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Donald R. Stern, M.D., M.P.H., Acting Commissioner
Grayson B. Miller, Jr., M.D., Epidemiologist
Editor: Elizabeth Eustis Turf, Ph.D.
Layout Editor: Vickie L. O'Dell

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Assessing the Public Health Threat Associated with Waterborne Cryptosporidiosis: Report of a Workshop*

The following summary is adapted from the MMWR Recommendations and Reports published June 16, 1995.

INTRODUCTION

In 1993, an outbreak of cryptosporidiosis affecting greater than 400,000 persons occurred in Milwaukee. The magnitude of this outbreak, coupled with its association with water obtained from a municipal water plant that was operating within existing state and federal regulations, emphasized the need for improved surveillance by public health agencies to detect and prevent such outbreaks and coordination among interested groups and agencies to respond appropriately to such outbreaks. It also stimulated efforts to develop regulatory standards for *Cryptosporidium* in drinking water. To assist CDC and state public health departments in providing guidance on these issues, CDC's National Center for Infectious Diseases (NCID) convened a workshop entitled "Prevention and Control of Waterborne Cryptosporidiosis: An Emerging Public Health Threat" on September 22-23, 1994.

Invitations to the workshop were extended to CDC staff and representatives of state and local health departments, city and county water utilities, regulatory agencies, food and soft-drink industries, groups representing immunosuppressed persons, and other groups. The objectives of the workshop were developed on the basis of discussions with these persons and organizations. The workshop agenda was designed to update participants regarding cryptosporidiosis and to develop, with participant assistance, reports regarding the following four specific objectives:

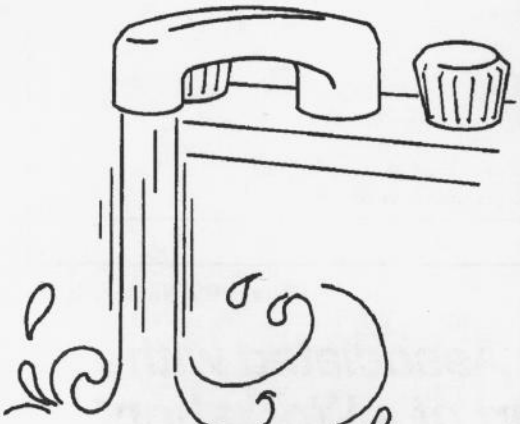
- To identify surveillance systems and epidemiologic study designs for assessing the public health importance of low levels of *Cryptosporidium* oocysts or elevated turbidity in public drinking water.
- To provide guidance for public health responses to the detection of *Cryptosporidium* oocysts in drinking water and to provide methods for notifying the public of potential risks for waterborne transmission.
- To identify and examine options for preventing waterborne transmission of *Cryptosporidium* to immunocompromised persons who use public water supplies.
- To evaluate and address
  a) water sampling methods for identifying *Cryptosporidium* oocysts,
  b) interpretation of data derived from these methods,
  c) the status of alternative methods of sampling, and
  d) laboratory research priorities.

BACKGROUND

Cryptosporidium parvum has been recognized as a human pathogen since 1976. During 1976-1982, the disease was reported rarely and occurred predominantly in immunocompromised persons. In 1982, the number of reported cases began to increase as a result of the acquired immunodeficiency syndrome (AIDS) epidemic. Initially, the increase in incidence was limited to immunocompromised persons; however, outbreaks and sporadic infections in immunocompetent persons were identified with the aid of newly developed laboratory diagnostic techniques.

Cryptosporidium is a protozoan parasite transmitted by ingestion of oocysts that have been excreted in the feces of infected humans or animals. The infection can be transmitted through person-to-person or animal-to-person contact, ingestion of fecally contaminated water or food, or contact with fecally contaminated environmental surfaces. Several municipal waterborne outbreaks of cryptosporidiosis[1-7], including the 1993 outbreak in Milwaukee, have focused attention and concern on the potential for waterborne transmission.

