

Outbreak of Cryptosporidiosis Associated with a Firefighting Response — Indiana and Michigan, June 2011

On June 20, 2011, the Indiana Department of Homeland Security notified the Indiana State Department of Health (ISDH) of an Indiana fire station that reported gastrointestinal illness among a substantial percentage of their workers, causing missed workdays and one hospitalization as a result of cryptosporidiosis. All ill firefighters had responded to a barn fire in Michigan, 15 miles from the Michigan-Indiana border on June 6; responding firefighters from Michigan also had become ill. ISDH immediately contacted the Michigan Department of Community Health (MDCH) concerning this outbreak. The investigation was led by MDCH in partnership with ISDH and the Michigan local health department (LHD). Among 34 firefighters who responded to the fire, 33 were interviewed, and 20 (61%) reported gastrointestinal illness ≤ 12 days after the fire. *Cryptosporidium parvum* was identified in human stool specimens, calf fecal samples, and a swimming pond. Based on these findings, the following public health recommendations were issued: 1) discontinue swimming in the pond, 2) practice thorough hygiene to reduce fecal contamination and fecal-oral exposures, and 3) decontaminate firefighting equipment properly. No additional primary or secondary cases associated with this exposure have been reported. The findings highlight a novel work-related disease exposure for firefighters and the need for public education regarding cryptosporidiosis prevention.

On June 6, 2011, a fire occurred in a barn housing approximately 240 week-old calves. A total of 34 firefighters responded from three Michigan fire stations and one Indiana fire station. Local hydrant water and onsite swimming pond water were used to extinguish the fire. Investigators hypothesized that exposures to calves or contaminated drinking water were potential infection sources. A retrospective cohort study was performed among responding firefighters to identify additional ill persons, assess possible risk factors, and guide implementation of control measures. A clinical case was defined as diarrhea (three or more loose stools in a 24-hour period) or gastrointestinal illness (four or more symptoms [e.g., abdominal cramps, nausea, vomiting, or fever]) in a person within 12 days after the fire response. Using CDC case definitions (1), a confirmed case was defined as a clinical case with *Cryptosporidium* organisms detected in stool, intestinal fluid, or tissue samples; *Cryptosporidium* antigens in stool or intestinal fluid; or *Cryptosporidium* nucleic acid in stool. A probable case was defined as a clinical case that lacked laboratory confirmation but was linked epidemiologically to a confirmed case.

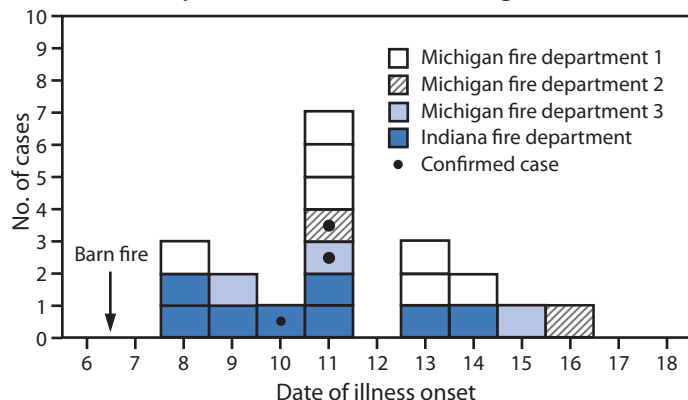
Beginning on June 22, MDCH and LHD interviewed firefighters using a standardized telephone questionnaire. Of 34 firefighters from all four fire stations, 33 (97%) completed the interview. Twenty (61%) of 33 study participants had illness meeting the probable (n = 17) or confirmed (n = 3) case definition (Figure). All patients were men; median age was 33 years (range: 21–58 years). Median time from exposure to illness onset was 5 days (range: 2–10 days). Common symptoms included diarrhea (n = 20 [100%]), abdominal cramps (n = 15 [75%]), fatigue (n = 11 [55%]), gas/bloating (n = 11 [55%]), nausea (n = 10 [50%]), and weight loss (n = 10 [50%]). Among 17 (85%) patients whose symptoms had resolved before interview, median illness duration was 4 days (range: 0.5–15 days). Nine (45%) ill firefighters sought medical care; six submitted stool specimens to their health-care providers. A previously healthy immunocompetent man was hospitalized and underwent a cholecystectomy for acalculous cholecystitis secondary to cryptosporidiosis. No deaths were reported.

