ANNUAL SUMMARY 1979
ISSUED SEPTEMBER 1981

CENTERS FOR DISEASE CONTROL

Water-related Disease Outbreaks

SURVEILLANCE

J.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service

Water-related disease
outbreaks surveillance

PREFACE

This report summarizes information received from state and local health departments and the Environmental Protection Agency. The information is preliminary and is most useful to those persons in disease control activities. Anyone wishing to quote this report should contact the Water-Related Diseases Activity, Enteric Diseases Branch, for further interpretation.

Contributions to the report are most welcome. Please address them to:

Enteric Diseases Branch
Bacterial Diseases Division
Center for Infectious Diseases
Centers for Disease Control
Atlanta, Georgia 30333

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These organizational designations reflect the organization under which the data were collected and analyzed.
*Through June 1981.

WATER-RELATED DISEASES SURVEILLANCE ANNUAL SUMMARY 1979

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NTS

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I. INTRODUCTION

Since 1971 the Centers for Disease Control (CDC) has tabulated foodborne and waterborne disease outbreak data separately and reported these data in annual reports. The Water-Related Diseases Activity has set the following goals: 1) to determine the frequency of epidemics of water-related diseases in the United States, 2) to characterize the epidemiology of water-related diseases, 3) to disseminate information on prevention and control of water-related diseases to appropriate public health personnel, 4) to train federal, state, and local health department personnel in epidemiologic techniques for the investigation of water-related diseases outbreaks, and 5) to collaborate with local, state, other federal and international agencies in initiatives concerning prevention of water-related diseases. Also included in the responsibilities of the Water-Related Diseases Activity is the investigation of outbreaks of acute gastrointestinal disease on ocean-going vessels.

II. WATERBORNE DISEASE OUTBREAKS, 1979

In 1979, 41 outbreaks of waterborne disease involving 9,720 cases were reported to the Centers for Disease Control (CDC).

A. Definition of Terms

A waterborne disease outbreak is an incident in which 1) 2 or more persons experienced similar illness after consumption of water, or after use of water, intended for drinking, and 2) epidemiologic evidence implicated the water as the source of illness. In addition, a single case of chemical poisoning constitutes an outbreak if laboratory studies indicated that the water was contaminated by the chemical. Only outbreaks associated with water intended for drinking are included.

Community public water systems (municipal systems) are public or investor-owned water systems that serve large or small communities, subdivisions or trailer parks of at least 15 service connections or 25 year-round residents. Noncommunity public water systems (semi-public water systems) are those in institutions, industries, camps, parks, hotels, or service stations that may be used by the general public. Individual systems (private water systems), generally wells and springs, are those used by single or several residences or by persons traveling outside populated areas. These definitions correspond to those in the Safe Drinking Water Act (PL 93-523) of 1974.

B. Sources of Data

State health departments report waterborne disease outbreaks to CDC on a standard reporting form (Section F). In addition, the Health Effects Research Laboratory of the Environmental Protection Agency (EPA) contacts all state water-supply agencies annually to obtain information about waterborne disease outbreaks; information from both sources is included in this report. Representatives from CDC and EPA review and summarize outbreak data and also work together in the investigation and evaluation of waterborne disease outbreaks. In addition, upon request by state health departments, CDC and EPA offer epidemiologic assistance, provide consultation in the engineering and environmental aspects of water treatment, and, when indicated, collect large volume water samples for identification of viruses, parasites, and bacterial pathogens.

C. Interpretation of Data

The limitations of the data in this report must be appreciated to avoid misinterpretation. The number of waterborne disease outbreaks reported to CDC and EPA clearly represents a fraction of the total number that occur. Since investigations were sometimes incomplete or conducted long after the outbreak, the waterborne hypothesis could not be proved in all instances; however, it was the most logical explanation in these outbreaks. The likelihood of an outbreak coming to the attention of health authorities varies considerably from 1 locale to another depending largely upon consumer awareness, physician interest, and disease surveillance activities of state and local health and environmental agencies. Large interstate outbreaks and outbreaks of serious illness are more likely to come to the attention of health authorities. The quality of investigation conducted by state or local health departments varies considerably according to the department's interest in waterborne disease outbreaks and its budgetary, investigative, and laboratory capabilities.

This report should not be the basis for firm conclusions about the true incidence of waterborne disease outbreaks, and it should not be used to draw firm conclusions about the relative incidence of waterborne diseases of various etiologies. The number of reported outbreaks of different etiologies may depend upon the interest of a particular health department or individual. If an epidemiologist or microbiologist becomes interested in Giardia lamblia or Norwalk-like viruses, he is likely to confirm more outbreaks caused by these agents. Furthermore, a few outbreaks involving very large numbers of persons may vastly alter the relative proportion of cases attributed to various etiologic agents.

These data are helpful in revealing the etiologies of reported waterborne disease outbreaks, the seasonality of outbreaks, and the deficiencies in water systems that most frequently result in outbreaks. As in the past, the pathogens responsible for many outbreaks in 1979 remain unknown. It is hoped that more complete epidemiologic investigations, advances in laboratory techniques, and standardization of reporting of waterborne disease outbreaks will augment our knowledge of waterborne pathogens and the factors responsible for waterborne disease outbreaks.

D. Analysis of Data

In 1979, 41 outbreaks involving an estimated 9,720 persons were reported to CDC and EPA. This is the largest number of outbreaks reported in a single year since the beginning of the current surveillance system in 1971 (Table 1).

Figure 1 shows the geographic distribution of outbreaks by state; 20 states reported at least 1 outbreak. For the seventh consecutive year Pennsylvania reported more outbreaks than any other state (7/41 - 17.1%).

Table 2 shows the number of outbreaks and cases by etiology and type of water system. Of the 41 outbreaks, 22 (53.6%) were of unknown etiology and were designated as "acute gastrointestinal illness" (AGI). This category includes outbreaks characterized by upper or lower gastrointestinal symptoms for which no etiologic agent was identified. The remaining 19 (46.3%) outbreaks were of a confirmed etiology: G. lamblia (7), chemical (7), Shigella (2), Norwalk agent (2), and Salmonella (1). In 2 of the 3 outbreaks with over 1000 persons affected, an etiologic agent was found.

In the 34 nonchemical outbreaks, results of microbiologic tests of water samples were reported in 23; evidence of contamination (presence of coliforms or pathogens) was found in 18. Four of the 5 outbreaks with coliform tests reported as negative were of undetermined etiology, and the water samples were gathered after the outbreaks were over. The other was an outbreak of giardiasis. Water samples were positive for Giardia in 2 of 4 giardiasis outbreaks in which large volume water sampling was attempted. Most outbreaks involved noncommunity (34.1%) and community (56.1%) public water systems. Outbreaks attributed to water from community public water systems affected an average of 294 persons compared with 209 persons in noncommunity public water system outbreaks and 6 persons in outbreaks involving individual water systems (Table 2). Use of untreated or inadequately treated water accounted for 26 (63.4%) of the outbreaks (Table 3). Outbreaks occurred most frequently from June through October (Table 4).

Table 1 Waterborne Disease Outbreaks, by Year and Type of System, United States, 1971-1979

	1971	1972	1973	1974	1975	1976	1977	1978	1979	TOTAL(%)
Community	5	10	5	11	6	9	12	10	23	91 (34)
Noncommunity	10	18	16	10	16	23	19	18	14	144 (54)
Private	4	2	3	5	2	3	3	4	4	30 (12)
TOTAL	19	30	24	26	24	35	34	32	41	265
TOTAL CASES	5182	1650	1784	8363	10879	5068	3860	11435	9720	57966