In This Issue:



Recent studies indicate that *Cryptosporidium* oocysts are present in 65%-97% of surface water (i.e., rivers, lakes, and streams) tested throughout the United States[8-10]. Because *Cryptosporidium* is highly resistant to chemical disinfectants used to treat drinking water, physical removal of the parasite from water by filtration is an important component of the municipal water treatment process. However, many cities in the United States do not use filtration as part of their water treatment process, and no current method can guarantee complete removal of oocysts. The risk for transmission can be reduced by water filtration if the filters are properly operated and maintained.

In the United States, all outbreaks of waterborne cryptosporidiosis detected from 1984 through 1993 occurred in communities where water utilities met state and federal standards for acceptable drinking water quality, and all surface water supplies implicated in those outbreaks had been filtered. These outbreaks indicate that utility compliance with Environmental Protection Agency (EPA) water treatment standards did not adequately protect against waterborne cryptosporidiosis. The EPA turbidity standards have been strengthened since the Milwaukee outbreak, and the finished (i.e., tap) water in Milwaukee at the time of the outbreak would not have met the new standards. Nevertheless, recent reports of *Cryptosporidium* oocysts in fully treated (i.e., disinfected and filtered) municipal water that was meeting these new standards indicate small numbers of oocysts breached water treatment filters in 27%-54% of the communities evaluated[11,12].

The health risk associated with drinking filtered or unfiltered tap water contaminated with small numbers of *C. parvum* oocysts is unknown. Although researchers have recovered small numbers of oocysts from drinking water, current laboratory methods cannot reliably determine if these oocysts are viable or are infectious to humans. Moreover, research has not determined whether a) the number of oocysts usually present in drinking water is sufficient to cause illness in humans, b) immunosuppressed persons are more susceptible to lower doses of oocysts than are immunocompetent persons, or c) strains of *C. parvum* vary in virulence and infectious dose. The results of a study that used a *Cryptosporidium* strain derived from calves suggested that the infectious dose of oocysts to healthy human volunteers is small (i.e., a median infectious dose could be as few as 132 oocysts)[13]. Other reports based on mathematical modeling algorithms indicate that some persons could become infected with a dose as low as one oocyst[14].

EPA has proposed a plan to collect data concerning a) the occurrence of several pathogens and chemicals in water and b) the ability of water treatment plants to remove these substances[15]. The EPA plan -- the Information Collection Rule (ICR) -- will require utilities in the United States that both obtain water from surface water sources and provide service to greater than or equal to 10,000 persons to test for *Cryptosporidium* oocysts in source water (and in some cases, finished water) for a period of 12-18 months. Almost all utilities are likely to detect oocysts in their surface source water on some occasions, and 24%-50% of utilities can expect to detect oocysts in their treated water[16]. When low levels of oocysts are identified in treated water through testing required by the ICR, public health agencies and other local and state officials could be pressured to issue immediate boil-water advisories[†] or respond in other ways to the perceived public health threat, regardless of whether such measures are necessary. Local and state health departments and water utilities have expressed concern because current data are insufficient to determine the health risks associated with low-level oocyst contamination of fully treated drinking water.

SUMMARIES OF WORK GROUP REPORTS

Work Group I. Surveillance Systems and Epidemiologic Study Designs

Surveillance Systems

Local public health officials should consider developing one or more surveillance systems to establish baseline data on the occurrence of cryptosporidiosis among residents of their community and, where possible, obtain sufficient epidemiologic data to identify potential sources of infection. No single surveillance strategy can be recommended or would be feasible for all locations; therefore communities should select a method that meets local needs and is most compatible with existing disease surveillance systems or ongoing special studies. Because neither increased incidence of diarrhea, nor *Cryptosporidium* infection in a community establishes water as the source of infection, further epidemiologic investigation will be required to identify the cause(s) if an increase is detected. The work group suggested the following seven approaches to surveillance, which are presented hierarchically by increasing order of the perceived effort and cost:

FLU CORNER

Well, it's that time of year again. The Office of Epidemiology has once again instituted its sentinel surveillance system to monitor influenza activity in Virginia. There are 44 health care offices reporting, including public and private clinics, private physician offices and university student health centers. Baseline surveillance began the week of October 9-13 and reporting will continue through the end of the season (hopefully before April!). As expected, sporadic cases of influenza-like illness have been reported but none have been laboratory confirmed. The CDC national surveillance system reports no confirmed cases to date.

