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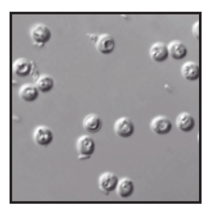
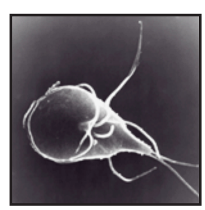
Cryptosporidiosis Surveillance — United States 1999–2002

and

Giardiasis Surveillance — United States, 1998–2002





DEPARTMENT OF HEALTH AND HUMAN SERVICES

CENTERS FOR DISEASE CONTROL AND PREVENTION

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* Proposed.

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Cryptosporidiosis Surveillance — United States 1999–2002

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Abstract

Problem/Condition: Cryptosporidiosis, a gastrointestinal illness, is caused by protozoa of the genus *Cryptosporidium*.

Reporting Period: 1999–2002.

System Description: State and two metropolitan health departments voluntarily reported cases of cryptosporidiosis through CDC's National Electronic Telecommunications System for Surveillance.

Results: During 1999–2002, the total number of reported cases of cryptosporidiosis increased from 2,769 for 1999 to 3,787 for 2001 and then decreased to 3,016 for 2002. The number of states reporting cryptosporidiosis cases increased from 46 to 50, and the number of states reporting more than four cases per 100,000 population increased from two to five. A greater number of case reports were received for children aged 1–9 years and for adults aged 30–39 years compared with other age groups. Incidence of cryptosporidiosis was particularly high in the upper Midwest and Vermont. Peak onset of illness occurred annually during early summer through early fall.

Interpretation: Transmission of cryptosporidiosis occurs throughout the United States, with increased diagnosis or reporting occurring in northern states. However, state incidence figures should be compared with caution because individual state surveillance systems have varying capabilities to detect cases. The seasonal peak in age-specific case reports coincides with the summer recreational water season and might reflect increased use of communal swimming venues (e.g., lakes, rivers, swimming pools, and water parks) by young children.

Public Health Action: Cryptosporidiosis surveillance provides data to educate public health practitioners and health-care providers about the epidemiologic characteristics and the disease burden of cryptosporidiosis in the United States. These data are used to improve reporting of cases, plan prevention efforts, and establish research priorities.

Introduction

Cryptosporidiosis is a gastrointestinal illness caused by coccidian protozoa of the genus *Cryptosporidium* (*1*). The hallmark symptom of this disease is diarrhea, which can be accompanied by abdominal cramps, loss of appetite, low-grade fever, nausea, vomiting, and weight loss; however, asymptomatic infection occurs frequently (*2*). *Cryptosporidium* can also cause an opportunistic infection in human immunodeficiency virus (HIV)–infected patients, who might experience life-threatening infection with profuse, watery, cholera-like diarrhea. The incidence of this parasitic infection among the HIV-infected population, however, has decreased since the introduction of highly active antiretroviral therapy (HAART) for treating persons with HIV infection (*3*). Nitazoxanide (NTZ, Alinia™, Romark Laboratories, L.C.; Tampa Bay, Florida), the only drug approved in the United States for treating cryptosporidiosis, can be used solely to treat children aged 1–11 years (*4*).

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A zoonotic disease, cryptosporidiosis also affects domestic (e.g., dogs, cattle, and sheep) and wild animals. *Cryptosporidium hominus* (known previously as *Cryptosporidium parvum* genotype I) naturally infects only humans, whereas *Cryptosporidium parvum* (known previously as *Cryptosporidium parvum* genotype II) infects both humans and cattle (*5*). Infected cattle serve as an important reservoir of *C. parvum* and therefore are substantial contributors to sporadic human cryptosporidiosis (*6,7*). Use of the term *Cryptosporidium* denotes either species unless otherwise noted.

Cryptosporidium infection is transmitted by the fecal-oral route and results from the ingestion of *Cryptosporidium* oocysts through the consumption of fecally contaminated food or water or through person-to-person or animal-to-person transmission. The oocysts are infectious immediately upon being excreted in feces. The infectious dose is low; ingestion of as few as 10–30 oocysts has been reported to cause infection in healthy persons (*8,9*). Certain infected persons have been reported to shed ≤10^9 oocysts in their stool per day and to excrete oocysts for ≤15 days after their symptoms have resolved (*10,11*).

Persons at increased risk for infection include 1) persons who have contact with infected animals, 2) persons who have ingested contaminated recreational (e.g., lake, river, pool, or hot tub) or drinking water, 3) close contacts of infected persons (e.g., those in the same family or household or in child care settings), and 4) travelers to disease-endemic areas (*1,6*).

Although cryptosporidiosis cases can occur sporadically, outbreaks are well documented. During 1991–2000, *Cryptosporidium* was identified as a causal agent of 37.7% (40 of 106) of reported recreational water-associated and 8.5% (11 of 130) of reported drinking water-associated outbreaks of gastroenteritis of known and suspected infectious etiology* (*12–16*). Additionally, foodborne outbreaks of cryptosporidiosis linked to ill foodhandlers and unpasteurized apple cider have been reported (*17,18*). Outbreaks resulting from person-to-person transmission in child care centers and from animal-to-person transmission in an animal nursery also have been reported (*19,20*).

Reporting of cryptosporidiosis as a nationally notifiable disease began in 1995. This report summarizes national cryptosporidiosis surveillance data for 1999–2002.

Methods

Laboratory-confirmed cases of cryptosporidiosis can be reported voluntarily to CDC. Laboratory-confirmed cryptosporidiosis is defined as the detection (in symptomatic or asymptomatic persons) of *Cryptosporidium*

- oocysts in stool or intestinal fluid by microscopic examination with or without staining (e.g., modified acid-fast) or by fluorescent antibody assays, either direct (DFA) or indirect (IFA); or
- oocyst or sporozoite antigens in stool or intestinal fluid by immunodiagnostic methods (e.g., enzyme immunoassay [EIA]); or
- parasite DNA in stool, in intestinal or other bodily fluids (e.g. bile or sputum), or in tissue samples by polymerase chain reaction (PCR) techniques when available; or
- life-cycle stages (e.g. trophozoites or merozoites) in tissue samples (*21*).

* The denominator includes outbreaks whose etiology was reported to be acute gastrointestinal illness because they were suspected to be caused by an unidentified infectious agent.

Testing for cryptosporidiosis should be specifically requested because it is not always included in routine examination of stool for ova and parasites (*1*). DFA is the most sensitive and the most specific detection method; however, other immunodiagnostic kits that do not require microscopy (e.g., EIA and rapid immunochromatographic cartridge assays) are also available (*22*). Only genetic testing (e.g., PCR) can be used to speciate isolates of *Cryptosporidium*.

State, District of Columbia (DC), New York City (NYC), commonwealth, and territorial health departments can voluntarily report laboratory-confirmed cases of cryptosporidiosis to CDC through the National Electronic Telecommunications System for Surveillance (NETSS). Reports include the patient's geographic information (i.e., state and county), age, sex, race, ethnicity (i.e., Hispanic or non-Hispanic) and date of illness onset and indicate whether the case is related to a known outbreak. An outbreak-related case is a laboratory-confirmed case that is linked epidemiologically to another laboratory-confirmed case. The patient's HIV-status is not reported to CDC.

Analysis of national cryptosporidiosis surveillance data for 1999–2002 was conducted by using SAS® v 8.2 (SAS Institute Inc.; Cary, North Carolina) and the Food Safety Information Link (FSI Link). FSI Link, an intranet-based tool available to CDC staff, provides access to NETSS data and is used to monitor trends in, and investigate outbreaks of, reportable foodborne and waterborne diseases.

Results

During the reporting period 1999–2002, the total number of reported cases of cryptosporidiosis increased 36.8% from 2,769 in 1999 to 3,787 in 2001 and then decreased 20.4% to 3,016 in 2002 (Table 1). Cases reported to be outbreak related made up 10.3%–13.7% of the total number of cases reported annually for 1999–2001 and 6.9% of the total reported for 2002. The number of states reporting cryptosporidiosis cases increased from 46 to 50 during the reporting period, and the number of states reporting more than four cases per 100,000 population increased from two in 1999 to five in 2002.

For 2002, incidence of cryptosporidiosis ranged from 0.2 cases (multiple states) to 9.5 cases (Wisconsin) per 100,000 population, with Minnesota, North Dakota, South Dakota, Vermont, and Wisconsin each reporting more than four cases per 100,000 population (Figure 1) (Table 1). Wisconsin reported the greatest number of cases per 100,000 population for each of the 4 years of the reporting period.