Fig. 1 **WATERBORNE DISEASE OUTBREAK, UNITED STATES, 1979**

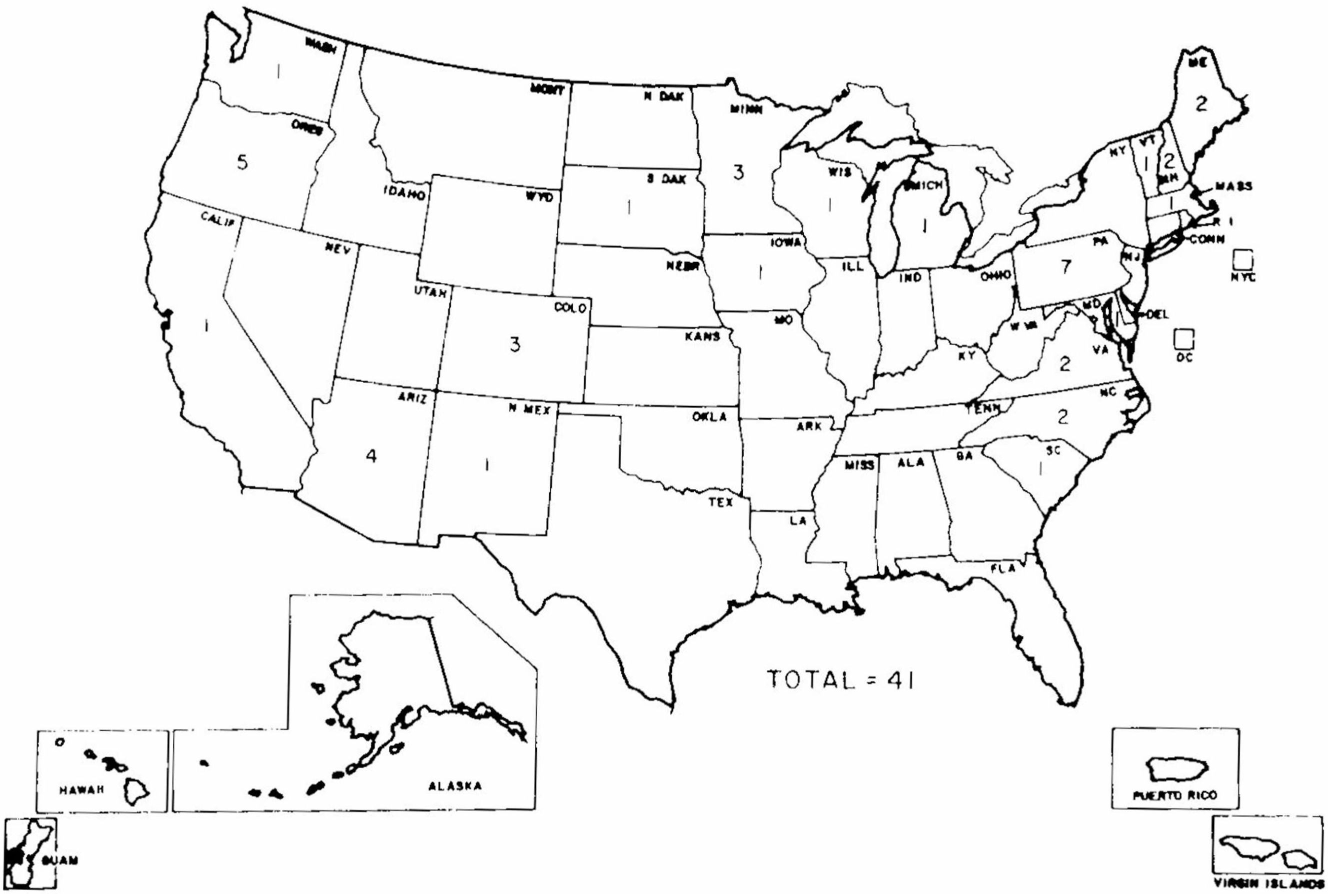

Table 2 Waterborne Disease Outbreaks by Etiology and Type of Water System, 1979

	Public Water Systems				Private Water Systems		Total	
	Community		Noncommunity					
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
AGI*	12	2946	9	454	1	12	22	3412
Giardia	3744	2	2120	0	0	7	7	5864
Chemical	5	60	0	0	2	9	7	69
Norwalk Agent	0	0	2	296	0	0	2	296
Shigella	1	14	0	0	1	4	2	18
Salmonella	0	0	1	61	0	0	1	61
Total	23	6764	14	2931	4	25	41	9720

*Acute gastrointestinal illness of unknown etiology

Table 3
Waterborne Disease Outbreaks, by Type of System and Type of Deficiency, 1979

	Public Water Systems				Private Water Systems		Total	
	Community		Noncommunity					
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
Untreated surface water	0	0	0	0	0	0	0	0
Untreated ground water	1	500	8	523	2	16	11	1039
Treatment deficiencies	12	5720	3	304	0	0	15	6024
Deficiencies in distribution system	7	496	3	2104	0	0	10	2600
Miscellaneous	3	48	0	0	2	9	5	57
TOTAL	23	6764	14	2931	4	25	41	9720

Table 4 Waterborne Disease Outbreaks, by Month of Occurrence, United States, 1979

Month	Number of Outbreaks	Month	Number of Outbreaks
January	1	July	8
February	1	August	4
March	4	September	6
April	2	October	5
May	1	November	2
June	4	December	3

Total: 41

Outbreaks in recreational areas continued to be a problem in 1979, accounting for 26.8% of all outbreaks. Of the 14 outbreaks associated with noncommunity public water systems, implicated water supplies were in camps and campgrounds (7), restaurants (2), resorts (2), a motel (1), a town (1), and a mobile home park (1).

In 8 of the 22 outbreaks of acute gastroenteritis of unknown etiology an incubation period was reported. In each instance the median incubation period was less than 48 hours, and the mean was approximately 33 hours. Efforts to document a bacterial etiology were made in 7 of the 22 outbreaks, and stool specimens were submitted for viral studies in 4 outbreaks.

E. Comments

The increase in the number of outbreaks reported in 1979 is probably due to more complete reporting rather than an actual increase. Intensive surveillance can identify relatively small waterborne disease outbreaks that often originate in noncommunity public water systems. It is hoped that increased investigation and reporting will define major deficiencies commonly affecting noncommunity public water systems, especially in recreational areas, so that they can be better understood and corrected. However, in many instances investigations have not been initiated until long after the outbreaks have occurred, precluding timely collection of specimens for determining the etiology.

Water systems used on a seasonal basis such as those in camps, parks, and resorts have an abnormal demand placed upon them by large numbers of visitors during specific periods of the year and in some instances cannot meet such demands. For the most part these are noncommunity systems. Water supply systems in such areas, especially campgrounds and parks, must be reappraised, monitored, and corrections made to ensure the continued provision of safe water during periods of increased demand. The large outbreaks that occurred in 1975 in Crater Lake National Park (1) and Yellowstone National Park (2) underscore the problems related to water supplies in recreational areas that can occur.

For only the second year since 1971, the number of outbreaks related to community systems exceeded the number related to noncommunity systems in 1979. However, for the period 1971-1979 the rate of waterborne outbreaks in community public water systems was 1.4 times as high as the rate in noncommunity public water systems ($X^2=5.02, p=0.025$). Defects in the distribution systems account for the greatest part of this difference (Table 5); community public water systems are 6.4 times more likely to have a waterborne outbreak due to a distribution system defect than a noncommunity public water system ($X^2=38.6$, $p<.001$), perhaps reflecting the greater size of the distribution networks in community public water systems.

Table 5 Waterborne Disease Outbreaks in Community and Noncommunity Public Water Systems, United States, 1971-1979+

	No. of Systems*	Outbreaks due to Distribution System Defects: Number	Outbreaks due to Distribution System Defects: Rate/10,000 Systems	Outbreaks due to Other Defects: Number	Outbreaks due to Other Defects: Rate/10,000 Systems	TOTAL OUTBREAKS: Number	TOTAL OUTBREAKS: Rate/10,000 Systems
Community	61,628	35	5.7	52	8.4	87	14.1
Noncommunity	134,891	12	0.9	127	9.4	139	10.3

*1979 Estimates

+Note: These tabulations are not consistent with our previously published statistics. In 1981 the Water-Related Diseases Activity carefully reviewed its files of outbreaks reported since 1971 and reclassified outbreaks using standard definitions so that the outbreak data could be interfaced with data the EPA collects on public drinking water supplies.

An outbreak in Arizona in June 1979 was attributed to giardiasis, but few specimens were collected when one considered the total population at risk, and no specimens were collected for study for the Norwalk agent. Giardia were found in stools of ill individuals, but other agents may have been involved; this was suggested by the fact that many of the ill individuals had incubation periods of 24-36 hours and a mild diarrheal illness suggesting a viral etiology. One earlier outbreak was found to have multiple etiologies; outbreaks involving more than 1 agent may occur with greater frequency than the summary data would indicate (3). Many of the reported waterborne outbreaks occur because of sewage contamination of water, and there is little reason to believe that the sewage contains only 1 pathogen.

Six chemicals accounted for the 7 outbreaks due to chemical contamination of water: fluoride (2), nitrate (1), waste oil (1), arsenic (1), chlordane (1), and morpholine (a colorless, hygroscopic oil) (1). The 2 outbreaks of acute fluoride poisoning were caused by overfeeds of the ion to municipal water systems. An outbreak in Maryland resulted in 1 death in a dialysis patient. The chlordane and morpholine entered the systems through cross-connections; the nitrate was naturally occurring. The waste oil and the arsenic, which resulted in 2 deaths, were allegedly added to the water deliberately.

In addition to these 41 outbreaks related to drinking water systems, 4 outbreaks were reported that resulted from contaminated water not meant for drinking (Table 6). The etiologic agent in 1 of these was the Norwalk virus and was undetermined in the others. Water in natural springs and creeks should be considered nonpotable and should be disinfected before it is consumed.