1 Make cryptosporidiosis reportable to CDC.‡
2 Monitor sales of antidiarrheal medications.
3 Monitor logs maintained by Health Maintenance Organizations and hospitals for complaints of diarrheal illness.
4 Monitor incidence of diarrhea in nursing homes.
5 Monitor laboratory data for *Cryptosporidium.*
6 Monitor tap water in selected cities.
7 Rapid response teams based at CDC and EPA should be organized and be available to provide immediate epidemiologic assistance.

Epidemiologic Study Designs

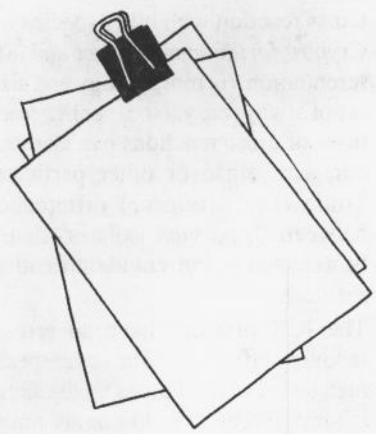
Epidemiologic studies are needed to assess the public health importance of low levels of *Cryptosporidium* oocysts or elevated turbidity in public drinking water. The following study designs were based on the assumption that a more reliable test will be available in the future or that studies could be designed without the need to quantify precisely the number of oocysts present in drinking water:

1 Surveys of stool specimens to compare the prevalence of laboratory-confirmed *Cryptosporidium* in stool samples obtained from two populations (i.e., one group exposed to water contaminated with oocysts and the other group not exposed).
2 Surveys of serologic specimens.
3 Case-control studies.
4 Intervention cohort studies.

Work Group II. Public Health Responses

Discovering *Cryptosporidium* oocysts in low levels in finished water should not be the only reason for issuing a boil-water advisory. Additional support for such an advisory should include other data indicating that the water quality is unacceptable. Adverse effects of boil water advisories, such as economic losses (e.g. increases in energy used and/or losses to the food, beverage, and tourism industries), erosion of public confidence, diversion of public health resources, and burn injuries, should be considered. A task force should be created to develop general guidelines for implementing and lifting boil-water advisories and to assist local agencies in deciding when boil-water advisories are necessary.

CRYPTOSPORIDIOSIS FACT SHEETS AVAILABLE

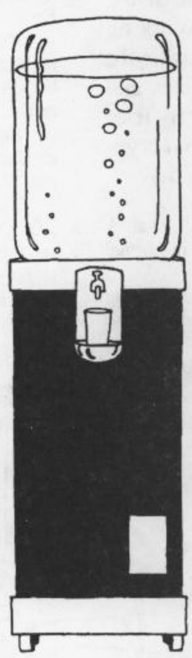


The Virginia Department of Health, Office of Epidemiology has developed three fact sheets on cryptosporidiosis:

- ***one with general information on the organism and disease;***
- ***one entitled "Cryptosporidiosis and Drinking Water"; and***
- ***a third one entitled "Additional Information on Preventing Cryptosporidiosis for Persons who are Immunocompromised."***

These are available for distribution to all interested parties. Please contact your local health department.