These surveillance data display a bimodal age distribution, with the greatest number of reported cases occurring among

TABLE 1. Cryptosporidiosis case reports, by state/area — United States, 1999–2002

	1999				2000				2001				2002			
State/Area	No.	(%)	Rate*	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases
Alabama	16	(0.6)	0.4		16	(0.5)	0.4		18	(0.5)	0.4		47	(1.6)	1.0	
Alaska	NR[†]				NR				1	(<0.1)	0.2		1	(<0.1)	0.2	
Arizona	16	(0.6)	0.3		10	(0.3)	0.2		11	(0.3)	0.2		19	(0.6)	0.3	
Arkansas	2	(0.1)	0.1		16	(0.5)	0.6		10	(0.3)	0.4		8	(0.3)	0.3	
California	279	(10.1)	0.8		235	(7.5)	0.7		229	(6.0)	0.7		200	(6.6)	0.6	
Colorado	14	(0.5)	0.3		72	(2.3)	1.7	14	44	(1.2)	1.0		57	(1.9)	1.3	
Connecticut	22	(0.8)	0.6		29	(0.9)	0.9		17	(0.4)	0.5		19	(0.6)	0.5	
Delaware	1	(<0.1)	0.1		9	(0.3)	1.1		6	(0.2)	0.8		4	(0.1)	0.5	
District of Columbia	7	(0.3)	1.2		18	(0.6)	3.1		14	(0.4)	2.4		5	(0.2)	0.9	
Florida	189	(6.8)	1.2	186	240	(7.7)	1.5	233	91	(2.4)	0.6		106	(3.5)	0.6	97
Georgia	170	(6.1)	2.1		191	(6.1)	2.3		162	(4.3)	1.9		123	(4.1)	1.4	
Hawaii	NR				NR				3	(0.1)	0.2	3	2	(0.1)	0.2	2
Idaho	8	(0.3)	0.6		28	(0.9)	2.2		23	(0.6)	1.7		29	(1.0)	2.2	
Illinois	90	(3.3)	0.7		126	(4.0)	1.0		483	(12.8)	3.9	341	121	(4.0)	1.0	
Indiana	47	(1.7)	0.8	1	72	(2.3)	1.2		90	(2.4)	1.5		70	(2.3)	1.1	
Iowa	56	(2.0)	1.9		77	(2.5)	2.6		82	(2.2)	2.8		49	(1.6)	1.7	
Kansas	2	(0.1)	0.1		9	(0.3)	0.3		4	(0.1)	0.1		16	(0.5)	0.6	
Kentucky	7	(0.3)	0.2	7	7	(0.2)	0.2	7	5	(0.1)	0.1	5	10	(0.3)	0.2	10
Louisiana	24	(0.9)	0.5		14	(0.4)	0.3		8	(0.2)	0.2		10	(0.3)	0.2	
Maine	31	(1.1)	2.4		20	(0.6)	1.6		19	(0.5)	1.5		12	(0.4)	0.9	
Maryland	17	(0.6)	0.3		14	(0.4)	0.3		40	(1.1)	0.7		19	(0.6)	0.3	
Massachusetts	71	(2.6)	1.1	55	37	(1.2)	0.6	2	55	(1.5)	0.9		77	(2.6)	1.2	2
Michigan	52	(1.9)	0.5		97	(3.1)	1.0		187	(4.9)	1.9		135	(4.5)	1.3	
Minnesota	91	(3.3)	1.9	2	190	(6.1)	3.9	4	197	(5.2)	4.0	11	206	(6.8)	4.1	32
Mississippi	12	(0.4)	0.4		16	(0.5)	0.6		15	(0.4)	0.5		10	(0.3)	0.3	
Missouri	26	(0.9)	0.5		31	(1.0)	0.6		55	(1.5)	1.0		41	(1.4)	0.7	
Montana	13	(0.5)	1.4		10	(0.3)	1.1		37	(1.0)	4.1		6	(0.2)	0.7	
Nebraska	15	(0.5)	0.9		82	(2.6)	4.8		185	(4.9)	10.8		52	(1.7)	3.0	
Nevada	9	(0.3)	0.5	4	4	(0.1)	0.2	3	7	(0.2)	0.3		4	(0.1)	0.2	
New Hampshire	20	(0.7)	1.6	20	25	(0.8)	2.0	25	17	(0.4)	1.4	17	31	(1.0)	2.4	31
New Jersey	54	(2.0)	0.6		19	(0.6)	0.2		24	(0.6)	0.3		17	(0.6)	0.2	
New Mexico	44	(1.6)	2.4		25	(0.8)	1.4		30	(0.8)	1.6		20	(0.7)	1.1	
New York[§]	452	(16.3)	2.4	4	310	(9.9)	1.6		248	(6.5)	1.3	4	300	(9.9)	1.6	3
New York City	260	(9.4)	3.5		171	(5.5)	2.1		123	(3.2)	1.5		147	(4.9)	1.8	
North Carolina	35	(1.3)	0.4	4	28	(0.9)	0.3		31	(0.8)	0.4		40	(1.3)	0.5	1
North Dakota	20	(0.7)	3.1		18	(0.6)	2.8		15	(0.4)	2.4		41	(1.4)	6.5	
Ohio	67	(2.4)	0.6		260	(8.3)	2.3	134	185	(4.9)	1.6		119	(3.9)	1.0	
Oklahoma	14	(0.5)	0.4		30	(1.0)	0.9		16	(0.4)	0.5		16	(0.5)	0.5	
Oregon	98	(3.5)	2.9	61	20	(0.6)	0.6		58	(1.5)	1.7		40	(1.3)	1.1	
Pennsylvania	123	(4.4)	1.0		64	(2.0)	0.5		102	(2.7)	0.8		111	(3.7)	0.9	
Rhode Island	6	(0.2)	0.6		4	(0.1)	0.4		10	(0.3)	0.9		21	(0.7)	2.0	
South Carolina	NR				NR				7	(0.2)	0.2		8	(0.3)	0.2	
South Dakota	7	(0.3)	0.9		15	(0.5)	2.0		8	(0.2)	1.1		42	(1.4)	5.5	22
Tennessee	13	(0.5)	0.2		12	(0.4)	0.2		24	(0.6)	0.4		61	(2.0)	1.1	
Texas	69	(2.5)	0.3		115	(3.7)	0.6		96	(2.5)	0.4		34	(1.1)	0.2	
Utah	4	(0.1)	0.2		28	(0.9)	1.3	1	84	(2.2)	3.7		16	(0.5)	0.7	
Vermont	36	(1.3)	6.0	7	28	(0.9)	4.6		34	(0.9)	5.5		33	(1.1)	5.4	
Virginia	30	(1.1)	0.4		21	(0.7)	0.3		27	(0.7)	0.4		35	(1.2)	0.5	
Washington	NR				NR				NR				46	(1.5)	0.8	
West Virginia	3	(0.1)	0.2		3	(0.1)	0.2		2	(0.1)	0.1		3	(0.1)	0.2	
Wisconsin	386	(13.9)	7.2	2	428	(13.7)	8.0	5	664	(17.5)	12.3	6	515	(17.1)	9.5	5
Wyoming	1	(<0.1)	0.2		5	(0.2)	1.0		7	(0.2)	1.4	2	9	(0.3)	1.8	2
Total	**2,769**	**(100.0)[¶]**	**1.0**	**353**	**3,128**	**(100.0)**	**1.1**	**428**	**3,787**	**(100.0)**	**1.3**	**389**	**3,016**	**(100.0)**	**1.0**	**207**

Sources: Population estimates are from the Population Division, US Census Bureau. Estimates of the population of states: ST-99-4 State Rankings of Population Change and Demographic Components of Population Change for the Period July 1, 1998, to July 1, 1999, available at http://www.census.gov/popest/archives/1990s/ST-99-01.txt, and Table 1: Annual estimates of the population for the United States and States and Puerto Rico: April 1, 2001, to July 1, 2003 (NST-EST 2003 01), available at http://www.census.gov/popest/states/tables/NST-EST2003-01.xls. Estimates of the New York City population: (SU-99-7) Population Estimates for Places (Sorted Alphabetically Within State): Annual Time Series, July 1, 1990 to July 1, 1999 (includes April 1, 1990 Population Estimates Base), available at http://www.census.gov/popest/archives/1990s/su-99-07/SU-99-7_NY.txt, and Table 1: Annual Estimates of the Population for Incorporated Places over 100,000, Ranked by July 1, 2003 Population: April 1, 2001, to July 1, 2003 (SUB-EST 2003-01), available at http://www.census.gov/popest/cities/tables/SUB-EST2003-01.xls.