In bivariate analysis, patients were statistically more likely than nonpatients to have had direct calf contact (e.g., carrying or leading calves from the barn) (relative risk = 2.88; 95% confidence interval = 1.04–12.76); patients also were more likely to have been from the Indiana fire station, had exposure to pond water through drinking or washing themselves, or drunk from a cooler filled with water from an undetermined source, but these associations did not reach statistical significance (Table 1).

The environmental investigation began on June 27. LHD requested stool specimens from symptomatic or recently recovered Michigan patients for confirmatory *Cryptosporidium* testing (Table 2). Five firefighters provided stool specimens, which were split into three sample tubes (formalin, polyvinyl alcohol, and Cary-Blair) and submitted to MDCH's Bureau of Laboratories and CDC. Twenty-five calf fecal specimens were collected from stalls and submitted to CDC for *Cryptosporidium* and *Giardia* testing. Water samples from the swimming pond and drinking well were submitted to CDC's Waterborne Disease Prevention Branch and the Michigan State University Environmental and Molecular Microbiology Laboratory for *Cryptosporidium* (both laboratories) and *Giardia* (Michigan State University only) testing. Additionally, a well water sample was submitted to a local water quality-testing laboratory for standard bacterial testing.

Cryptosporidium antigen was detected in one human stool specimen (from the hospitalized patient). *Cryptosporidium parvum*

FIGURE. Number of probable and confirmed cryptosporidiosis cases* among firefighters who responded to a barn fire, by date of illness onset and fire department — Indiana and Michigan, June 2011



* A clinical case was defined as diarrhea (three or more loose stools in a 24-hour period) or gastrointestinal illness (four or more symptoms [e.g., abdominal cramps, nausea, vomiting, or fever]) in a person within 12 days after the fire response. A confirmed case was defined as a clinical case with *Cryptosporidium* organisms detected in stool, intestinal fluid, or tissue samples; antigens in stool or intestinal fluid; or nucleic acid in stool. A probable case was defined as a clinical case that lacked positive laboratory confirmation but was linked epidemiologically to a confirmed case. Cases not marked as confirmed are probable cases.

What is already known on this topic?

Cryptosporidiosis has been implicated in outbreaks involving recreational water use, contaminated municipal water, and exposure to infected animals.

What is added by this report?

This is the first report of cryptosporidiosis being a potential occupational hazard for rural firefighters. Twenty of 34 firefighters responding to a fire in a barn housing week-old calves became ill with gastrointestinal symptoms; three of six tested were positive for *Cryptosporidium*. *Cryptosporidium parvum* was identified in samples from two of the firefighters, the calves, and a nearby swimming pond.

What are the implications for public health practice?

Firefighters, like other visitors to facilities housing livestock, are at potential risk for *Cryptosporidium* infection. This investigation highlights the continued importance of public education regarding cryptosporidiosis prevention and control, in particular the importance of minimizing contact with animal feces, practicing thorough hygiene, and not drinking from untreated water sources.

TABLE 1. Number, percentage, and relative risk for cryptosporidiosis cases* among firefighters (N = 33) responding to a barn fire, by reported exposure to calves, pond water, and cooler water — Indiana and Michigan, June 2011

Exposure	Exposed			Not exposed			Relative risk	(95% CI)	p value
	Ill	Total	Ill (%)	Ill	Total	Ill (%)			
Calves at farm	18	25	(72)	2	8	(25)	2.88	(1.04–12.76)	0.023
Michigan fire department 1	7	11	(64)	13	22	(59)	1.08	(0.61–1.90)	1.000
Michigan fire department 2	2	7	(29)	18	26	(69)	0.41	(0.12–1.37)	0.084
Michigan fire department 3	3	6	(50)	17	27	(63)	0.79	(0.34–1.86)	0.659
Indiana fire department	8	9	(89)	12	24	(50)	1.78	(1.12–2.82)	0.056
Drinking cooler water†	13	18	(72)	5	12	(42)	1.73	(0.90–4.17)	0.100
Drinking bottled water‡	14	22	(64)	5	10	(50)	1.27	(0.68–2.92)	0.522
Drinking or other contact with pond water¶	5	9	(56)	1	6	(17)	3.33	(0.73–44.31)	0.182

Abbreviation: CI = confidence interval.