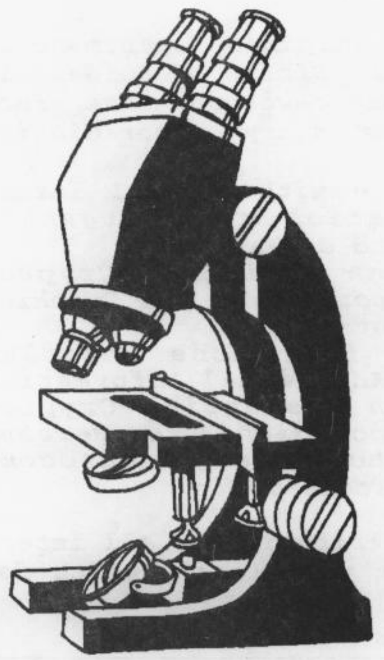
Before the ICR is implemented, local public health officials and water utility officials should develop coalitions with other groups (e.g., health-care providers and members of advocacy groups for immunosuppressed persons) to discuss the public health implications of the ICR, develop plans for communicating important public health information, decide what specific action will be taken if *Cryptosporidium* oocysts are detected in municipal water, and agree on the criteria for, and logistics of, issuing boil-water advisories.



Work Group III. Cryptosporidiosis in Immunocompromised Persons

No current data indicate that immunocompromised persons are more likely than immunocompetent persons to acquire cryptosporidiosis during waterborne outbreaks. However, immunocompromised persons who have HIV/AIDS, patients receiving treatment for cancer, recipients of organ or bone marrow transplants, and persons who have congenital immunodeficiencies are at greater risk than are immunocompetent persons for developing severe, life-threatening cryptosporidiosis if they become infected. A high priority should be placed on educating such persons. Immunosuppressed persons should be provided information about how to reduce the risk for cryptosporidiosis, regardless of the source of transmission (e.g., sexual practices involving fecal exposure, contact with infected adults or with infected children who wear diapers, contact with infected animals, drinking or eating contaminated water or food, and exposure to contaminated recreational water), and about measures they can take to ensure their drinking water is safe. The following specific measures can help reduce the risk for waterborne cryptosporidiosis:

- Boiling water for one minute is the most certain method of killing *Cryptosporidium* oocysts.
- Only microstraining water filters capable of removing particles 1µm in size should be used as personal-use filters at home or in the office to reduce the risk of transmission of *Cryptosporidium.* The greatest certainty of oocyst removal is provided by filters that produce water by reverse osmosis, those labeled according to filter manufacturing industry standards as "Absolute" 1µm filters, and those labeled as meeting American National Standards Institute (ANSI/NSF) International standard #53 for "Cyst Removal." Manufacturer's instructions for filter replacement and use should be strictly followed. Immunocompromised patients should either have someone



else change the used cartridges or use disposable gloves if they themselves change the cartridges.

- Many brands of bottled water adequately reduce the risk for cryptosporidiosis and, thus, provide a reasonable alternative to boiling tap water. However, labeling of bottled water is not standardized with regard to the manufacturing practices used to test for and remove or kill *Cryptosporidium* oocysts. Consumers may have to contact company representatives to determine the source of bottled water, the kinds of tests performed on it, and the type of treatment it has received.

Work Group IV. Water Sampling Methods and Interpretation of Results

Current methods are limited with regard to detecting oocysts in source and finished drinking water. These technical limitations restrict the ability of public health officials to practically interpret data on the occurrence and public health importance of *Cryptosporidium* in drinking water. Research should be accelerated to develop alternative, dependable drinking water testing methods because of the following limitations:

1 The tests are labor intensive and require lengthy processing time; furthermore, their use requires expertise in microscopy and parasitology.

2 The assays do not effectively differentiate viable-infectious or viable-noninfectious oocysts from nonviable oocysts.

3 Cross reaction with other species of *Cryptosporidium* may occur and differentiation via morphology and size is not always easy. Nonspecific reactions or cross-reactions can also occur with algae or other particles. Strain (i.e., virulence) differences between *C. parvum* isolates cannot be assessed by current identification methods.

4 The ICR methods have an erratic recovery efficiency. The same specimen tested several times by the same laboratory could yield counts ranging from 0 to 30 oocysts per 100 L of water.

5 The level of laboratory expertise required is particularly critical.

6 Methodologies for detection of *Cryptosporidium* oocysts have not been adequately standardized.

7 Alternative methods or modifications to existing methods have been reported or are being developed, but none of these alternatives supplant or improve the current methods.