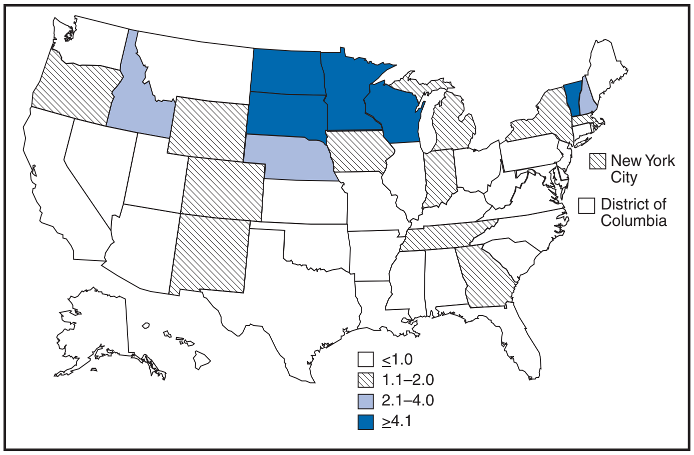
* Per 100,000 population on the basis of U.S. Census Bureau population estimates.

† No cases reported.

§ New York State case counts include New York City cases.

¶ Percentages might not total 100% because of rounding.

FIGURE 1. Incidence* of cryptosporidiosis, by state — United States, 2002



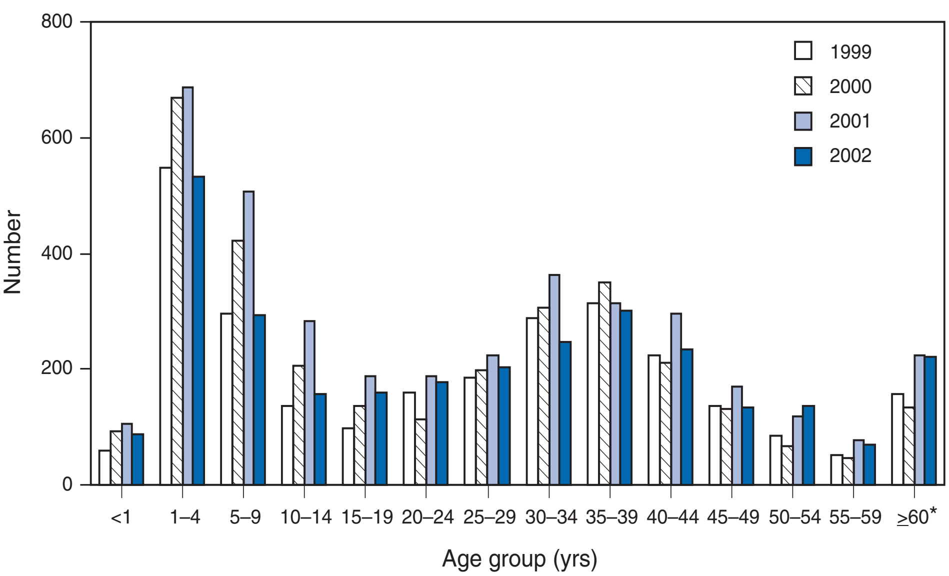
* Per 100,000 population.

children aged 1–4 and 5–9 years and among adults aged 30–34 and 35–39 years (Figure 2). When reports for which patients' sex was unknown or missing are excluded, the percentage of cases reported to have occurred among males varied annually from 53.5% (2,002 of 3,745) for 2001 to 58.9% (1,623 of 2,755) for 1999 (Table 2).

A five- to sixfold increase in reported cryptosporidiosis cases by illness onset occurred during June–October (i.e., weeks 25–42 [early summer through early fall]) compared with January–March (Figure 3). However, the date of illness onset was indicated for only 56.6% (1,567 of 2,769) of reported cases for 1999, for 51.7% (1,616 of 3,128) for 2000, for 60.6% (2,296 of 3,787) for 2001, and for 59.4% (1,791 of 3,016) for 2002. Age-specific analysis indicated that the seasonality in onset of illness was exhibited particularly among children aged 1–4 and 5–9 years (Figure 4) and across all age groups.

The majority of cases for which data on race were available for 1999–2002 occurred among whites, followed by blacks, Asians and Pacific Islanders, and Native Americans (Table 2). However, data on race were lacking for 28.2%–36.5% of the total annual case reports. Of patients for whom data on ethnicity were reported, 9.8%–12.8% (185 of 1,889 for 2001 and 213 of 1,660 for 1999, respectively) were reported to be Hispanic (Table 2). However, data on ethnicity were lacking for 39.6%–50.1% of the total annual case reports for 1999–2002.

FIGURE 2. Number of cryptosporidiosis case reports, by age group and year — United States, 1999–2002



* Case reports decreased with increased age.

Discussion

National cryptosporidiosis surveillance data are used to assess the epidemiologic characteristics and disease burden of cryptosporidiosis in the United States. The total number of cases reported annually increased during 1999–2001 and then decreased in 2002. Whether this decrease reflects changes in reporting patterns and behavior or a real change in infection and disease caused by *Cryptosporidium* is unclear. FoodNet data document a decrease in case reports of cryptosporidiosis and other enteric diseases for 1996–2003; this decrease has been attributed to increased government and food industry emphasis on improved food safety (*23*).

Cryptosporidiosis is geographically widespread in the United States. These data and data from the previous national cryptosporidiosis surveillance summary (1995–1998) indicate that the diagnosis or transmission of cryptosporidiosis might be higher in northern states (*24*). However, differences in cryptosporidiosis surveillance systems among states can affect the capability to detect cases, making interpretation of this observation difficult.

Although cryptosporidiosis affects persons in all age groups, the number of reported cases was highest among children aged 1–9 years and adults aged 30–39 years. These data are consistent with reports of cryptosporidiosis incidence being higher among younger children and of transmission to their

TABLE 2. Number and percentage* of cryptosporidiosis case reports, by selected demographic characteristics — United States, 1999–2002

	1999		2000		2001		2002	
Characteristic	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**
Sex								
Male	1,623	(58.6)	1,753	(56.0)	2,002	(52.9)	1,658	(55.0)
Female	1,132	(40.9)	1,341	(42.9)	1,743	(46.0)	1,301	(43.1)
Unknown/Missing	14	(0.5)	34	(1.1)	42	(1.1)	57	(1.9)
Total	**2,769**	**(100.0)**	**3,128**	**(100.0)**	**3,787**	**(100.0)**	**3,016**	**(100.0)**
Race								
Native American	4	(0.1)	6	(0.2)	18	(0.5)	11	(0.4)
Asian/Pacific Islander	27	(1.0)	32	(1.0)	30	(0.8)	26	(0.9)
Black	280	(10.1)	322	(10.3)	301	(7.9)	267	(8.9)
White	1,481	(53.5)	1,807	(57.8)	2,026	(53.5)	1,842	(61.1)
Other	19	(0.7)	14	(0.4)	29	(0.8)	17	(0.6)
Unknown/Missing	958	(34.6)	947	(30.3)	1,383	(36.5)	853	(28.2)
Total	**2,769**	**(100.0)**	**3,128**	**(100.0)**	**3,787**	**(100.0)**	**3,016**	**(100.0)**
Ethnicity								
Hispanic	213	(7.7)	187	(6.0)	185	(4.9)	182	(6.0)
Non-Hispanic	1,447	(52.3)	1,576	(50.4)	1,704	(45.0)	1,639	(54.3)
Unknown/Missing	1,109	(40.1)	1,365	(43.6)	1,898	(50.1)	1,195	(39.6)
Total	**2,769**	**(100.0)**	**3,128**	**(100.0)**	**3,787**	**(100.0)**	**3,016**	**(100.0)**

*Percentages might not total 100% because of rounding.

caregivers (e.g., child care staff, family members, and other household contacts) (*19,24–26*).

A marked seasonality in the onset of illness occurs in early summer through early fall, and a five- to sixfold increase in transmission of cryptosporidiosis occurs during the summer. This increase coincides with increased outdoor activities (e.g., swimming during the summer recreational water season) and might reflect heavy use of community swimming (essentially communal bathing) venues by younger children (*6,12–16*). *Cryptosporidium* is the leading cause of reported recreational water-associated outbreaks of gastroenteritis; transmission through recreational water is facilitated by the substantial number of *Cryptosporidium* oocysts that can be shed by a single person; the extended periods of time that oocysts can be shed; the low infectious dose; the resistance of *Cryptosporidium* oocysts to chlorine; and the prevalence of improper pool maintenance (i.e., insufficient disinfection, filtration, and recirculation of water), particularly of children's wading pools (*8–16,27,28*). This seasonal variation also has been noted in state, Canadian provincial, and previous U.S. national surveillance data for cryptosporidiosis, as well as for giardiasis (*24–26,29*).

