Molecular Epidemiology of Cryptosporidiosis — Idaho, 2012–2015

Ahmed M. Kassem, MBBCh, MPH, PhD[1,2]; Kris Carter, DVM, MPVM[2,3]; Amanda J. Bruesch, MS[4]; Dawn M. Roellig, MS, PhD[5]

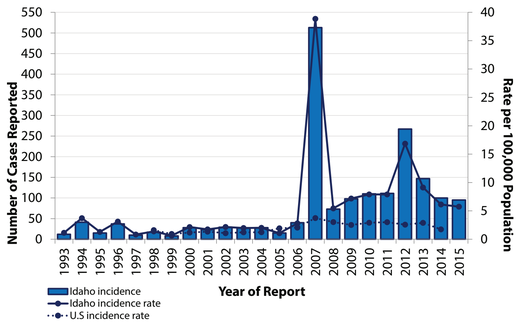
[1]Epidemic Intelligence Service, CDC; [2]Bureau of Communicable Disease Prevention, Divison of Public Health, Idaho Department of Health and Welfare; [3]Office of Public Health Preparedness and Response, CDC; [4]Bureau of Laboratories, Division of Public Health, Idaho Department of Health and Welfare; [5]Waterborne Disease Prevention Branch, National Center for Emerging and Zoonotic Infectious Diseases, CDC

Background

Cryptosporidium, a genus of apicomplexan protozoans

- Cryptosporidiosis, a gastrointestinal illness caused by *Cryptosporidium*, represents a significant disease burden in the United States. Hospitalizations associated with cryptosporidiosis have an estimated cost of $45.8 million/year.[1]
- During 2006–2012, cryptosporidiosis incidence rates (2.8–38.9/100,000 persons) in Idaho, a northwestern state with a population of 1.6 million, were consistently higher than United States rates (2.1–3.7/100,000 persons)[2] (Figure 1).
- *Cryptosporidium* can be spread by fecal-oral route via multiple modes
  - Ingestion of contaminated water or food
  - Contact with infected persons or animals
- *Cryptosporidium* species/genotypes/subtypes are morphologically indistinguishable by traditional laboratory tests (e.g., direct fluorescent antibody, enzyme immunoassays).[3]
- Molecular testing for *Cryptosporidium* species and subtype might help differentiate animal sources from human sources, and could help to detect and differentiate cryptosporidiosis outbreaks.
- Our objective was to explore the molecular epidemiology of cryptosporidiosis in Idaho.

Figure 1. Cryptosporidiosis cases and rate of disease per 100,000 population: Idaho and U.S., 1993–2015*



*Cryptosporidiosis was not tracked in Idaho until 1993. It was not tracked nationally until 1998.

Methods

- We analyzed surveillance and laboratory records of cryptosporidiosis cases reported to Idaho Department of Health and Welfare during September 2012–August 2015.**
- Available stool specimens from cases with laboratory diagnosis were submitted by the Idaho Bureau of Laboratories to CDC's CryptoNet[3] for molecular testing.
- Molecular testing involved the following two techniques:
  1. Polymerase chain reaction-based restriction fragment length polymorphism (PCR-RFLP) analysis of the small ribosomal subunit RNA gene (18S rRNA)
  2. DNA sequencing of a portion of the 60-kDa glycoprotein gene (GP60)
- We compared the characteristics of cryptosporidiosis cases with Idaho population (Table 1), and mapped their geographic distribution (Figure 2). We described molecular profiles of *Cryptosporidium* (Table 2), and examined characteristics of sporadic (not associated with an outbreak) cases by molecular profile (Table 3).

**Cryptosporidiosis cases were defined using the CDC/CSTE 2012 Case Definition for Cryptosporidiosis available at https://www.cdc.gov/nndss/conditions/cryptosporidiosis/case-definition/2012/.The case classification includes probable and confirmed classifications by laboratory testing used for diagnosis, if any.

Results

Among 429 reported cryptosporidiosis cases:

- 305 (71%) had indeterminate transmission mode
- 134 (31%) had ≥2 suspected potential exposures
- 38 (9%) had stool specimens available for molecular testing, which were submitted from 3 out of 7 public health districts (Figure 2)

Table 1. Characteristics of persons with cryptosporidiosis cases with molecular testing results and all persons with cryptosporidiosis cases during September 2012–August 2015 compared with Idaho population (2015)

	Idaho population, U.S. Census Bureau estimates (2015) (n = 1,654,930)	All reported cases (n = 429)	Cases with molecular testing results (n =38)
	Percent		
Age under 18 years	26.2	38.9	52.6
Age 65 years and over	14.7	9.6	2.6
Female	49.9	56.2	65.8
Hispanic or Latino†	12.2	11	10.5
White†	93.4	67.1	71.1

†18%–32% of values for race and ethnicity were missing.