AFTERWORD

In November 1994, as a result of the workshop, NCID initiated the Working Group on Waterborne Cryptosporidiosis. This group is a coalition of agencies and organizations that meets biweekly by teleconference to discuss concerns about cryptosporidiosis. (See article on page 5.)

References

1. D'Antonio RG, Winn RE, Taylor JP, et al. A waterborne outbreak of cryptosporidiosis in normal hosts. Ann Intern Med 1985;103:886-8.

2. Gallaher MM, Herndon JL, Nims LJ, Sterling CR, Grabowski DJ, Hull HF. Cryptosporidiosis and surface water. Am J Public Health 1989;79:39-42.

3. Hayes EB, Matte TD, O'Brien TR, et al. Large community outbreak of cryptosporidiosis due to contamination of a filtered public water supply. N Engl J Med 1989;320:1372-6.

4. CDC. Surveillance for waterborne disease outbreaks -- United States, 1986-1988. MMWR 1990;39(No. SS-1):1-21.

5. CDC. Surveillance for waterborne disease outbreaks -- United States, 1989-1990. MMWR 1991;40(No. SS-3):1-21.

6. CDC. Surveillance for waterborne disease outbreaks -- United States, 1991-1992. MMWR 1993;42(No. SS-5):1-22.

7. Mac Kenzie WR, Hoxie MS, Proctor ME, et al. A massive outbreak in Milwaukee of *Cryptosporidium* infection transmitted through the public water supply. N Engl J Med 1994;331:161-7.

8. Rose JB. Occurrence and significance of *Cryptosporidium* in water. Journal of the American Water Works Association 1988;80:53-8.

9. Rose JB, Gerba CP, Jakubowski W. Survey of potable water supplies for *Cryptosporidium* and Giardia. Environmental Science and Technology 1991;25:1393-400.

10. LeChevallier MW, Norton WD, Lee RG. Occurrence of Giardia and *Cryptosporidium* spp. in surface water supplies. Appl Environ Microbiol 1991;57:2610-6.

11. LeChevallier MW, Norton WD, Lee RG. Giardia and *Cryptosporidium* spp. in filtered drinking water supplies. Appl Environ Microbiol 1991;57:2617-21.

12. LeChevallier MW, Moser RH. Occurrence of Giardia and *Cryptosporidium* in raw and finished drinking water. Journal of the American Water Works Association (in press).

13. 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.

14. Haas CN, Rose JB. Reconciliation of microbial risk models and outbreak epidemiology: the case of the Milwaukee outbreak. In: Proceedings of the American Water Works Association 1994 Annual Conference: Water Quality. Denver: American Water Works Association, 1994:517-23.

15. Environmental Protection Agency. National primary drinking water regulations: monitoring requirements for public drinking water supplies: *Cryptosporidium*, Giardia, viruses, disinfection byproducts, water treatment plant data and other information requirements. Federal Register 1994;59:6332-444.

16. LeChevallier MW, Moser RH. Monitoring of Giardia and *Cryptosporidium* in the American water system. Voorhees, NJ: American Water Works Service Company, Inc., 1993.

17. Payment P, Franco E, Richardson L, Siemiatycki J. Gastrointestinal health effects associated with the consumption of drinking water produced by point-of-use domestic reverse-osmosis filtration units. Appl Environ Microbiol 1991;57:945.

18. Arrowood MJ, Sterling CR. Comparison of conventional staining methods and monoclonal antibody-based methods for *Cryptosporidium* oocyst detection. J Clin Microbiol 1989;27:1490-5.

19. Clancy JL, Gollnitz WD, Tabib Z. Commercial labs: how accurate are they? Journal of the American Water Works Association 1994;86:89-97.