Although the reason is unknown, increased transmission appears to occur among males, a finding that has been reported repeatedly (*24–26*). Because data on race and ethnicity are incomplete, conclusions cannot be made about differences in the epidemiology of cryptosporidiosis among

FIGURE 3. Number of cryptosporidiosis case reports, by date of illness onset — United States, 1999–2002

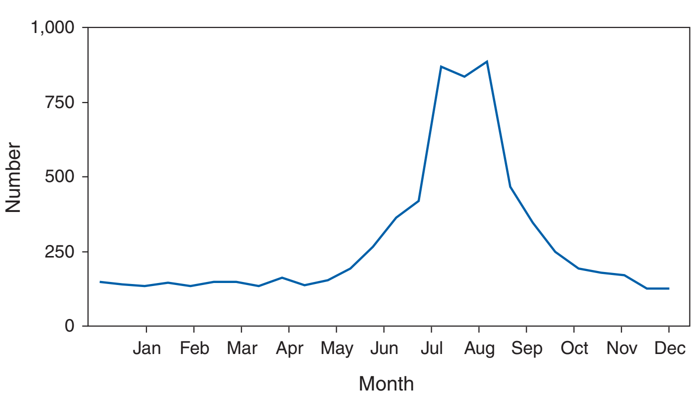
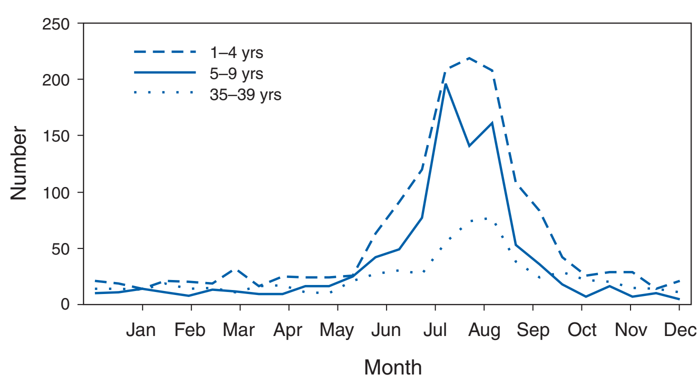


FIGURE 4. Number of cryptosporidiosis case reports, by selected age group* and date of illness onset — United States, 1999–2002



* The 1–4 and 5–9 year age groups are presented because they have the highest numbers of cryptosporidiosis case reports and the greatest seasonality. The 35–39 year age group was chosen to illustrate the less pronounced seasonality of the other age groups.

members of different racial populations and between Hispanics and non-Hispanics.

The data reported likely underestimate the cryptosporidiosis burden in the United States. Diarrheal diseases are highly underreported because 1) not all infected persons are symptomatic; 2) those who are symptomatic do not always seek medical care; 3) health-care providers do not always include diagnostics in their workup of diarrheal diseases because they might treat patients without testing stool for the pathogen; and 4) case-reports are not always completed for positive laboratory results or forwarded to public health officials (*30*).

An estimated 1%–5% of cases of salmonellosis, another diarrheal illness, are reported to CDC through passive surveillance (*31*). If these estimates are used to extrapolate from the 3,016 cryptosporidiosis cases reported by the 50 states and DC for 2002, the cryptosporidiosis disease burden in the United States in 2002 could have been 60,320–301,600 cases (20.9–104.7 cases per 100,000 population). The true burden of cryptosporidiosis in the United States is likely to fall between these two estimates.

Its low infectious dose, protracted communicability, and chlorine resistance make *Cryptosporidium* ideally suited for transmission through drinking and recreational water, food, and both person-to-person and animal-to-person contact. Prevention measures (Box 1) and measures to improve surveillance for cryptosporidiosis and increase understanding of its epidemiology and the associated disease burden (Box 2) have been recommended. Information about cryptosporidiosis is available from CDC at http://www.cdc.gov/ncidod/dpd/parasites/cryptosporidiosis/factsht_cryptosporidiosis.htm.

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BOX 1. Recommendations to prevent and control cryptosporidiosis

Always practice good hand hygiene.

- Wash hands with soap and water for at least 15 seconds, rubbing hands together vigorously and scrubbing all surfaces
  - — after using the toilet,
  - — before handling food,
  - — after every diaper change (even if wearing gloves),
  - — after direct contact with preschool-aged children, and
  - — after any contact with animals or their feces.

Prevent contamination of recreational water (e.g., swimming pools, spas, interactive fountains, lakes, rivers, and oceans).

- Do not swim when ill with diarrhea (e.g., swimming in or entering the water at pools, spas, interactive fountains, lakes, rivers, or oceans).
- Take children on frequent bathroom breaks and check their diapers often.
- Change diapers in the bathroom, not at the poolside.
- Wash children thoroughly (especially their bottoms) with soap and water after they use the toilet or their diapers are changed and before they enter the water.
- Shower before entering the water.

Information about recreational water illnesses (RWIs) and how to stop them from spreading is available from CDC at http://www.cdc.gov/healthyswimming.

Prevent infection and illness caused by water that might be contaminated.

- Do not swallow water in swimming pools, spas, and interactive fountains.
- Do not swallow untreated water from lakes, rivers, springs, ponds, streams, or shallow wells.
- Do not drink inadequately treated water during communitywide outbreaks caused by contaminated drinking water.
- Do not use or drink inadequately treated water when traveling in countries where the water supply might be unsafe.
- If the safety of drinking water is in doubt,
  - — disinfect it by heating the water to a rolling boil for 1 minute, or
  - — use a filter that has been tested and rated by National Safety Foundation (NSF) Standard 53 or NSF Standard 58 for cyst reduction; filtered water will need additional treatment to kill or inactivate bacteria and viruses.

Information about water filters and bottled water is available from CDC at http://www.cdc.gov/ncidod/dpd/parasites/cryptosporidiosis/factsht_crypto_prevent_water.htm.

Prevent infection and illness caused by eating food that might be contaminated.

- Use properly treated water to wash all food that will be eaten raw.
- Do not eat uncooked foods when traveling in areas where cryptosporidiosis is common.

Prevent contact and contamination with feces during sex.

- Use a barrier (e.g., a condom) during oral-anal sex.
- Wash hands immediately after handling a condom used during anal sex and after touching the anus or rectal area.

Additional recommendations for prevention and control of cryptosporidiosis for persons with compromised immune systems.

- Minimize contact with the stool of all animals, particularly young animals.
  - — Have others change litter boxes and clean cages.
  - — Wear disposable gloves when cleaning up after a pet and always wash hands when finished.
- Wash hands after any contact with animals or their living areas.
- Wash hands after gardening, even if wearing gloves.
- Wash, peel, and, if needed, cook, all raw vegetables.
- Boil or filter drinking water to ensure its safety, particularly in an area experiencing an outbreak; filtered water will need additional treatment to kill or inactivate bacteria and viruses.

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BOX 2. Recommended measures to improve surveillance for cryptosporidiosis and increase understanding of its epidemiology and associated disease burden

- Encourage health-care providers to consider and specifically request testing for *Cryptosporidium* in the workup of gastrointestinal illness.
- Encourage laboratories to test for *Cryptosporidium* when examining stool for ova and parasites.
- Continue to educate health-care providers as well as public and private laboratories to improve reporting of cases of cryptosporidiosis to jurisdictional health departments.
- Encourage jurisdictional health departments to transmit cryptosporidiosis data to CDC through the National Electronic Disease Surveillance System (NEDSS), which will replace the National Electronic Telecommunications System for Surveillance (NETSS).
- Publish and distribute cryptosporidiosis surveillance data regularly for public health education purposes.
- Conduct further epidemiologic studies of the geographic variability, incidence, and risk factors for cryptosporidiosis.

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Giardiasis Surveillance — United States, 1998–2002

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Abstract

Problem/Condition: Giardiasis, a gastrointestinal illness, is caused by the protozoan parasite *Giardia intestinalis*.

Reporting Period: 1998–2002.

System Description: State, commonwealth, territorial, and two metropolitan health departments voluntarily reported cases of giardiasis through CDC's National Electronic Telecommunications System for Surveillance.