* A case was either a probable or confirmed case of cryptosporidiosis. A clinical case was defined as diarrhea (three or more loose stools in a 24-hour period) or gastrointestinal illness (four or more symptoms [e.g., abdominal cramps, nausea, vomiting, or fever]) in a person within 12 days after the fire response. A confirmed case was defined as a clinical case with *Cryptosporidium* organisms detected in stool, intestinal fluid, or tissue samples; antigens in stool or intestinal fluid; or nucleic acid in stool. A probable case was defined as a clinical case that lacked positive laboratory confirmation but was linked epidemiologically to a confirmed case.

† Three persons did not answer the question about drinking water from the cooler. The source of the water used to fill the cooler could not be determined.

‡ One person did not answer.

¶ Only 15 of 33 persons interviewed were asked if they had contact (e.g., drinking or washing/cooling themselves) with the pond water.

was identified in two human stool specimens, 10 calf fecal samples, and pond water samples (Table 2). *Giardia* species were detected in pond water. Four calf fecal samples tested positive for *Giardia duodenalis*. No human specimens tested positive for *Giardia*. Although well water tested negative for *Cryptosporidium* and *Giardia*, LHD testing revealed that well water had high bacterial (non-*Escherichia coli*) concentrations and was unsafe for drinking.

LHD recommended that the farmer who owned the barn treat the well water with chlorine and, until the water was declared safe, boil water used for human consumption. On the basis of the presence of *Giardia* and *Cryptosporidium* in the swimming pond, difficulty of decontamination, and likely continued contamination with wildlife and livestock fecal matter, LHD recommended the farmer's family no longer use the pond for swimming. The family also was notified by LHD

TABLE 2. Laboratory analysis methods and results from an investigation of gastrointestinal illness among firefighters responding to a barn fire — Indiana and Michigan, June 2011

Type of sample	Laboratory	Method	Results
Human samples			
Stool from hospitalized patient	Local hospital	Antigen test	Positive for <i>Cryptosporidium</i> spp.
Stool in buffered 10% formalin (n = 5)	MDCH BOL	Modified Ziehl-Neelsen acid-fast stain Direct immunofluorescent stain	All negative for <i>Cryptosporidium</i> spp. All negative for <i>Cryptosporidium</i> spp.
Stool in Cary-Blair (n = 5)	CDC	PCR-RFLP for <i>Cryptosporidium</i> spp. Nested PCR for <i>Giardia</i> spp.	Two positive for <i>C. parvum</i> All negative for <i>Giardia</i> spp.
Calf samples			
Calf feces in preservative-free tubes (n = 25)	CDC	PCR-RFLP for <i>Cryptosporidium</i> PCR-RFLP for <i>Giardia</i>	10 positive for <i>C. parvum</i> ; one subtyped as IlaA16G2R2 Four positive for <i>G. duodenalis</i> assemblage A*
Water samples			
Pond water (one 20L sample to each laboratory; two total)	CDC	UF, fluorescence microscopy and RT-PCR	Positive for <i>C. parvum</i>
	MSU	EPA Method 1623	Positive for <i>Cryptosporidium</i> spp. Positive for <i>Giardia</i> spp.
Well water (one 20L sample to each laboratory; two total)	CDC	UF, fluorescence microscopy and RT-PCR	Negative for <i>Cryptosporidium</i> spp.
	MSU	EPA Method 1623	Negative for <i>Cryptosporidium</i> spp. Negative for <i>Giardia</i> spp.
Well water (estimated 0.2 L; n = 1)	Local lab	Bacterial testing	Positive for high concentrations of non- <i>Escherichia coli</i> bacteria

Abbreviations: MDCH BOL = Michigan Department of Community Health Bureau of Laboratories; MSU = Michigan State University Environmental and Molecular Microbiology Laboratory; PCR = polymerase chain reaction; PCR-RFLP = polymerase chain reaction restriction fragment length polymorphism; RT-PCR = real-time polymerase chain reaction; UF = ultrafiltration; EPA Method 1623 = U.S. Environmental Protection Agency Method 1623: *Cryptosporidium* and *Giardia* in water by filtration/immunomagnetic separation/immunofluorescence assay.