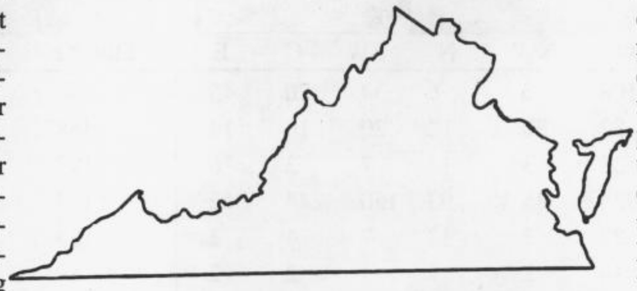
20. LeChevallier MW, Trok TM, Burns MO, Lee RG. Comparison of the zinc sulfate and immunofluorescence techniques for detecting Giardia and *Cryptosporidium.* Journal of the American Water Works Association 1995;82:75-82.

**Adapted from MMWR 44(RR-6);1-19. June 16, 1995.*

†Statements to the public advising persons to boil water before drinking it.

‡ The Office of Epidemiology is currently reviewing the Regulations for Disease Reporting and Control. The addition of cryptosporidiosis to the list of notifiable diseases in Virginia is being considered.

Cryptosporidiosis: What's Happening in Virginia



Cryptosporidiosis is not a reportable condition in Virginia at this time so we do not have good statistical information regarding the incidence of this infection in our state. During the current review of the Regulations for Disease Reporting and Control, the addition of cryptosporidiosis to the list of reportable conditions is being considered. Currently any reports that are received are being accepted and recorded.

During April and May of 1995, the Virginia Department of Health, Offices of Water Programs and Epidemiology presented a series of six workshops on *Cryptosporidium* in drinking water to regional groups consisting of representatives from the public health community, water utility owners, and health department regulators. In addition to providing the most recent scientific information on this pathogen, the workshops created a framework for continuing communication and cooperation among the represented groups including the sharing of methods for analyzing risks and communicating with the public, especially high-risk populations. Further information on medical and epidemiologic aspects of cryptosporidiosis is available from the Office of Epidemiology, (804) 786-6261. For assistance with water quality and testing issues contact the Office of Water Programs (804) 786-6278 or your local Environmental Engineering Field Office.

NOTE

In the July issue of the *Virginia Epidemiology Bulletin* we reported that a rabid cow had been identified in Orange County. Unfortunately, the cow actually lived in Madison County. We apologize for the mix-up.

Cryptosporidiosis: An Update from the CDC's National Center for Infectious Diseases

Since November 1994, the Working Group on Waterborne Cryptosporidiosis (WGWC), a consortium of public health experts from the CDC, the Environmental Protection Agency, the U.S. Department of Agriculture, the Food and Drug Administration, state and local government agencies and private groups ranging from the AIDS Coalition to Unleash Power to the American Water Works Association, has been meeting bimonthly by teleconference to address this emerging threat. Working together, they have developed public health messages for the immunocompromised and other groups, drafted guidelines for public health and water utility officials and prepared informational materials for both laboratory clinicians and health care providers. Over the next several months these materials will be completed and made available to the groups at whom they are targeted.

Treatment and Prevention

There is currently no cure for cryptosporidiosis, though drug research is continuing. Patients who suspect they may have cryptosporidiosis should drink extra fluids and may wish to drink oral rehydration therapy liquid, to avoid dehydration. HIV-positive individuals who suspect they have cryptosporidiosis should contact their health care provider. Infected individuals should be advised to wash their hands frequently, especially before preparing food and after going to the toilet. They should also avoid close contact with anyone who has a weakened immune system. Individuals with diarrhea should not swim in public bathing areas while they have diarrhea and for at least 2 weeks after the last episode of diarrhea.

Washing hands is the most effective means of preventing cryptosporidiosis transmission. Immunocompromised individuals should avoid the stool of all humans and animals and wash their hands thoroughly after any contact with animals or the living areas of animals. Immunocompromised persons may also wish to wash, peel, or cook all vegetables and to take extra measures, such as boiling or filtering their drinking water, to ensure its safety.