Results: During 1998–2002, the total number of reported cases of giardiasis decreased from 24,226 for 1998 to 19,708 for 2001 and then increased to 21,300 for 2002. The number of states reporting giardiasis cases increased from 42 to 46; however, the number of states reporting more than 15 cases per 100,000 population decreased from 10 to five. A greater number of case reports were received for children aged 1–9 years and for adults aged 30–39 years compared with other age groups. Incidence of giardiasis was highest in northern states. Peak onset of illness occurred annually during early summer through early fall.

Interpretation: The increase observed for 2002 might reflect increased reporting after reporting of giardiasis as a nationally notifiable disease began in 2002. Transmission of giardiasis occurs throughout the United States, with increased diagnosis or reporting occurring in northern states. However, state incidence figures should be compared with caution because individual state surveillance systems have varying capabilities to detect cases. The seasonal peak in age-specific case reports coincides with the summer recreational water season and might reflect increased use of communal swimming venues (e.g., lakes, rivers, swimming pools, and water parks) by young children.

Public Health Action: Giardiasis surveillance provides data to educate public health practitioners and health-care providers about the epidemiologic characteristics and the disease burden of giardiasis in the United States. These data are used to improve reporting of cases, plan prevention efforts, and establish research priorities.

Introduction

Giardia intestinalis (also known as *G. lamblia* and *G. duodenalis*) is the most common intestinal parasite identified by public health laboratories in the United States (*1*). This flagellated protozoan causes clinical illness (i.e., giardiasis) characterized by diarrhea, abdominal cramps, bloating, weight loss, and malabsorption; however, asymptomatic infection also frequently occurs (*2–4*). Case reports indicate that giardiasis also might be associated with the development of reactive arthritis (*5*). A zoonotic disease, giardiasis also affects domestic and wild mammals (e.g., cats, dogs, cattle, deer, and beavers) (*2*).

Giardia infection is transmitted by the fecal-oral route and results from the ingestion of *Giardia* cysts through the consumption of fecally contaminated food or water or through person-to-person or animal-to-person transmission. The cysts are infectious immediately upon being excreted in feces. The infectious dose is low; ingestion of 10 cysts has been reported to cause infection (*6*). Infected persons have been reported to shed $\leq 10^9$ cysts in their stool per day and to excrete cysts for months (*6–8*).

Persons at increased risk for infection include 1) travelers to disease-endemic areas; 2) children in child care settings; 3) close contacts of infected persons (e.g., those in the same family or household or in the child care setting); 4) persons who ingest contaminated drinking water; 5) persons who swallow contaminated recreational water (e.g., water in lakes, rivers, and pools); 6) persons taking part in outdoor activities (e.g., backpacking and camping) who consume unfiltered, untreated water or who fail to practice hygienic behaviors (e.g., hand washing); 7) persons who have contact with infected animals; and 8) men who have sex with men (*2,9–13*). The relative contribution of person-to-person, animal-to-person, foodborne, and waterborne transmission to sporadic human giardiasis in the United States is unknown.

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Although giardiasis cases can occur sporadically, outbreaks are well documented. During 1991–2000, *Giardia* was identified as a causal agent of 9.4% (10 of 106) of reported recreational water-associated and 16.2% (21 of 130) of reported drinking water-associated outbreaks of gastroenteritis of known or suspected infectious etiology* (*13–17*). Additionally, foodborne outbreaks of giardiasis linked to infected foodhandlers and uninfected foodhandlers who diapered infected children have been reported (*18*). Outbreaks resulting from person-to-person transmission in child care centers also have been reported (*19*).

In 1992, the Council of State and Territorial Epidemiologists (CSTE) assigned giardiasis an event code (code 11570) to facilitate transmission of reported giardiasis data to CDC. Reporting of giardiasis as a nationally notifiable disease began in 2002. This report summarizes national giardiasis surveillance data for 1998–2002.

Methods

Laboratory-confirmed and probable cases of giardiasis can be reported voluntarily to CDC. Laboratory-confirmed giardiasis is defined as the detection (in symptomatic or asymptomatic persons) of *Giardia intestinalis*

- cysts in stool specimens or trophozoites in stool specimens, duodenal fluid, or small-bowel tissue by microscopic examination using staining methods (e.g., trichrome) or direct fluorescent antibody assays (DFA); or
- antigens in stool specimens by immunodiagnostic testing (e.g., enzyme-linked immunosorbent assay) (*20*).

A probable case of giardiasis is a clinically compatible case that is linked epidemiologically to a laboratory-confirmed case (*20*). DFA is the most sensitive and specific detection method for *Giardia* (*21*). Because *Giardia* cysts can be excreted intermittently, and multiple stool collections increase testing sensitivity, a total of three stool specimens should be collected, each on a different day (*22*).

State, District of Columbia (DC), New York City (NYC), commonwealth, and territorial health departments can voluntarily report laboratory-confirmed and probable cases of giardiasis to CDC through the National Electronic Telecommunications System for Surveillance (NETSS). Reports include the patient's geographic information (i.e., state and county), age, sex, race, ethnicity (i.e., Hispanic or non-Hispanic), and date of illness onset and indicate whether the case is related to a known outbreak. An outbreak-related case is a laboratory-confirmed or a probable case that is linked epidemiologically to a laboratory-confirmed case.

Analysis of the national giardiasis surveillance data for 1998–2002 was conducted by using SAS® v 8.2 (SAS Institute, Inc.; Cary, North Carolina) and the Food Safety Information Link (FSI Link). FSI Link, an intranet-based tool available to CDC staff, provides access to NETSS data and is used to monitor trends in and investigate outbreaks of reportable foodborne and waterborne diseases.

Results

During the 1998–2002 reporting period, the total number of reported cases of giardiasis decreased 18.6% from 24,226 for 1998 to 19,708 for 2001 and then increased 8.1% to 21,300 for 2002 (Table 1). Cases reported to be outbreak related made up 1.6%–11.6% of the total number of cases reported annually for 1999–2002. Although the number of states reporting cases increased from 42 to 46 during the reporting period, the number of states reporting >15 cases per 100,000 population decreased from 10 in 1998 to five in 2002.

For 2002, among states reporting cases, incidence of giardiasis ranged from <0.1 cases (Texas) to 23.5 cases (Vermont) per 100,000 population. Vermont reported the greatest number of cases per 100,000 population for each of the 5 years of the reporting period. Northern states reported more cases annually per 100,000 population than southern states (Figure 1) (Table 1).

These surveillance data display a bimodal age distribution, with the greatest number of reported cases occurring among children aged 1–9 years and adults aged 30–39 years (Figure 2). When reports for which patients' sex was missing or unknown are excluded, the percentage of cases reported to have occurred among males varied annually from 52.0% (12,125 of 23,310) for 1998 to 55.8% (10,851 of 19,460) for 2001.

A twofold increase in reported giardiasis cases by onset of illness occurred during June–October (i.e., weeks 26–42 [early summer through early fall]) compared with January–March (Figure 3). However, the date of onset of illness was indicated for only 43.3% (10,480 of 24,226) of reported cases for 1998, for 43.8% (10,197 of 23,281) for 1999, for 42.6% (9,290 of 21,813) for 2000, for 49.2% (9,692 of 19,708) for 2001, and for 48.1% (10,245 of 21,300) for 2002. Age-specific analysis indicated that the seasonality in onset of illness was exhibited among children aged 1–4 and 5–9 years and adults aged 35–39 years (Figure 4) and among all age groups.

* The denominator includes outbreaks whose etiology was reported as acute gastrointestinal illness because they were suspected to be caused by an unidentified infectious agent.