Figure 2. Number of cryptosporidiosis cases and speciated *Cryptosporidium* isolates by public health district — Idaho, 2012–2015

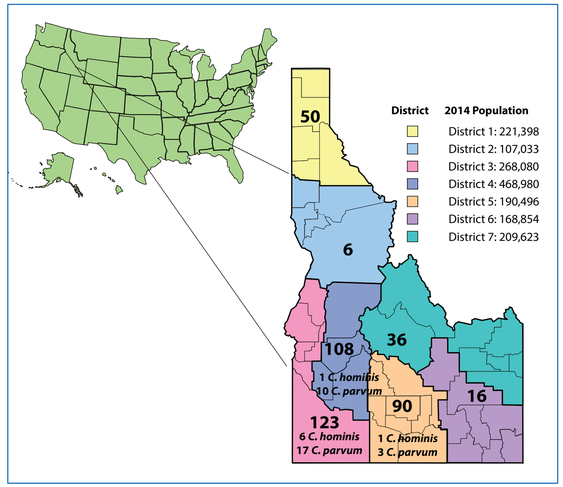


Table 2. Distribution of *Cryptosporidium* species and subtypes among cryptosporidiosis cases with molecular testing results — Idaho, 2012–2015

Species (18S rRNA PCR-RFLP)	Subtype family (GP60 sequencing)	Subtype	Number of cases (%) (n=38)	Number of cases associated with an outbreak†† (n=12)	Number of known outbreaks (n=6)
C. hominis	Ib	A10G2	3 (7.9)	2	1
	If	A12G1	5 (13.2)	0	0
C. parvum	IIa	A11G3R1	1 (2.6)	0	0
		A13G2R1	2 (5.3)	0	0
		A15G2R1	7 (18.4)	0	0
		A15G4R1	2 (5.3)	0	0
		A16G3R1	17 (44.7)	9	4
		A17G4R1	1 (2.6)	1	1

††Molecular testing results were not used in outbreak investigations because of lack of timeliness

Table 3. Characteristics of sporadic cryptosporidiosis cases with molecular testing results by *Cryptosporidium* species — Idaho, 2012–2015

Characteristics	Total (n = 26)	*C. hominis* (n = 6)	*C. parvum* (n = 20)
		No. (%)	
Patient			
Age ≤18 years	12 (46)	3 (50)	9 (45)
Female	19 (73)	5 (83)	14 (70)
Hispanic or Latino	3 (12)	0 (0)	3 (15)
Illness onset in summer, June–August	12 (46)	2 (33)	10 (50)
Hospitalized	5 (19)	0 (0)	5 (25)
Exposure			
Child care association	3 (12)	2 (33)	1 (5)
Animal contact	17 (65)	4 (67)	13 (65)
Recreational water	9 (35)	2 (33)	7 (35)
Private well	7 (27)	1 (17)	6 (30)

Strengths and Limitations

Strengths

- State-wide surveillance and laboratory data
- Examined several epidemiologic characteristics
- Used validated laboratory methods for molecular testing

Limitations

- Convenience, non-representative sample
- Small sample size
- Cross-sectional design
- Did not examine molecular testing use in outbreak investigations

Conclusion

- Compared with Idaho population, cryptosporidiosis cases in Idaho were more likely to be in females and in children aged less than 18 years.
- The cryptosporidiosis molecular profile in Idaho might be dominated by *C. parvum*, but this needs to be confirmed with additional molecular testing of isolates.
- A16G3R1 was the most common *C. parvum* subtype and was associated with the majority of the outbreaks. This subtype has been previously found in cattle and humans.[4]
- Increased molecular surveillance has potential to disentangle person-to-person, animal-to-person, waterborne, and foodborne *Cryptosporidium* transmission routes, and target prevention efforts. However, we could not confirm this in our study and this should be examined in future studies.

Recommendations

- Encourage stool sample submission to Idaho Bureau of Laboratories for *Cryptosporidium* testing.
- Consider allocating resources to perform molecular testing of *Cryptosporidium* isolates.

References

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