Table 6 Waterborne Disease Outbreaks Not Related to Potable Water Systems, United States, 1979

State	Month	Etiology	Cases	Water Source	Location
CA	Sept	Norwalk virus	30	Irrigation System	High School
MN	June	AGI	11	Spring	Camp
VA	July	AGI	72	Creek	City
VA	July	AGI	8	Spring	Camp

DEPARTMENT OF
HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
CENTER FOR INFECTIOUS DISEASES
ATLANTA, GEORGIA 30333

INVESTIGATION OF A WATERBORNE OUTBREAK

Form Approved
OMB No. 0920-0004

1. Where did the outbreak occur? ______ (1-2) City or Town ______ State ______

2. Date of outbreak: (Date of onset of 1st case) ______ (3-8)

3. Indicate actual (a) or estimated (e) numbers:

Persons exposed ______ (9-11)
Persons ill ______ (12-14)
Hospitalized ______ (15-16)
Fatal cases ______ (17)

4. History of exposed persons:

No. histories obtained ______ (18-20)
No. persons with symptoms ______ (21-23)
Nausea ______ (24-26) Diarrhea ______ (33-35)
Vomiting ______ (27-29) Fever ______ (36-38)
Cramps ______ (30-32)
Other, specify (39) ______

5. Incubation period (hours):

Shortest ______ (40-42) Longest ______ (43-45)
Median ______ (46-48)

Shortest ______ (49-51) Longest ______ (52-54)
Median ______ (55-57)

7. Epidemiologic data (e.g., attack rates [number ill/number exposed] for persons who did or did not eat or drink specific food items or water, attack rate by quantity of water consumed, anecdotal information) * (58)

ITEMS SERVED	NUMBER OF PERSONS WHO ATE OR DRANK SPECIFIED FOOD OR WATER				NUMBER WHO DID NOT EAT OR DRINK SPECIFIED FOOD OR WATER			
	ILL	NOT ILL	TOTAL	PERCENT ILL	ILL	NOT ILL	TOTAL	PERCENT ILL

8. Vehicle responsible (item incriminated by epidemiologic evidence): (59-60) ______

9. Water supply characteristics

(A) Type of water supply** (61)

- ☐ Municipal or community supply (Name ______)
- ☐ Individual household supply
- ☐ Semi-public water supply
  - ☐ Institution, school, church
  - ☐ Camp, recreational area
  - ☐ Other, ______
- ☐ Bottled water

(B) Water source *(check all applicable)*:

(C) Treatment provided *(circle treatment of each source checked in B)*:

☐ Well	a	b	c	d
☐ Spring	a	b	c	d
☐ Lake, pond	a	b	c	d
☐ River, stream	a	b	c	d

a. no treatment
b. disinfection only
c. purification plant coagulation, settling, filtration, disinfection *(circle those applicable)*
d. other ______

10. Point where contamination occurred: (66)

☐ Raw water source ☐ Treatment plant ☐ Distribution system

*See CDC 52.13 (Formerly 4.245) Investigation of a Foodborne Outbreak, Item 7.
**Municipal or community water supplies are public or investor owned utilities. Individual water supplies are wells or springs used by single residences. Semipublic water systems are individual-type water supplies serving a group of residences or locations where the general public is likely to have access to drinking water. These locations include schools, camps, parks, resorts, hotels, industries, institutions, subdivisions, trailer parks, etc., that do not obtain water from a municipal water system but have developed and maintain their own water supply.

CDC 52.12 (Formerly 4.461)
REV. 7-81

This report is authorized by law (Public Health Service Act, 42 USC 241).
While your response is voluntary, your cooperation is necessary for the understanding and control of the disease.

11. Water specimens examined: (67)
(Specify by "X" whether water examined was original (drunk at time of outbreak) or check-up (collected before or after outbreak occurred)

ITEM		ORIGINAL	CHECK UP	DATE	FINDINGS		BACTERIOLOGIC TECHNIQUE (e.g., fermentation tube, membrane filter)
					Quantitative	Qualitative	
Examples:	Tap water	X		6/12/74	10 fecal coliforms per 100 ml.		
	Raw water		X	6/2/74	23 total coliforms per 100 ml.		

12. Treatment records: *(Indicate method used to determine chlorine residual):*
Example: **Chlorine residual — One sample from treatment plant effluent on 6/11/74 — trace of free chlorine**
Three samples from distribution system on 6/12/74 — no residual found

13. Specimens from patients examined (stool, vomitus, etc.) (68)

SPECIMEN	NO. PERSONS	FINDINGS
Example: Stool	11	8 *Salmonella typhi*
		3 negative

14. Unusual occurrence of events:
Example: Repair of water main 6/11/74; pit contaminated with sewage, no main disinfection. Turbid water reported by consumers 6/12/74.

15. Factors contributing to outbreak *(check all applicable):*

- ☐ Overflow of sewage
- ☐ Seepage of sewage
- ☐ Flooding, heavy rains
- ☐ Use of untreated water
- ☐ Use of supplementary source
- ☐ Water inadequately treated
- ☐ Interruption of disinfection
- ☐ Inadequate disinfection
- ☐ Deficiencies in other treatment processes
- ☐ Cross-connection
- ☐ Back-siphonage
- ☐ Contamination of mains during construction or repair
- ☐ Improper construction, location of well/spring
- ☐ Use of water not intended for drinking
- ☐ Contamination of storage facility
- ☐ Contamination through creviced limestone or fissured rock
- ☐ Other (specify) ____________

16. Etiology: (69-70)

Pathogen ____________
Chemical ____________
Other ____________

(71)
Suspected 1
Confirmed . . . . 2 *(Circle one)*
Unknown 3

17. Remarks: *Briefly describe aspects of the investigation not covered above, such as unusual age or sex distribution; unusual circumstances leading to contamination of water; epidemic curve; control measures implemented; etc. (Attack additional page if necessary)*

Name of reporting agency: (72)

Investigating Official:

Date of investigation:

Note: Epidemic and Laboratory assistance for the investigation of a waterborne outbreak is available upon request by the State Health Department to the Centers for Disease Control, Atlanta, Georgia 30333.

To improve national surveillance, please send a copy of this report to: Centers for Disease Control
Attn: Enteric Diseases Branch, Bacterial Diseases Division
Center for Infectious Diseases
Atlanta, Georgia 30333

Submitted copies should include as much information as possible, but the completion of every item is not required.

CDC 52.12 (Formerly 4.461) (BACK)
REV. 7-81

G. Line Listing of Waterborne Outbreaks, United States, 1979

State	Month	Etiology*	Cases	Type of System #	Location of Outbreak	System Deficiency+	Water Source
AZ	Jun	*Giardia*[o]	2000	Noncommunity	Camp	4	Ground
AZ	Aug	AGI	6	Noncommunity	Motel	2	Ground
AZ	Sept	AGI	4	Noncommunity	Restaurant	4	Ground
AZ	Sept	*Shigella*	14	Community	Motel	4	Ground
CA	Feb	*Giardia*	120	Community	City	3	Surface
CO	Mar	AGI	200	Community	Town	3	Surface
CO	June	*Giardia*	53	Community	Town	3	Surface
CO	July	AGI	258	Community	Power Plant	4	Ground
IA	Apr	AGI	100	Noncommunity	Camp	4	Ground
MA	Mar	AGI	500	Community	City	2	Ground
MD	Nov	Fluoride	26	Community	Town	5	Ground
ME	May	Fluoride	6	Community	Town	5	Ground
ME	Jun	AGI	70	Noncommunity	Camp	2	Ground
MI	Sept	AGI	12	Community	Military Base	4	Unknown
MN	June	*Salmonella*	61	Noncommunity	Resort	2	Ground
MN	July	AGI	9	Noncommunity	Resort	2	Ground
MN	Nov	Nitrate	1	Individual	Home	5	Ground
NC	Mar	AGI	35	Community	Subdivision	4	Ground
NC	Oct	Norwalk agent	145	Noncommunity	Camp	2	Ground
NH	Apr	*Giardia*	50	Community	Town	3	Surface
NH	Aug	AGI	38	Noncommunity	Camp	2	Ground
NM	Aug	Morpholine	2	Community	School	4	Ground
OR	July	AGI	300	Community	Town	3	Surface
OR	Oct	AGI	1200	Community	City	3	Surface
OR	Oct	*Giardia*	21	Community	Town	3	Surface
OR	Dec	*Giardia*	120	Noncommunity	Town	3	Surface
OR	Dec	AGI	120	Community	City	3	Surface
PA	Mar	AGI	12	Individual	Residence	2	Ground
PA	July	Norwalk agent	151	Noncommunity	Camp	2	Ground
PA	July	AGI	165	Community	Restaurant	4	Unknown
PA	Aug	AGI	43	Noncommunity	Mobile Home Pk	2	Ground
PA	Sept	AGI	35	Community	Subdivision	3	Ground
PA	Sept	*Giardia*	3500	Community	City	3	Surface
PA	Oct	AGI	135	Noncommunity	Restaurant	3	Ground
SC	Dec	AGI	104	Community	Subdivision	3	Ground
SD	July	Waste Oil	16	Community	Town	5	Ground
VA	Jan	Arsenic	8	Individual	Residence	5	Ground
VA	Oct	Chlordane	10	Community	City	4	Surface
VT	July	AGI	17	Community	Subdivision	3	Ground
WA	July	AGI	49	Noncommunity	Camp	3	Surface
WI	July	*Shigella*	4	Individual	Residence	2	Ground

*AGI = acute gastrointestinal illness of unknown etiology

#SYSTEM: Community systems: Public or investor-owned water supplies that serve large or small communities, subdivisions and trailer parks of at least 15 service connections or 25 year-round residents.