TABLE 1. Giardiasis case reports, by state/area — United States, 1998–2002

	1998				1999				2000				2001				2002			
State/Area	No.	(%)	Rate*	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases	No.	(%)	Rate	No. of outbreak cases
Alabama	288	(1.2)	6.6		340	(1.5)	7.8		227	(1.0)	5.1		231	(1.2)	5.2		205	(1.0)	4.6	
Alaska	109	(0.4)	17.7		96	(0.4)	15.5		115	(0.5)	18.3		121	(0.6)	19.1		115	(0.5)	17.9	21
Arizona	250	(1.0)	5.4		255	(1.1)	5.3		313	(1.4)	6.1		267	(1.4)	5.0	2	269	(1.3)	4.9	1
Arkansas	168	(0.7)	6.6		152	(0.7)	6.0		203	(0.9)	7.6		160	(0.8)	5.9		175	(0.8)	6.5	
California	NR[†]				NR				NR				NR				2,561	(12.0)	7.3	
Colorado	618	(2.6)	15.6		704	(3.0)	17.4	4	695	(3.2)	16.2	5	632	(3.2)	14.3	2	571	(2.7)	12.7	5
Connecticut	NR				NR				462	(2.1)	13.6		417	(2.1)	12.1		260	(1.2)	7.5	
Delaware	39	(0.2)	5.2		52	(0.2)	6.9		92	(0.4)	11.7		59	(0.3)	7.4		54	(0.3)	6.7	
District of Columbia	34	(0.1)	6.5		37	(0.2)	7.1		38	(0.2)	6.6		70	(0.4)	12.2		47	(0.2)	8.3	
Florida	1,676	(6.9)	11.2	1,636	1,360	(5.8)	9.0	1,334	1,521	(7.0)	9.5	1,459	1,155	(5.9)	7.1		1,318	(6.2)	7.9	1,226
Georgia	1,215	(5.0)	15.9		1,355	(5.8)	17.4		1,201	(5.5)	14.7		963	(4.9)	11.5		926	(4.3)	10.8	
Hawaii	123	(0.5)	10.3	99	117	(0.5)	9.9	117	105	(0.5)	8.7	105	118	(0.6)	9.6	118	91	(0.4)	7.3	91
Idaho	177	(0.7)	14.4	1	134	(0.6)	10.7	1	139	(0.6)	10.7		172	(0.9)	13.0	1	137	(0.6)	10.2	1
Illinois	1,472	(6.1)	12.2		1,458	(6.3)	12.0	11	1,093	(5.0)	8.8		1,108	(5.6)	8.9		1,011	(4.8)	8.0	
Indiana	772	(3.2)	13.1		654	(2.8)	11.0	3	517	(2.4)	8.5		3	(<0.1)	<0.1		NR			
Iowa	429	(1.8)	15.0	4	377	(1.6)	13.1		420	(1.9)	14.4		345	(1.8)	11.8		314	(1.5)	10.7	
Kansas	226	(0.9)	8.6	7	220	(0.9)	8.3		205	(0.9)	7.6		178	(0.9)	6.6		192	(0.9)	7.1	
Kentucky	NR				NR				NR				NR				NR			
Louisiana	NR				21	(0.1)	0.5		41	(0.2)	0.9		14	(0.1)	0.3		6	(<0.1)	0.1	
Maine	277	(1.1)	22.2		238	(1.0)	19.0		238	(1.1)	18.7		197	(1.0)	15.3	1	213	(1.0)	16.4	
Maryland	NR				119	(0.5)	2.3		125	(0.6)	2.4	8	NR				118	(0.6)	2.2	5
Massachusetts	833	(3.4)	13.6	637	851	(3.7)	13.8	640	632	(2.9)	10.0	12	908	(4.6)	14.2	27	935	(4.4)	14.6	1
Michigan	1,172	(4.8)	11.9	8	1,166	(5.0)	11.8	2	1,135	(5.2)	11.4	1	1,003	(5.1)	10.0	1	923	(4.3)	9.2	
Minnesota	1,324	(5.5)	28.0	8	1,555	(6.7)	32.6	9	1,227	(5.6)	24.9	22	1,061	(5.4)	21.3	16	982	(4.6)	19.5	
Mississippi	131	(0.5)	4.8	131	145	(0.6)	5.2		116	(0.5)	4.1		NR				NR			
Missouri	790	(3.3)	14.5		807	(3.5)	14.8		839	(3.8)	15.0		715	(3.6)	12.7		512	(2.4)	9.0	
Montana	119	(0.5)	13.5	2	83	(0.4)	9.4	1	91	(0.4)	10.1	1	95	(0.5)	10.5		94	(0.4)	10.3	
Nebraska	249	(1.0)	15.0		238	(1.0)	14.3		300	(1.4)	17.5	1	234	(1.2)	13.6		191	(0.9)	11.1	
Nevada	222	(0.9)	12.7	140	215	(0.9)	11.9	121	211	(1.0)	10.6	138	208	(1.1)	9.9		162	(0.8)	7.5	
New Hampshire	83	(0.3)	7.0	83	64	(0.3)	5.3	64	56	(0.3)	4.5	56	38	(0.2)	3.0	38	46	(0.2)	3.6	46
New Jersey	218	(0.9)	2.7		NR				NR				494	(2.5)	5.8		474	(2.2)	5.5	
New Mexico	238	(1.0)	13.7		261	(1.1)	15.0	1	164	(0.8)	9.0		148	(0.8)	8.1		153	(0.7)	8.3	
New York[§]	3,739	(15.4)	20.6	55	3,696	(15.9)	20.3	78	3,346	(15.3)	17.6	83	2,903	(14.7)	15.2	66	2,764	(13.0)	14.4	80
New York City	2,079	(8.6)	28.1		1,894	(8.1)	25.5		1,737	(8.0)	21.7		1,520	(7.7)	18.9		1,417	(6.7)	17.6	
North Carolina	NR				NR				NR				NR				NR			
North Dakota	82	(0.3)	12.9		104	(0.4)	16.4		65	(0.3)	10.1		78	(0.4)	12.3		47	(0.2)	7.4	
Ohio	1,093	(4.5)	9.7	1	1,110	(4.8)	9.9	2	1,058	(4.9)	9.3	1	1,090	(5.5)	9.6	1	972	(4.6)	8.5	6
Oklahoma	148	(0.6)	4.4		152	(0.7)	4.5		96	(0.4)	2.8		NR				85	(0.4)	2.4	
Oregon	900	(3.7)	27.4		808	(3.5)	24.4	2	654	(3.0)	19.1	13	543	(2.8)	15.6	4	447	(2.1)	12.7	4
Pennsylvania	1,461	(6.0)	12.2	2	1,124	(4.8)	9.4	4	1,083	(5.0)	8.8	10	1,150	(5.8)	9.4	8	1,066	(5.0)	8.6	1
Rhode Island	130	(0.5)	13.2		149	(0.6)	15.0		157	(0.7)	15.0		168	(0.9)	15.9		170	(0.8)	15.9	
South Carolina	NR				NR				NR				NR				149	(0.7)	3.6	
South Dakota	181	(0.7)	24.8		143	(0.6)	19.5	5	108	(0.5)	14.3	16	106	(0.5)	14.0	15	83	(0.4)	10.9	7
Tennessee	220	(0.9)	4.0		187	(0.8)	3.4		187	(0.9)	3.3		189	(1.0)	3.3		191	(0.9)	3.3	
Texas	NR				NR				NR				NR				3	(<0.1)	<0.1	
Utah	291	(1.2)	13.9		256	(1.1)	12.0	19	281	(1.3)	12.6	42	284	(1.4)	12.5	3	335	(1.6)	14.4	
Vermont	326	(1.3)	55.2		345	(1.5)	58.1	30	217	(1.0)	35.6		220	(1.1)	35.9		145	(0.7)	23.5	
Virginia	503	(2.1)	7.4		471	(2.0)	6.9	1	437	(2.0)	6.2		417	(2.1)	5.8		386	(1.8)	5.3	
Washington	740	(3.1)	13.0		560	(2.4)	9.7		622	(2.9)	10.6		512	(2.6)	8.5		510	(2.4)	8.4	
West Virginia	90	(0.4)	5.0	4	93	(0.4)	5.1	1	80	(0.4)	4.4	3	83	(0.4)	4.6		78	(0.4)	4.3	
Wisconsin	1,003	(4.1)	19.2		936	(4.0)	17.8	10	811	(3.7)	15.1	3	765	(3.9)	14.2	12	691	(3.2)	12.7	5
Wyoming	45	(0.2)	9.4		37	(0.2)	7.7		49	(0.2)	9.9	1	37	(0.2)	7.5	1	29	(0.1)	5.8	
Total state	**24,204**	**(99.9)**	**9.0**	**2,818**	**23,245**	**(99.8)**	**8.5**	**2,460**	**21,772**	**(99.8)**	**7.7**	**1,980**	**19,659**	**(99.8)**	**6.9**	**316**	**21,206**	**(99.6)**	**7.4**	**1,500**
Guam	9	(<0.1)	6.0		23	(0.1)	15.1		17	(0.1)	10.9		9	(<0.1)	5.7		7	(<0.1)	4.3	
Northern Mariana Islands	NR		—		NR		—		NR		—		NR		—		1	(<0.1)	1.4	
Puerto Rico	13	(0.1)	0.3		13	(0.1)	0.3		24	(0.1)	0.6		40	(0.2)	1.0	3	86	(0.4)	2.2	2
Total	**24,226**	**(100.0)[¶]**		**2,818**	**23,281**	**(100.0)**		**2,460**	**21,813**	**(100.0)**		**1,980**	**19,708**	**(100.0)**		**319**	**21,300**	**(100.0)**		**1,502**