* One calf fecal sample was positive for both *Cryptosporidium parvum* and *Giardia duodenalis*.

and MDCH of the presence of *Cryptosporidium* and *Giardia* in their calf population. Practicing thorough hygiene to reduce fecal contamination and fecal-oral exposures was recommended to the family and firefighters. Furthermore, recommendations were provided to decontaminate firefighter tanker trucks, clothing, and other equipment to prevent further exposure. No secondary cases were identified through firefighter interviews or state disease surveillance system reports.

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Editorial Note

The cryptosporidiosis outbreak described in this report involved 20 firefighters who responded to a fire in a barn housing preweaned calves. *Cryptosporidium parvum*, the protozoan isolated in this outbreak, can infect humans and ruminants and is more prevalent among preweaned calves than older calves (2). *Cryptosporidium* previously has been implicated in gastrointestinal illness outbreaks associated with recreational waterparks, contaminated municipal water sources, and exposure to young livestock (1,3). This is the first reported occupational exposure of firefighters to *Cryptosporidium* species.

Cryptosporidium was detected in the stool of three of six patients tested; two specimens were identified as containing *C. parvum*, and one was identified only as positive for *Cryptosporidium* spp. *C. parvum* also was detected in swimming pond water and calf fecal samples. Failure to detect *Cryptosporidium* in some infected patients is typical; the parasite is shed intermittently, and often only one stool specimen is collected per patient. Health-care providers do not request

Cryptosporidium testing regularly, and routine laboratory testing of stool specimens often does not include *Cryptosporidium* (1). The actual number of infected firefighters might have been larger than reported because healthy persons infected with *Cryptosporidium* frequently are asymptomatic and thus they would not have met the case definition. Symptoms typically are self-limiting and can include watery diarrhea, abdominal cramps, low-grade fever, nausea, vomiting, and weight loss (1,4). In this outbreak, the immunocompetent hospitalized patient who experienced cholecystitis likely received an excess of the infectious dose of *Cryptosporidium*, having fallen into a manure pit while rescuing calves.

Direct contact with calves was linked epidemiologically to illness. Among 20 ill persons, only two did not report direct calf contact. These two patients had both washed themselves at the farm using water that might have been contaminated with *Cryptosporidium* oocysts. Only 15 of 33 firefighters were asked about pond water exposure because that question was added to the interview tool after interviews had begun. Five of nine firefighters who reported pond water exposure became ill. Although other gastrointestinal pathogens might have contributed to the symptoms experienced by some of the firefighters, the fact that *Cryptosporidium* was found in stool specimens from three of six firefighters tested suggests that *Cryptosporidium* was the primary cause of the outbreak.

General prevention and control measures for *Cryptosporidium* include 1) practicing proper hygiene (e.g., thorough hand washing, not swimming while experiencing diarrhea, and minimizing contact with animal feces); 2) treating or avoiding contaminated water (e.g., not swallowing water while swimming and not drinking untreated water); 3) exercising caution while traveling; and 4) avoiding fecal exposure during sexual activity (1,4). *Cryptosporidium* is a chlorine-tolerant organism and is not inactivated readily by alcohol-based hand sanitizers.

Although occupationally acquired cryptosporidiosis has been reported among veterinary personnel (5,6), this is the first report of cryptosporidiosis transmitted during a firefighting response. To prevent similar outbreaks, adequate drinking water during firefighting responses and decontamination of firefighting equipment are recommended. Firefighters should only consume treated or bottled water, or sports drinks. Firefighting equipment and clothing should be decontaminated at the

scene whenever possible, especially if grossly contaminated with feces, to reduce transmission of *Cryptosporidium*, *Giardia*, and other zoonotic enteric pathogens (e.g., *E. coli*, *Salmonella*, and *Campylobacter*). Clothing contaminated with feces should be machine-washed and heat-dried on the highest clothes dryer heat setting for 30 minutes whenever possible (7); all other non-machine-washable items and equipment should be cleaned with soap and water to remove gross fecal contamination, air-dried, and left in the sun for at least 4 hours after drying. For equipment that cannot be cleaned with soap and water or equipment that contacts the mouth (e.g., respirator pieces), soaking in 3% hydrogen peroxide solution for 20 minutes is recommended after consulting manufacturer guidelines (7).

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