Noncommunity systems: Those in institutions, industries, camps, parks, hotels, service stations, etc., which have their own water system available for use by the general public.

Individual systems: Generally wells and springs, used by single or several residences or by persons traveling outside populated areas.

+DEFICIENCY: (1) Untreated surface water, (2) untreated ground water, (3) treatment deficiencies (4) distribution system deficiencies, (5) miscellaneous.

[o]May have been multiple etiologies, but *Giardia* was the only pathogen found.

H. Guidelines for Confirmation of Waterborne Disease Outbreaks

Etiologic Agent	Clinical Syndrome	Epidemiologic Criteria
1. *Escherichia coli*	a) Incubation period 6-36 hours	a) Demonstration of organisms of same serotype in epidemiologically incriminated water and stool of ill individuals and not in stools of controls -OR-
	b) Gastrointestinal syndrome: marjority of cases with diarrhea	b) Isolation of organisms of the same serotype which have been shown to be enterotoxigenic or invasive by special laboratory techniques from stool of most ill individuals.
2. *Salmonella*	a) Incubation period 6-48 hrs	a) Isolation of *Salmonella* organism from epidemiologically implicated water -OR-
	b) Gastrointestinal syndrome: majority of cases with diarrhea	b) Isolation of *Salmonella* organism from stools or tissues of ill individuals
3. *Shigella*	a) Incubation period 12-48 hrs	a) Isolation of *Shigella* organism from epidemiologically implicated water. -OR-
	b) Gastrointestinal syndrome: majority of cases with diarrhea	b) Isolation of *Shigella* organism from stools of ill individuals.
4. *Campylobacter jejuni*	a) Incubation period usually 2-5 days	a) Isolation of *Campylobacter* organisms from epidemiologically implicated water -OR-
	b) Gastrointestinal syndrome: majority of cases with diarrhea	b) Isolation of *Campylobacter* organisms from stools of ill individuals.
5. *Yersinia enterocolitica*	a) Incubation period 3-7 days	a) Isolation of *Yersinia* organisms from epidemiologically implicated water -OR-
	b) Gastrointestinal syndrome: majority of cases with diarrhea or cramps	b) Isolation of *Yersinia* organisms from stools of ill individuals. -OR- c) Significant rise in bacterial agglutinating antibodies in acute and early convalescent sera.
6. Others	Clinical and laboratory data appraised in individual circumstances	

Etiologic Agent	Clinical Syndrome	Epidemiologic Criteria
CHEMICAL		
1. Heavy metals Antimony Cadmium Copper Iron Tin Zinc, etc.	a) Incubation period 5 min. to 8 hours (usually <1 hour) b) Clinical syndrome compatible with heavy metal poisoning--usually gastrointestinal syndrome and often metallic taste	Demonstration of high concentration of metallic ion in epidemiologically incriminated water.
2. Fluoride	a) Incubation period usually <1 hr b) Gastrointestinal illness usually nausea, vomiting, and abdominal pain	Demonstration of high concentration of fluoride ion in epidemiologically incriminated water.
3. Other chemicals	Clinical and laboratory data appraised in individual circumstances	
PARASITIC		
1. *Giardia lamblia*	a) Incubation period 1-4 weeks b) Gastrointestinal syndrome: chronic diarrhea, cramps, fatigue and weight loss	a) Demonstration of *Giardia* cysts in epidemiologically incriminated water -OR b) Demonstration of *Giardia* trophs or cysts in stools or duodenal aspirates of ill individuals.
2. Amebiasis	a) Incubation period: usually 2-4 weeks b) Variable: gastrointestinal syndrome from acute fulminating dysentery with fever, chills, and bloody stools to mild abdominal discomfort with diarrhea	a) Demonstration of *Entamoeba histolytica* cysts in epidemiologically incriminated water -OR- b) Demonstration of *Entamoeba histolytica* trophs or cysts in stools of affected individuals
3. Others	Clinical and laboratory data appraised in individual circumstances	

. Hepatitis A	a) Incubation period 14-28 days b) Clinical syndrome compatible with hepatitis--usually including jaundice, GI symptoms, dark urine	Liver function tests compatible with hepatitis in affected persons who consumed the epidemiologically incriminated food
. Norwalk and Norwalk-like agents	a) Incubation period 16-72 hours b) Gastrointestinal syndrome: vomiting, watery, diarrhea, abdominal cramps	a) Demonstration of virus particles in stool of ill individuals by immune electron microscopy -OR- b) Significant rise in antiviral antibody in paired sera
. Rotavirus	a) Incubation period 24-72 hours b) Gastrointestinal syndrome: vomiting, watery diarrhea, abdominal cramps	a) Demonstration of the virus in the stool of ill individuals b) Significant rise in antiviral antibody in paired sera
. Enterovirus	a) Incubation period: Variable b) Syndrome: Variable; poliomyelitis, aseptic meningitis, herpangina, etc.	a) Isolation of virus from epidemiologically implicated water -OR- b) Isolation of virus from ill individuals
. Others	Clinical and laboratory evidence appraised in individual circumstances	

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J. Selected Waterborne Disease Outbreak Articles, 1979, taken from Morbidity and Mortality Weekly Report

Giardiasis--California, Colorado, Oregon, Pennsylvania

Several recent reports exemplify the increasing frequency with which *Giardia* is being implicated as the cause of waterborne outbreaks of diarrhea. These and past outbreaks have several features in common, namely, that they occur in communities in which 1) surface (streams, rivers, lakes), not well water, is used; 2) chlorination is the principal method for disinfecting water; and 3) water treatment does not include filtration, or existing filters have structural or operational defects.

California: From January 1976 through September 1979, 42 cases of giardiasis were confirmed in Plumas County residents or vacationers. Preliminary investigation disclosed that most had occurred in the spring and summer months and were predominantly in persons from the town of Graeagle.

In September 1979, a survey was undertaken of 378 subscribers of the Graeagle Water Company and 200 randomly selected control households in a neighboring town. The Graeagle Water Company used a surface water source which was chlorinated but not filtered, whereas the water supply of the control town was well water. Responses from the Graeagle subscribers reported on a total of 463 people. Of these, 79 (17%)--including 19 previously confirmed cases--gave histories suggestive of giardiasis (that is diarrhea of $\geq$5 days duration or recurrent diarrhea accompanied by 2 or more of the following symptoms--abdominal pain, fever, bloating, nausea, vomiting, and weight loss).

In contrast 3% of the residents in the control town had an illness compatible with *Giardia*. Among confirmed cases, exposure to the Graeagle water system was the only common risk factor identified. Attempts by the California Department of Health Services to isolate *G. lamblia* cysts from Graeagle water samples were unsuccessful. However, 2 of 3 beavers trapped in the Graeagle watershed were found to be infected with the organism. An ordinance to boil all water was put into effect in Plumas County until the water could be filtered.

Colorado: During August 1979, a giardiasis-like illness was reported from both residents of and visitors to Estes Park, Colorado. Sixteen of 28 stool specimens from residents examined by the Colorado State Department of Health were found to be positive for *G. lamblia*. During the month of August 1978, 3 of 17 (17%) stools examined were found to be positive for *Giardia*.

Estes Park is a resort town and receives water from the Fall River plant, which utilizes surface water that is both filtered and chlorinated. A study of Estes Park residents supplied with water from the Fall River plant and a control population supplied with water from other Estes water plants revealed no difference in the attack rate for giardiasis, defined as any diarrheal illness persisting for 7 days or more during the study period (August 1-September 19, 1979). However, a study of 23 nonresidents of Estes Park who visited the town during the study period showed that 7 of 23 (31%) were ill; 7 of 11 (63%) persons remembered drinking water at establishments supplied by the Fall River plant, whereas none of the 12 who did not drink water from establishments supplied by the Fall River plant became ill ($p < .01$, Fisher's exact test). Eight of the 13 high-volume water-sampling filters placed at different locations in Estes Park and Denver were positive for *G. lamblia* cysts. Positive samples were obtained from water collected before and after treatment at the Fall River plant. The plant has been closed and will not be reopened until new chemical and filtration measures are instituted.