Sources: Population estimates are from the Population Division, US Census Bureau. Estimates of the population of states: ST-99-4 State Rankings of Population Change and Demographic Components of Population Change for the Period July 1, 1998, to July 1, 1999, available at http://www.census.gov/popest/archives/1990s/ST-99-01.txt, and Table 1: Annual estimates of the population for the United States and States and Puerto Rico: April 1, 2001, to July 1, 2003 (NST-EST 2003 01), available at http://www.census.gov/popest/states/tables/NST-EST2003-01.xls. Estimates of the New York City population: (SU-99-7) Population Estimates for Places (Sorted Alphabetically Within State): Annual Time Series, July 1, 1990, to July 1, 1999 (includes April 1, 1990 Population Estimates Base), available at http://www.census.gov/popest/archives/1990s/su-99-07/SU-99-7_NY.txt, and Table 1: Annual Estimates of the Population for Incorporated Places over 100,000, Ranked by July 1, 2003 Population: April 1, 2001, to July 1, 2003 (SUB-EST 2003-01), available at http://www.census.gov/popest/cities/tables/SUB-EST2003-01.xls. Estimates of the population of Guam, the Northern Mariana Islands, and Puerto Rico: International Data Base (IDB) Data Access — Spreadsheet, available at http://www.census.gov/ipc/www/idbsprd.html.

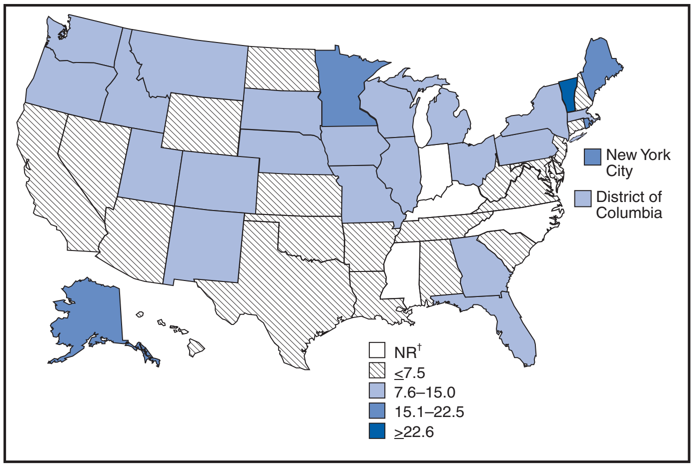
* Per 100,000 population on the basis of U.S. Census Bureau population estimates.

† No cases reported to CDC.

§ New York State counts include New York City cases.

¶ Percentages might not total 100% because of rounding.

FIGURE 1. Incidence* of giardiasis, by state — United States, 2002



* Per 100,000 population.
† No cases reported to CDC.

The majority of cases for which data on race were available for 1998–2002 occurred among whites, followed by blacks, Asians and Pacific Islanders, and Native Americans (Table 2). However, data on race were not included for 39.2%–46.8% of total annual case reports. Of patients for whom data on ethnicity were reported, 13.6%–16.3% (1,651 of 12,158 for 1998 and 1,526 of 9,361 for 2001, respectively) were reported to be Hispanic. However, data on ethnicity were lacking for 49.5%–54.5% of total annual case reports for 1998–2002.

Discussion

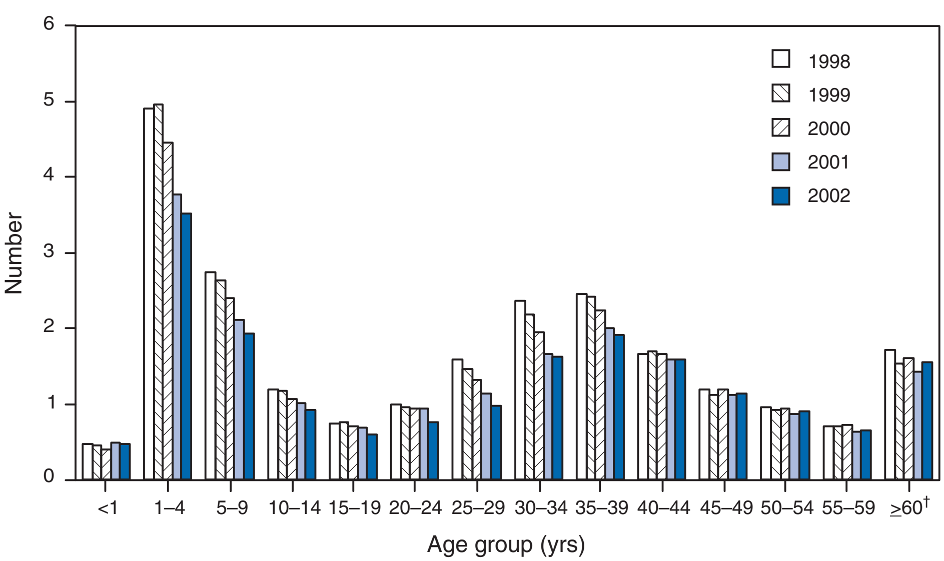
National giardiasis surveillance data are used to assess the epidemiologic characteristics and disease burden of giardiasis in the United States. The total number of cases reported annually decreased during 1998–2001 and then increased in 2002. Reporting of giardiasis as a nationally notifiable disease began in 2002. California, which reported giardiasis cases for the first time in 2002, recorded 2,561 cases, which likely explains the observed increase in case reports for that year. Whether the decrease in reported cases for 1999–2001 reflects changes in reporting patterns and behavior or a real change in infection and disease caused by *Giardia* is unclear. FoodNet data document a decrease in case reports of other enteric diseases for 1996–2003; this decrease has been attributed to increased government and food industry emphasis on improved food safety (*23*).

Giardiasis is geographically widespread in the United States. These data and data from the previous national giardiasis surveillance summary (1992–1997) indicate that the diagnosis or transmission of giardiasis might be higher in northern states (*24*). However, because differences in giardiasis surveillance systems among states can affect the capability to detect cases, whether this finding is of true biologic significance or is only the result of differences in case detection or reporting is difficult to determine.

Although giardiasis affects persons in all age groups, the number of reported cases was highest among children aged 1–9 years and adults aged 30–39 years. These data are consistent with previously published reports of giardiasis incidence being higher among younger children and of transmission to their caregivers (e.g., child care staff, family members, and other household contacts) (*2,24–26*).

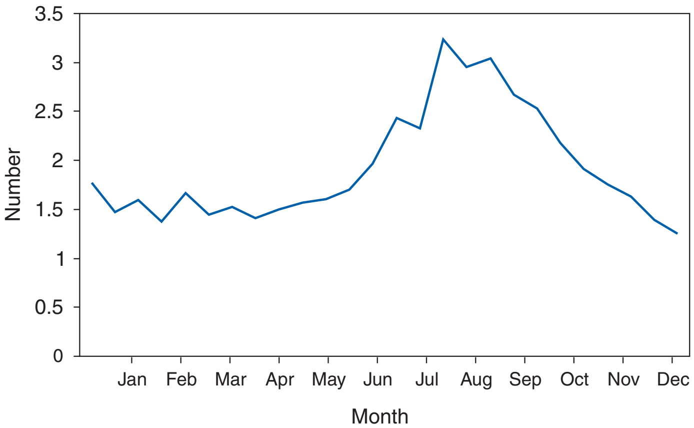
A marked seasonality in the onset of illness occurs in early summer through early fall, and a twofold increase in transmission of giardiasis occurs during the summer. This increase coincides with increased outdoor activities (e.g., swimming during the summer recreational water season and camping) and might reflect heavy use of community swimming (essentially communal bathing) venues by younger children. Transmission through use of surface water (e.g., lakes and rivers) and disinfected venues (e.g., swimming pools and water parks) is facilitated by the substantial number of *Giardia* cysts that can be shed by a single person; the extended periods of time

FIGURE 2. Number* of giardiasis case reports, by age group and year — United States, 1998–2002



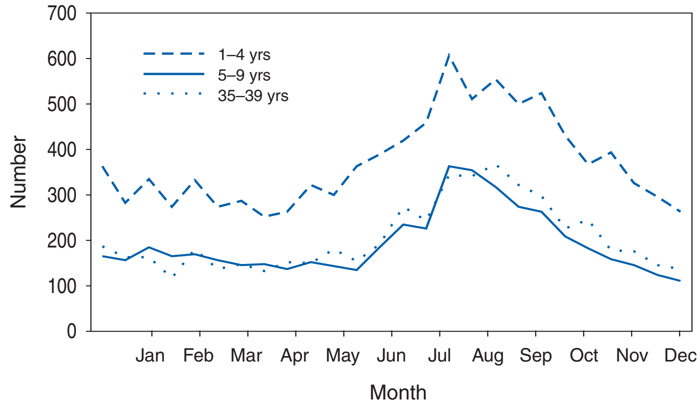
* In 1,000s.
† Case reports decreased with increased age.