Further Information

CDC now has a "voice-fax" telephone system for cryptosporidiosis. Callers to this "Cryptosporidiosis Information Line" can listen to recorded messages on cryptosporidiosis and order printed materials, designed for different audiences, by fax. The information line number is **(404)330-1242**. Many of the same materials available from the information line are also available at the National Center for Infectious Diseases Internet Home Page on the World Wide Web, at http://www.cdc.gov/ncidod/diseases/crypto/crypto.htm. Additionally, the WGWC plans, in 1996, to issue a guidance notebook on waterborne cryptosporidiosis outbreaks for use by public health and water utility officials. More information on this notebook will be available, when it is released, from state public health offices, CDC, and public health agencies.

Cases of Selected Notifiable Diseases, Virginia, September 1 through September 30, 1995.*

Disease	Total Cases Reported This Month						Total Cases Reported to Date in Virginia		
		Regions							
	State	NW	N	SW	C	E	This Yr	Last Yr	5 Yr Avg
AIDS	108	3	6	34	20	45	984	857	737
Campylobacteriosis	82	20	12	20	16	14	488	582	507
Giardiasis[§]	33	3	14	7	3	6	197	219	249
Gonorrhea	934	85	93	150	244	362	8187	9729	11271
Hepatitis A	27	2	12	7	4	2	159	125	136
Hepatitis B	14	2	1	7	2	2	89	92	140
Hepatitis NANB	5	0	2	0	2	1	14	20	27
HIV Infection[§]	151	6	1	22	77	45	922	775	959
Influenza	0	0	0	0	0	0	879	825	689
Legionellosis	2	1	1	0	0	0	15	6	11
Lyme Disease	10	4	2	3	0	1	47	113	96
Measles	0	0	0	0	0	0	0	2	27
Meningitis, Aseptic	200	28	31	8	25	108	556	190	227
Meningitis, Bacterial[†]	5	0	0	0	4	1	100	58	85
Meningococcal Infections	5	0	1	2	2	0	51	54	42
Mumps	4	0	1	2	1	0	20	35	52
Pertussis	5	0	1	1	0	3	15	29	25
Rabies in Animals	53	20	8	10	5	10	320	313	240
Rocky Mountain Spotted Fever	6	4	0	1	0	1	24	15	15
Rubella	0	0	0	0	0	0	0	0	0
Salmonellosis	199	18	63	28	42	48	869	813	861
Shigellosis	46	3	17	1	1	24	237	557	338
Syphilis, Early[‡]	86	1	4	6	14	61	930	1057	1101
Tuberculosis	23	0	4	5	5	9	202	232	293

Localities Reporting Animal Rabies: Accomack 3 raccoons; Albemarle 2 raccoons, 2 skunks; Alleghany 1 raccoon; Appomatox 1 skunk; Augusta 2 skunks; Bath 1 skunk; Bedford 2 raccoons, 1 skunk; Clarke 1 fox; Dinwiddie 1 raccoon; Fairfax 1 cat, 1 fox, 1 raccoon; Frederick 1 raccoon; Grayson 1 raccoon; Greensville 2 raccoons; Hanover 1 raccoon; Loudoun 1 cat, 2 raccoons; Madison 1 skunk; Middlesex 1 cat; Montgomery 1 raccoon; Nelson 1 fox; Page 1 raccoon; Pittsylvania 1 raccoon, 1 skunk; Prince William 1 raccoon, 1 skunk; Richmond City 1 raccoon; Rockingham 5 skunks; Shenandoah 2 skunks; Spotsylvania 1 skunk; Suffolk 2 raccoons; Virginia Beach 2 bats, 2 raccoons.

Occupational Illnesses: Asbestosis 36; Carpal Tunnel Syndrome 45; Coal Workers' Pneumoconiosis 17; Lead Poisoning 1; Loss of Hearing 23.

*Data for 1995 are provisional.

[†]Other than meningococcal. [‡]Includes primary, secondary, and early latent.

[§]*Note:* Giardiasis and HIV infection have replaced Reye Syndrome and Kawasaki Syndrome in this table. This change was based on the current number of reports of these diseases and their public health significance.

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