Oregon: Giardiasis outbreaks occurred in 2 communities in Oregon in 1979. The first outbreak was in the mountain resort community of Zig Zag in September 1979. Epidemiologic investigation showed that 66 of 690 individuals (10%) reported intestinal symptoms consistent with giardiasis. Sixteen of 66 (24%) were treated for giardiasis, and 8 of 16 (50%) were found to have *Giardia* cysts in their stools. A study of the water system showed *Giardia* cysts in beaver feces collected from the watershed. *Giardia* cysts were also found in the distribution system at the chlorinator station.

The second outbreak occurred in Government Camp in November. Several cases of giardiasis were reported among persons who drank the chlorinated, but unfiltered, water in this resort community. An epidemiologic investigation of permanent residents of Government Camp showed that 55 of 95 (58%) had gastrointestinal illness during October-November 1979; 20 of 95 (21%) had diarrhea, gas, or cramps lasting 7 days or more. Seven of 95 (7%) had laboratory-confirmed giardiasis. A study of a control community using a different water source showed that 50 of 151 (33%) had gastrointestinal illness during the study period, with 12 of 151 (8%) having symptoms suggestive of giardiasis. However, none were found to have *Giardia* in their stools. The differences between these 2 communities were statistically significant. *Giardia lamblia* cysts were identified in beaver feces collected from the stream above the intake of the Government Camp water system. An ordinance to boil water was issued.

Pennsylvania: During the 8-week period October 20-December 15, 1979, 407 cases of giardiasis were confirmed among residents of Bradford. Epidemiologic investigation showed that the illness had begun as early as July, but cases peaked in September and October. The cases were widespread, and geographic clustering was not evident.

The water supply of Bradford is disinfected by chlorine gas; the water is not filtered. A marked turbidity problem was reported in July and August; it was attributed to a prolonged rainy season. Intermittently, high coliform counts and high turbidity levels were measured in the finished water. *Giardia* cysts were recovered from both raw and treated water. *Giardia* was also identified in the stool of a beaver trapped in 1 of the water supply reservoirs.

A random community questionnaire survey of Bradford showed that 5.4% had giardiasis-like illness (diarrhea for $\geq$10 days) compared with only 0.6% of Warren County residents who used well water ($X^2 = 9.58$, $p \leq .002$). During July-October 1979, 25% of Bradford residents had diarrheal illness compared with 10% of Warren County residents ($X^2 = 19.88$, $p \leq .0001$). A stool survey confirmed *Giardia* infection in 17 (16%) of 106 Bradford residents compared with none of 40 from the control county ($p < .003$, Fisher's exact test). To control the outbreak, the chlorine level in the water was increased to 2-3 ppm, and an ordinance to boil water was issued.

Reported by A Keifer, MD, G Lynch, Plumas County Health Dept, D Conwill, MD, RR Roberto, MD, MPH, C Powers, MS, J Gaston, MS, California State Dept of Health Services, in the California Morbidity Weekly Report, November 23, 1979; RW Sherwood, MD, MPH, L Johnston, PhD, Larimer County Health Dept, Fort Collins, Colorado; J Blair, B Early, RS Hopkins, MD, State Epidemiologist, E Scott, R Smade, Colorado State Dept of Health; H Osterud, MD, N Slifman, MD, University of Oregon Health Sciences Center, J Schilke, MD, C Hills, RN, Clackamas County Public Health Div., JA Googins, MD, State Epidemiologist, Oregon Dept of Human Resources in the Oregon Communicable Disease Summary, January 19, 1980; TJ Burkhart, MD, J Jenkins, MT, Bradford Hospital, Bradford, Pennsylvania; EJ Witte, VMD, MPH, Acting State Epidemiologist, M McCarthy, RN, T de Melfi, Pennsylvania State Dept of Health; J Erb, Dept of Environmental Resources, State of Pennsylvania; EC Lippy, MS, Environmental Protection Agency; Parasitic Diseases Div, Field Services Div, Water-Related Diseases Activity, Enteric Diseases Br, Bacterial Diseases Div, Bur of Epidemiology, CDC.

Editorial Note: The long-term solution to waterborne giardiasis requires improvements in and widespread use of water filtration. In the meantime, there is a continuing need to provide potable drinking water on an emergency basis to communities experiencing an outbreak. This has been accomplished in some communites by switching from surface water to well water sources, transporting drinking water from a nearby community where the water supply is not affected, and using bottled water. In most instances, however, alternative water supplies have not been readily available, and the costs of transporting water have been prohibitive. The only alternative in these situations is to kill *Giardia* cysts in the existing water supply. Regardless of the method used, it must be continued until the source of water contamination is eliminated or until the deficiencies in water treatment are corrected. Boiling is the most reliable method for killing *Giardia* cysts in water. Although time-temperature studies have not been done to determine the thermal death point of *Giardia* cysts, data are available on Ascaris eggs, acknowledged by most parasitologists to be the most resistant of parasite eggs and more resistant to physical and chemical factors than protozoan cysts. Ascaris eggs are killed immediately at 70 C (4). Since Giardia cysts would succumb to even lower temperatures, simply bringing drinking water to a boil is considered more than adequate to kill Giardia cysts. In circumstances where gross fecal contamination of the water supply is evident, boiling water for a longer period of time may be warranted to kill other enteric pathogens.

The effects of chemical disinfectants on Giardia cysts have received only limited study. Evidence from these and other outbreaks indicate that chlorine levels used in routine disinfection of municipal drinking water (0.4 mg/l free chlorine) are not effective against Giardia cysts. Recent experimental data suggested that hyperchlorination (5-9 mg/l free chlorine residual) may kill Giardia cysts (5,6) To determine the viability of cysts after exposure to various concentrations of chlorine, the investigators employed a recently developed method for inducing Giardia cysts to excyst in vitro. If Giardia cysts failed to excyst after treatment with chlorine, they were assumed to be dead. However, animal infectivity studies to validate the reliability of this technique for assessing viability have not been done. The amount of chlorine required to inhibit excystation of Giardia cysts depends on the water temperature, pH, turbidity, and contact time between the parasite and chlorine. In general, higher concentrations of chlorine are required for water that is cold (3-5 C), has an alkaline pH, or is turbid. Chlorine concentrations may be decreased if contact time with the organism is increased. By manipulating these variables it may be possible to reduce free chlorine residual to a level that would be satisfactory for use in municipal drinking water and still be effective against Giardia cysts. The minimum chlorine levels and optimal water conditions necessary to kill Giardia cysts in municipal water supplies are yet to be determined.

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Fluoride Intoxication in a Dialysis Unit - Maryland

On November 13, 1979, 2 days after an unreported spill of hydrofluosilicic acid into the Annapolis public water supply, 8 patients undergoing renal dialysis became ill; 1 patient died. Water used to mix dialysate in this unit was treated only by a softening device; no reverse osmosis or deionization--2 processes that purify water--occurred. The afebrile illness, predominantly characterized by hypotension, nausea, substernal pain, diarrhea, itching, and vomiting, developed after 1 to 2 hours of dialysis (Table 7).

Table 7 Signs and symptoms of fluoride overexposure in a dialysis unit, Annapolis, Maryland, November 13, 1979.

Signs/Symptoms	Number
Nausea	8
Hypotension	6
Substernal pain or pressure	6
Diarrhea	5
Itching	5
Vomiting	5
Malaise	5
Dyspnea	2
Flushing	2
Localized Numbness	2
Diaphoresis	2
Headache	2

One patient, a 36-year-old man, was offered hospitalization when he experienced nausea, vomiting, diarrhea, chest pressure, dyspnea, and a drop in blood pressure 20 to 30 mm Hg below normal. After he was taken off dialysis, he felt slightly better and refused hospitalization. Twelve hours after onset, the dyspnea worsened, and while the patient was being transported by ambulance to a local hospital he had a cardiorespiratory arrest. He was successfully resuscitated.

When this patient was admitted, the dialysis unit director notified the state health department and began calling the other 7 dialysis patients. A call was made to a 65-year-old patient who had had nausea and vomited blood-tinged material 1 hour and 40 minutes after dialysis. He subsequently had watery diarrhea, headache, diaphoresis, chest pain, extreme shakiness, and weakness. Dialysis had been terminated after 3 hours. He, too, had refused hospitalization and was taken home, where he remained in bed. When the director called, this patient's wife tried to wake him, but could not. He was pronounced dead on November 14, approximately 16 hours after the onset of his illness. On autopsy he was found to have severe hypertensive and arteriosclerotic heart disease, and high fluoride levels were found in the autopsied lung (5.6 ppm), kidney (7.0 ppm), brain (0.9 ppm), and blood (4.9 ppm).