FIGURE 3. Number* of giardiasis case reports, by date of illness onset — United States, 1998–2002



* In 1,000s.

FIGURE 4. Number of giardiasis case reports, by selected age group* and date of illness onset — United States, 1998–2002



* The three age groups (1–4, 5–9, and 35–39 years) with the highest numbers of giardiasis case reports are presented. All age groups exhibited a twofold increase.

that cysts can be shed; the low infectious dose; the moderate resistance to chlorine of *Giardia*; the prevalence of improper pool maintenance (i.e., insufficient disinfection, filtration, and recirculation of water), particularly of children's wading pools; the prevalence of *Giardia* in fecal material in pools; and documented transmission of *Giardia* infection among diapered children using swimming venues (*6–8,27–29*). This seasonal variation also has been noted in state, Canadian provincial, and previous U.S. national surveillance data for giardiasis, as well as for cryptosporidiosis (*24–26,30*).

Among patients for whom data on sex were reported, the proportion reported to be male increased annually during 1998–2001. However, because 12.9% of case reports for 2002 did not include data about sex, whether this increase continued in 2002 is unclear. Because data on race and ethnicity are incomplete, conclusions cannot be made about the differences noted in the epidemiology of giardiasis among members of different racial populations and between Hispanics and non-Hispanics.

TABLE 2. Number and percentage* of giardiasis case reports, by selected demographic characteristics — United States, 1998–2002

	1998		1999		2000		2001		2002	
Characteristic	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**
Sex										
Male	12,125	(50.0)	12,220	(52.5)	11,726	(53.8)	10,851	(55.1)	10,182	(47.8)
Female	11,185	(46.2)	10,718	(46.0)	9,808	(45.0)	8,609	(43.7)	8,374	(39.3)
Unknown/Missing	916	(3.8)	343	(1.5)	279	(1.3)	248	(1.3)	2,744	(12.9)
Total	**24,226**	**(100.0)**	**23,281**	**(100.0)**	**21,813**	**(100.0)**	**19,708**	**(100.0)**	**21,300**	**(100.0)**
Race										
Native American	95	(0.4)	98	(0.4)	71	(0.3)	197	(1.0)	76	(0.4)
Asian/Pacific Islander	586	(2.4)	499	(2.1)	515	(2.4)	497	(2.5)	498	(2.3)
Black	932	(3.8)	958	(4.1)	1,159	(5.3)	1,035	(5.3)	808	(3.8)
White	12,873	(53.1)	12,418	(53.3)	11,404	(52.3)	9,676	(49.1)	9,853	(46.3)
Other	66	(0.3)	104	(0.4)	123	(0.6)	114	(0.6)	99	(0.5)
Unknown/Missing	9,674	(39.9)	9,204	(39.5)	8,541	(39.2)	8,189	(41.6)	9,966	(46.8)
Total	**24,226**	**(100.0)**	**23,281**	**(100.0)**	**21,813**	**(100.0)**	**19,708**	**(100.0)**	**21,300**	**(100.0)**
Ethnicity										
Hispanic	1,651	(6.8)	1,627	(7.0)	1,673	(7.7)	1,526	(7.7)	1,486	(7.0)
Non-Hispanic	10,507	(43.4)	10,094	(43.4)	9,336	(42.8)	7,835	(39.8)	8,206	(38.5)
Unknown/Missing	12,068	(49.8)	11,560	(49.7)	10,804	(49.5)	10,347	(52.5)	11,608	(54.5)
Total	**24,226**	**(100.0)**	**23,281**	**(100.0)**	**21,813**	**(100.0)**	**19,708**	**(100.0)**	**21,300**	**(100.0)**

* Percentages might not total 100% because of rounding.

The data reported likely underestimate the giardiasis burden in the United States. Diarrheal diseases are highly underreported because 1) not all infected persons are symptomatic; 2) those who are symptomatic do not always seek medical care; 3) health-care providers do not always include diagnostics in their workup of diarrheal diseases because they might treat patients without testing stool for the pathogen; and 4) case reports are not always completed for positive laboratory results or forwarded to public health officials (*31*).

An estimated 1%–5% of cases of salmonellosis, another diarrheal illness, are reported to CDC through passive surveillance (*32*). If these estimates are used to extrapolate from the 21,206 giardiasis cases reported by the 50 states and DC for 2002, the giardiasis disease burden in the United States in 2002 could have been 424,120–2,120,600 cases (147.3–736.4 cases per 100,000 population). The true burden of giardiasis in the United States is likely to fall between these two estimates.

Its low infectious dose, protracted communicability, and moderate chlorine resistance make *Giardia* ideally suited for transmission through drinking and recreational water, food, and both person-to-person and animal-to-person contact. Prevention measures (Box 1) and measures to improve surveillance for giardiasis and increase understanding of its epidemiology and the associated disease burden (Box 2) have been recommended. Information about giardiasis is available from CDC at http://www.cdc.gov/ncidod/dpd/parasites/giardiasis/factsht_giardia.htm.

BOX 1. Recommendations to prevent and control giardiasis

Always practice good hand hygiene.

- Wash hands with soap and water for at least 15 seconds, rubbing hands together vigorously and scrubbing all surfaces
  - — after using the toilet,
  - — before handling food,
  - — after every diaper change (even if wearing gloves),
  - — after direct contact with preschool-aged children, and
  - — after any contact with animals or their feces.

Prevent contamination of recreational water (e.g., swimming pools, spas, interactive fountains, lakes, rivers, and oceans).

- Do not swim when ill with diarrhea (e.g., swimming in or entering the water at pools, spas, interactive fountains, lakes, rivers, or oceans).
- Take children on frequent bathroom breaks and check their diapers often.
- Change diapers in the bathroom, not at the poolside.
- Wash children thoroughly (especially their bottoms) with soap and water after they use the toilet or their diapers are changed and before they enter the water.
- Shower before entering the water.

Information about recreational water illnesses (RWIs) and how to stop them from spreading is available from CDC at http://www.cdc.gov/healthyswimming.

Prevent infection and illness caused by water that might be contaminated.

- Do not swallow water in swimming pools, spas, and interactive fountains.
- Do not swallow untreated water from lakes, rivers, springs, ponds, streams, or shallow wells.
- Do not drink inadequately treated water during community-wide outbreaks caused by contaminated drinking water.
- Do not use or drink inadequately treated water when traveling in countries where the water supply might be unsafe.
- If the safety of drinking water is in doubt,
  - — disinfect it by heating the water to a rolling boil for 1 minute,
  - — use a filter that has been tested and rated by National Safety Foundation (NSF) Standard 53 or NSF Standard 58 for cyst reduction (filtered water will need additional treatment to kill or inactivate bacteria and viruses), or
  - — treat it with chlorine or iodine; however, these chemical methods are less effective against *Giardia* than boiling or filtering because they are highly dependent on the temperature, pH, and cloudiness of the water.

Prevent infection and illness caused by eating food that might be contaminated.

- Use properly treated water to wash all food that will be eaten raw.
- Do not eat uncooked foods when traveling in areas where giardiasis is common.

Prevent contact and contamination with feces during sex.

- Use a barrier (e.g., a condom) during oral-anal sex.
- Wash hands immediately after handling a condom used during anal sex and after touching the anus or rectal area.

BOX 2. Recommended measures to improve surveillance for giardiasis and increase understanding of its epidemiology and associated disease burden

- Encourage health-care providers to consider and specifically request testing for *Giardia* in the workup of gastrointestinal illness (i.e., order testing of stool for ova and parasites).
- Continue to educate and encourage health-care providers as well as public and private laboratories to improve reporting of cases of giardiasis to jurisdictional health departments.
- Encourage jurisdictional health departments to transmit giardiasis data to CDC through the National Electronic Disease Surveillance System (NEDSS), which will replace the National Electronic Telecommunications System for Surveillance (NETSS).
- Publish and distribute giardiasis surveillance data regularly for public health education purposes.
- Conduct further epidemiologic studies of the geographic variability, incidence, and risk factors for giardiasis.

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