating gastrointestinal illnesses among persons who may have went swimming in the Super 8 Motel pool in Salina, Kansas anytime from Wednesday, October 1, until Sunday, October 12.
To determine the cause of illness and to prevent future occurrences, we are collecting information from individuals who became ill as well as those that did NOT become ill. Your participation is completely voluntary, and any information you provide will be kept confidential.

Please submit a separate survey for each person that stayed at the motel.

1. Did you stay at the Super 8 Motel in Salina, KS anytime from October 1 to October 12?
   - ❍ Yes
   - ❍ No

2. When did you check into the Super 8 Motel?
   - ❍ October 1
   - ❍ October 2
   - ❍ October 3
   - ❍ October 4
   - ❍ October 5
   - ❍ October 6
   - ❍ October 7
   - ❍ October 8
   - ❍ October 9
   - ❍ October 10
   - ❍ October 11
   - ❍ October 12
   - ❍ October 13
   - ❍ October 14
   - ❍ October 15

3. When did you check out of the Super 8 Motel?
   - ❍ October 1
   - ❍ October 2
   - ❍ October 3
   - ❍ October 4
   - ❍ October 5
   - ❍ October 6
   - ❍ October 7

- ❍ October 8
- ❍ October 9
- ❍ October 10
- ❍ October 11
- ❍ October 12
- ❍ October 13
- ❍ October 14
- ❍ October 15
- ❍ October 16
- ❍ October 17
- ❍ October 18
- ❍ October 19
- ❍ October 20
- ❍ October 21
- ❍ October 22
- ❍ October 23
- ❍ October 24
- ❍ October 25

4. Name
   Last: _____ First: _____

5. Contact Information
   Phone _____
   City _____
   County _____
   State _____

6. Sex
   - ❍ Male
   - ❍ Female

7. Age
   Years: _____

8. During your stay did you swim in the motel pool?
   - ❍ Yes
   - ❍ No If no, please continue to question 10.

9. If yes, please list each date the the approximate length of time you were in the pool.
   Date _____ Length of Time _____
   Date _____ Length of Time _____
   Date _____ Length of Time _____
   Date _____ Length of Time _____
   Date _____ Length of Time _____

Date _____ Length of Time _____
Date _____ Length of Time _____
Date _____ Length of Time _____
Date _____ Length of Time _____

10. Since October 1, have you been ill with gastrointestinal symptoms?
    - ❍ Yes
    - ❍ No If no please continue with question 21.

11. If yes, what date and time did the symptoms begin?
    Date _____ Time (specify am or pm) _____

12. What was your first symptom?
    Symptom _____

13. Did you have any of the following symptoms?

	Yes	No	Don't Know
Diarrhea (3 or more loose stools in a 24 hour period)	❍	❍	❍
Abdominal Cramps	❍	❍	❍
Nausea	❍	❍	❍
Vomiting	❍	❍	❍
Fever	❍	❍	❍
Dehydration	❍	❍	❍
Loss of Appetite	❍	❍	❍
Weight Loss	❍	❍	❍

14. Did you see a doctor or other healthcare professional for this illness?
    - ❍ Yes
    - ❍ No

15. Were you hospitalized?
    - ❍ Yes
    - ❍ No

16. If yes, how many days were you in the hospital?
    Number of days _____

17. Did you submit a stool specimen?
    - ❍ Yes
    - ❍ No

18. If yes, what were the results?

Results _____

19. Are you still ill?
    - ❍ Yes
    - ❍ No

20. If no, when did you recover?
    Date _____
    Time (specify am or pm) _____

21. Comments
    _____
    _____

Thank you for your time.