Some hours after completion of dialysis, 4 other patients were hospitalized for observation. Serum fluoride levels obtained 16 to 20 hours after the completion of dialysis in these individuals ranged from 0.4 to 5.5 ppm. Normal values immediately after dialysis for patients with chronic renal failure dialyzed with water containing 1 ppm fluoride may reach levels of 0.88 ppm (Personal communication, Dr. Leon Singer, Professor of Biochemistry, University of Minnesota).

A sample of "softened" water used for dialysis on November 13 contained 50 ppm fluoride. A sample of dialysate fluid taken from the dialysis bath of the machine belonging to the first patient described above contained 35 ppm fluoride.

Subsequent investigation by the Maryland State Department of Health and Mental Hygiene revealed that on November 11, 1979, a technician at the Annapolis water treatment plant had failed to close a valve to stop the flow of 22% hydrofluosilicic acid from a 4,000-gallon storage tank to a 50-gallon fluoride feed container. One thousand gallons of the acid overflowed into drains leading to sand-filter-backwash and sludge-decant tanks from which decanted liquid was recycled as raw water. The accident had not been reported to health officials. Daily water samples were routinely tested for fluoride level by the treatment plant personnel using a colorimetric dye method capable of measuring up to 1.6 ppm (7); during the 2 days following the accident, fluoride levels were at least 1.6 ppm. On November 14, through serial dilutions made with commercial distilled water, a water sample was measured at 7.5 ppm fluoride.

An Annapolis soda-bottling company allowed health authorities to analyze soda bottled the week after the accident. The highest fluoride level was 30 ppm for soda bottled on November 14, By November 17, the fluoride content was less than 1 ppm. All remaining bottles or cans with levels greater than 5 ppm were recalled or not distributed.

Studies were conducted to determine if overfluoridation of the city water supply was associated with acute illnesses resembling fluoride intoxication in the community at large. A case of possible fluoride intoxication was defined as an afebrile illness characterized by nausea/vomiting and/or abdominal cramping (8). Review of records of emergency-room visits at the 1 large, acute-care hospital providing service to the people of Annapolis did not show an increase in cases compared with the week before the accident. There was also no increase in cases at a large Annapolis pediatric practice or at a prison dispensary located near the water treatment plant. School absenteeism throughout Annapolis did not increase in the 2 weeks after overfluoridation. A review of admissions to the hospital intensive and cardiac-care units also did not reveal any increase.

Fifty-eight persons working in the building where the dialysis unit was located completed investigation questionnaires. Thirteen had mild illness compatible with fluoride intoxication during the week following the fluoride accident, compared with 3 during the week preceding the accident (November 5) and 6 during the week beginning November 19. None of the 13 ill workers consulted a physician; 1 person missed 1 day of work. Thus, there was suggestive evidence of mild fluoride intoxication among the office workers.

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Editorial Note: This is the first instance of fluoride overexposure known to have caused serious illness in the 35 years since fluoridation of community water supplies was begun. There have been 5 previous accidents, all caused by equipment malfunctions.

The severe illness in the incident reported here was limited to a group of persons with end-stage renal disease who were undergoing dialysis and who received, intravenously, excessive amounts of fluoride.

In this instance, the water treatment plant had cross-connections which allowed a spilled chemical to enter the drinking water supply. Since water treatment plants have numerous other chemicals on site--many of which would be toxic in high doses--the Annapolis incident illustrates the need for existing plants to be inspected for such cross-connections. The incident also points out that fluoride levels should be monitored by methods capable of determining actual fluoride levels, without the necessity for serial dilutions. When a chemical accident does occur, appropriate public health officials should be immediately informed so that dialysis units and end-stage renal disease networks, in particular, can be promptly notified. Finally, it is recommended that persons responsible for dialysis patients use water-purification techniques such as reverse osmosis and deionization as aids to ensure high-quality dialysate.

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III. DISEASE OUTBREAKS RELATED TO RECREATIONAL WATER USE, 1979

A. Sources of Data

As with disease outbreaks associated with drinking water, the sources of data for outbreaks associated with recreational water use are the state epidemiologists and their staffs. However, reporting of these disease outbreaks is not systematic; therefore, the outbreaks reported here certainly represent a small fraction of the total number that occur. The likelihood of an outbreak coming to the attention of health authorities varies considerably from 1 locale to another, depending largely upon consumer awareness and physician interest. We have included in this section infections or intoxications related to recreational water, but have excluded wound infections caused by water-related organisms. Before 1978 outbreaks or cases of disease related to recreational use of water were not tabulated so comparisons with previous years cannot be made.

B. Comments

Six outbreaks related to recreational use of water were reported to CDC in 1979 (Section C).

Three of the outbreaks were gastroenteritis epidemics related to swimming. One outbreak in Michigan was caused by the Norwalk agent while the other 2 were of unknown etiology. Transmission occurred in small fresh water lakes in 2 outbreaks and in a swimming pool in the third.

Epidemic gastroenteritis in relation to swimming is not commonly reported in the medical literature. Examples of such reports include an outbreak of shigellosis after swimming in a river (9), an outbreak of shigellosis after swimming in a pool (10), an outbreak of viral gastroenteritis after swimming in a pool (Kappus, Karl, personal communication), and an outbreak of viral gastroenteritis after swimming in a lake (11). That such outbreaks occur more commonly than reported is suggested by Cabelli's data (12) which show a relationship between swimming water quality and gastrointestinal illness. Swimming related outbreaks may go unnoticed, since the persons involved may be from diverse places so that public health authorities may not associate the illnesses with swimming. It is only when the epidemic is caused by a discrete and unusual organism or when the affected population is easily defined that public health authorities recognize that an epidemic is occurring.

Water was tested for coliforms after 2 of these 3 outbreaks and met the current Environmental Protection Agency recommendation for recreational water quality. These recommendations were primarily derived from studies performed 3 decades ago (13). More recent studies indicate that appreciable rates of gastrointestinal illness may occur in persons who swim in water with much lower fecal coliform concentrations than the EPA maximum standard (12). If these findings are used to revise the recreational water quality standards, then recreational water quality may have to be more nearly the quality of drinking water to prevent transmission of enteric pathogens, especially those in which small infective doses contaminate the recreational water. That more outbreaks do not occur as a result of contaminated recreational water may be due to failure to recognize outbreaks when they do occur and to the rarity with which pathogens, even those with low infective doses, contaminate recreational water.

Three outbreaks of dermatitis related to whirlpools were reported for 1979; two were attributed to Pseudomonas aeruginosa while the etiology of the third was not determined.

In addition we received reports of 1 case of amebic meningoencephalitis from Texas (Section E) and of several cases of schistosome dermatitis (swimmer's itch) from Utah and Virginia.

C. Line Listing of Disease Outbreaks Related to Recreational Water Use, 1979

State	Month	Disease	Cases	Nature of Water
Maine	July	Gastroenteritis	30	Lake
Michigan	July	Gastroenteritis	239	Lake
Virginia	July	Gastroenteritis	72	Swimming Pool
Alabama	April	*Pseudomonas* dermatitis	27	Whirlpool
New Hampshire	April	Dermatitis	17	Whirlpool
Maryland	April	*Pseudomonas* dermatitis	12	Swimming Pool

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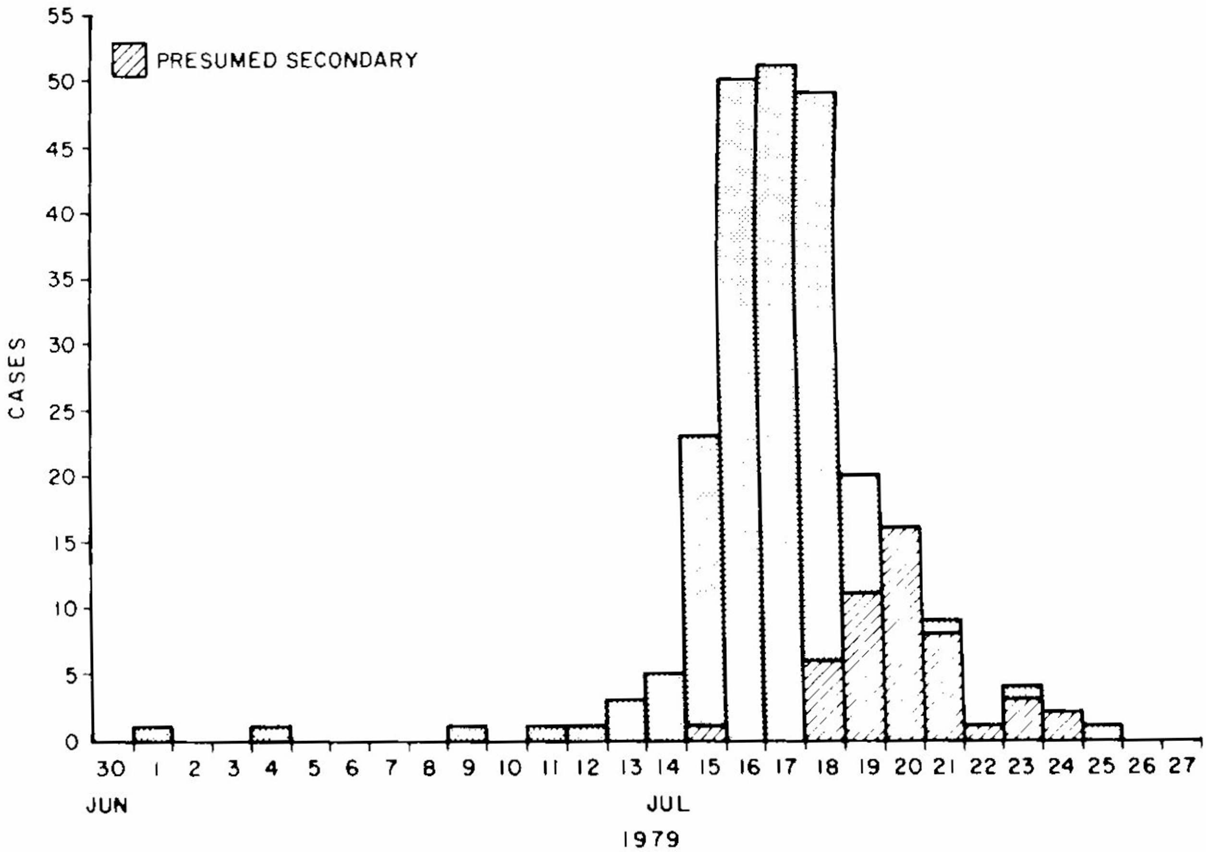
E. Selected Outbreaks Related to Recreational Water Use, 1979, Taken From Morbidity Mortality Weekly Report

Gastroenteritis Associated with Lake Swimming - Michigan

An outbreak of gastrointestinal illness involving at least 239 cases occurred among persons who visited a recreational park in Macomb County, Michigan, during July (Figure 2). The illness, suspected of being viral in nature, was associated with swimming in a lake at the park.

On July 17, the Macomb County Health Department (MCHD) received a report that several members of a group who had visited a local recreational park on July 15 had become ill with gastroenteritis. In the period July 17-27, in response to requests of the news media that park visitors who had become ill should notify the MCHD, 300 telephone calls reporting illness were received at the health department. The predominant symptoms in these persons, which included all age groups, were vomiting and/or diarrhea, with nausea, abdominal cramps, headache, low-grade fever, and sore throat as part of the syndrome. Most individuals recovered within 24 to 48 hours. For 52 persons who were the only cases in their respective households, the incubation period ranged from 6 hours to 8 days (median, 2 days). For 47 (90%) of these persons, incubation periods ranged from 6 hours to 3 days. A park-associated case was thus defined as gastroenteritis in a person who visited the park in July with onset within 3 days of the visit. There were 191 such cases. In 48 additional park visitors gastroenteritis developed ≥4 days after their visit, but each of these cases was associated with an earlier household case, suggesting secondary spread (Figure 2). Preliminary estimates of 20%-30% attack rates among household members who did not visit the park provided strong evidence that secondary transmission occurred.

Fig. 2 CASES OF GASTROENTERITIS IN VISITORS TO A RECREATIONAL PARK, BY DATE OF ONSET, MACOMB COUNTY, MICHIGAN, JULY 1979



Bacterial cultures of stool specimens taken from 5 persons with primary and secondary household cases were negative. Studies of paired serum specimens revealed that the outbreak was caused by the Norwalk agent.

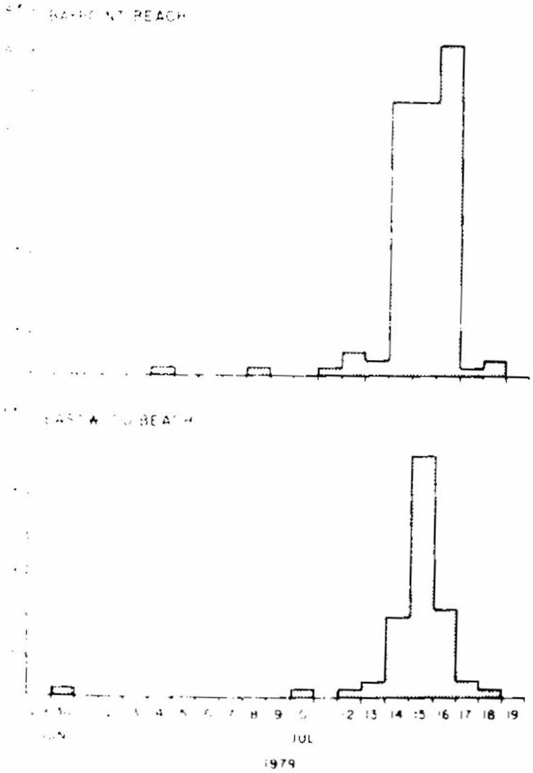
Illness was not associated with consumption of water from the park's drinking facilities or with consumption of food or iced beverages purchased at the park's 2 concession stands. However, among 135 individuals from 3 groups who visited the park on July 15, gastroenteritis was documented in 11 of 38 persons (29%) who waded or swam in the lake, but in only 1 of the 97 (1%) of those who did not ($p<.00001$). For those who went into the lake, risk increased with the amount of time spent in the water (Table 8). A case-control study showed that 44 of 47 park-associated cases (94%) were in persons who swam with their heads in or under the water, compared with only 26 of 35 family-matched controls (74%) ($.02<p<.05$). Of the 191 persons who became ill within 3 days of their park visit, 187 had visited one or the other of the park's 2 beaches (Figure 3). Since these beaches were located on opposite sides of the lake and were separated by 3,500 feet of water, this suggested widespread contamination of the water from July 14 through July 16.

Routine sampling of lake water on July 13 and July 17 failed to reveal abnormal coliform counts. A sanitary investigation conducted by the MCHD and the Michigan State Department of Natural Resources did not implicate faulty sewer lines or overflowing septic tanks as

TABLE 8 Gastroenteritis Associated with Swimming, 1979

Time in water	Ill	Well	Total	Attack rate (%)
<1/2 hour	2	12	14	14
1/2-1 hour	4	9	13	31
>1 hour	5	6	11	45
TOTAL	11	27	38	29

Fig 3. CASES OF GASTROENTERITIS, BY BEACH* AND DATE OF EXPOSURE, MICHIGAN, JUNE 30-JULY 18, 1979†



†EXCLUDES PATIENTS WHO COULD NOT RECALL WHICH BEACH THEY HAD VISITED
*BEACHES WERE CLOSED AT 4:00 PM ON JULY 18

potential sources of fecal contamination. The lake, which was closed for swimming on July 18, was reopened on August 9; no further cases of illness were reported.

Reported by L Brown, MD, L Costa, PHN, M Damon, J Dixon, PHN, L Lindsay, PHN, F Murphy, V Nunnely, PHN, L Swoish, PHN, B Van Dyke, Macomb County Health Dept; B Strom, MD, Oakland County Health Dept; J Isbister, MD, Acting State Epidemiologist, Michigan State Dept of Public Health; J Hey, Michigan State Dept of Natural Resources; Enteric and Neurotropic Viral Diseases Br, Viral Diseases Div, Epidemiologic Investigations Laboratory Br, Bacterial Dis Div, Bur of Epidemiology, CDC.

Editorial Note: Several outbreaks of acute acute infectious non-bacterial gastroenteritis (AING) have been traced to potable water sources contaminated with human sewage, and a single epidemic of viral gastroenteritis has been related to swimming in an unchlorinated public swimming pool. The etiologic role of 27 nm agents, including the Norwalk agent, in some of the more recent waterborne outbreaks of gastroenteritis has been established (14-16). The failure to document sewage contamination in the lake is not surprising since the period of maximum risk was apparently transient and did not overlap with the schedule for routine water sampling.

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Amebic Meningoencephalitis - Texas

In January 1979, a 2 1/2-year-old, previously healthy boy living on the Fort Bliss Army Base in El Paso, Texas, developed an insidious change in hand dominance from right to left. Over the next 6 months a progressive right hemiparesis was noted, with acute exacerbations and increasing residual neurologic deficit. The boy was afebrile and free of other systemic symptoms.

On September 4, the boy was admitted to Children's Hospital in Pittsburgh, Pennsylvania. His physical examination was unremarkable except for splenomegaly, a right hemiparesis, and a right reflex preponderance. His white blood cell count was 8,000/mm^3, with a normal differential. The cerebrospinal fluid (CSF) was clear and colorless with normal protein and glucose levels, 13 monocytes, and 1 lymphocyte. Routine cultures for bacteria, fungi, and acid-fast organisms were negative. Quantitative immunoglobulins, complement levels, and skull films were normal. A computerized tomographic brain scan revealed multifocal areas of decreased density in the subcortical white matter, and a gyriform pattern of enhancement.

The patient remained clinically unchanged for the first 2 weeks of his hospitalization. On September 18, his temperature rose to 39 C, and nuchal rigidity and right-sided focal motor seizures developed. He was begun on prednisone, 2 mg/kg/day, for 7 days with no change in his clinical status. A lumbar puncture on September 24 was again culture-negative but revealed an elevated protein level of 62 mg/dl, a glucose level of 38 mg/dl (serum level 88 mg/dl), 22 lymphocytes, and 5 monocytes. On September 26, he became comatose and unresponsive, with sluggishly reactive pupils and a spastic quadriparesis. His condition improved slightly following administration of intravenous mannitol. A cerebral angiogram was normal. A brain biopsy performed on September 26 revealed amebic trophozoites on permanent section morphologically suggestive of Acanthamoeba. On September 27, the boy was begun on miconazole, 140 mg intravenously, every 8 hours (30 mg/kg/day), and 5-fluorocytosine in a dose of 500 mg orally every 6 hours (140 mg/kg/day). Prednisone was rapidly tapered and discontinued. The patient's condition stabilized and gradually improved during the first 7 days of antimicrobial therapy. He became afebrile on the 14th day of treatment; then his level of consciousness again deteriorated, and he died on the 41st hospital day. The duration of illness from onset of symptoms was 7 1/2 months. The patient was on continuous treatment with miconazole and 5-fluorocytosine from the time of diagnosis until his death 18 days later.

There was no history of swimming or wading in ponds, pools, puddles, or lakes, or of traveling outside the United States. The neurology service at the William Beaumont Army Medical Center in El Paso, Texas, has reported no other cases of granulomatous encephalitis or atypical aseptic meningitis among personnel or dependents stationed at Fort Bliss.

A serum specimen submitted to CDC was weakly positive for Acanthamoeba at a nondiagnostic reciprocal titer of 8 by the immunofluorescent antibody assay. Sections of the brain biopsy examined at the Department of Neuropathology at Presbyterian-University Hospital, Pittsburgh, showed amebae on electron microscopy that demonstrated some resemblance to the Acanthamoeba-Hartmannella group and were not morphologically consistent with Naegleria. Immunofluorescent studies on brain sections at the Veterans Administration Hospital in Gainesville, Florida, were negative for Naegleria, Acanthamoeba, Hartmannella, and Vahlkampfia species. Amebic cultures of brain biopsy material prepared separately at the University of Pittsburgh, the University of Florida, and CDC failed to grow. Hanging drop and cytological studies of the patient's CSF failed to demonstrate amebae.

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Editorial Note: This case illustrates both the difficulties of establishing a specific diagnosis during the course of active meningeal infection with pathogenic free-living amebae and the therapeutic challenge of managing this rare but life-threatening group of infections.

Infection caused by Naegleria species is usually associated with swimming or bathing in waters containing these organisms. It usually has a short incubation period and a fulminant course lasting 10-14 days. These infections have shown some clinical response to amphotericin B, a finding supported by in vitro studies (17). The only documented case of successfully treated Naegleria infection in the United States required intravenous and intrathecal amphotericin B and miconazole as well as oral rifampin (18).

By contrast, Acanthamoeba infections are usually more chronic in nature and are not associated with any known mode of transmission. Hematogenous dissemination with appearance of the organism in skin, eye, and other organs has been reported (19,20), although this apparently did not occur in this patient. The role of immunosuppression or immune incompetence in this disease is unknown. The 12 best-documented cases of disseminated Acanthamoeba infection include 1 case of Hodgkin's disease, 1 diabetic, 1 alcoholic, 2 pregnant women, and 4 patients who received steroid therapy in the course of their treatment (21-22). The patient reported here demonstrated no detectable immune deficiency, but did receive steroid therapy during his treatment. Steroids have been shown to increase susceptibility to Acanthamoeba infections in mice (23). Immunodiagnostic testing in Acanthamoeba infections is frequently difficult. Of 9 cases studied by indirect fluorescent antibody tests, 6 showed positive tissue staining. Three of the 6 were also sero-positive; 3 cases were negative, as was the present case.

Laboratory facilities for in vitro cultivation of amebae are not generally available, making it difficult to evaluate sporadic and geographically scattered cases in a uniform manner. The finding of amebae in CSF and the efforts to grow them in culture from pathologic specimens have been more successful in Naegleria infections than in those involving Acanthamoeba species.

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IV. OUTBREAKS OF ACUTE GASTROINTESTINAL DISEASE ON OCEAN-GOING VESSELS

A. Sources of Data

After shipboard outbreaks of typhoid fever (24), viral gastroenteritis, and shigellosis (25) in 1971-1973, a review of ships' medical logs revealed an incidence of gastrointestinal illness on passenger cruise ships of 1% or less on 92% of cruises and 5% or greater on 2% of cruises (26). Shortly thereafter, the Bacterial Diseases Division and Quarantine Division, Bureau of Epidemiology, Center for Disease Control, established a surveillance system for shipboard gastrointestinal illness which required vessel masters to report all cases of diarrheal illness seen by the ship's physician as a part of his request for radio pratique (permission to enter a port). These reports are made by radio 4 to 24 hours before arrival in port and are logged by quarantine officers for forwarding to CDC monthly. In the event that 3% or more passengers on any 1 cruise visit the ship's physician with gastrointestinal illness, a quarantine officer will board and inspect the ship and then telephone a report to the Centers for Disease Control. Based on his report, the Enteric Diseases Branch may perform an in-depth investigation of the outbreak.

The Quarantine Division performs a vessel sanitation inspection on each cruise ship semiannually or more frequently if indicated by poor sanitary ratings. Since the sanitation rating represents the results of an inspection carried out at dockside on a given day, this rating may not reflect the sanitary conditions at sea. In 1978, however, results of the ships' reports of diarrheal illness since 1975 were compared with the vessel sanitation inspection reports for the same period. The number of outbreaks of diarrheal illness was significantly less frequent on vessels with sanitation scores that met the Public Health Service standards than on vessels which did not. (Dannenberg AL, Yashuk JC, Feldman RA. Gastrointestinal illness on passenger cruise ships, 1975-1978. Unpublished manuscript.)

B. Comments

In 1979, CDC personnel investigated 3 outbreaks of diarrheal illness on cruise ships that sailed between U. S. ports and Caribbean or Mexican ports. One was a foodborne epidemic caused by Salmonella heidelberg (Section D). The second outbreak was caused by the Norwalk agent and affected 400 persons on 2 cruises. Epidemiologic and microbiologic evidence suggested that contaminated drinking water was the vehicle of infection.

The third outbreak was probably caused by an Escherichia coli which produced a heat-stable enterotoxin. However, some people had evidence of infection by the Norwalk agent as well. Water was epidemiologically incriminated as the vehicle of infection. This ship caught fire and sank about 6 weeks after the epidemic.

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D. Selected Outbreaks on Ocean-going Vessels, 1979, Taken from Morbidity Mortality Weekly Report

Salmonella heidelberg Gastroenteritis Aboard a Cruise Ship

An outbreak of gastrointestinal illness occurred aboard the T.S.S. Festivale, a Caribbean cruise ship of Panamanian registry owned and operated by Carnival Cruise Lines, on its February 17-24 cruise. The outbreak was detected when several passengers who were ill aboard ship notified the Dade County Health Department and the U. S. Quarantine Officer after they disembarked in Miami. On the evening of February 26, a Quarantine Officer in San Juan, where the ship was docked, reviewed the ship's medical log and noted that the outbreak had begun on February 22 and that 32 (3%) of the 1,149 passengers had been seen by the physician for a diarrheal illness during the cruise. An outbreak was also apparently occurring on the February 24-March 3 cruise; 26 (2%) of the 1,160 passengers and 18 (3%) of the 540 crew had reported having diarrhea to the ship's physician by February 26, and many more passengers were complaining of a gastrointestinal illness. A Public Health Service (PHS) Quarantine Officer and a PHS sanitarian boarded the ship in St. Martin on February 28 to begin an epidemiologic and environmental investigation.

A questionnaire survey was conducted on March 1; of the 1,129 (97%) passengers responding, 379 (34%) reported a gastrointestinal illness defined as either watery diarrhea or severe cramps and vomiting; 198 passengers became ill within 48 hours of boarding the ship on February 24. Stool cultures previously obtained from 4 passengers ill during the earlier cruise and from 14 ill crew members, removed from the ship when it docked in St. Thomas on February 27, were positive for Salmonella group B.

A sanitation inspector for the Quarantine Division inspected the ship on March 2. The water was found to have adequate levels of residual chlorine and to be negative for coliforms. Multiple deficiencies in sanitation were found, particularly in food handling and preparation. Records revealed that the ship had not passed earlier sanitation inspections conducted by the Quarantine Division.

On March 3 a second questionnaire was distributed concerning food consumed during the cruise of February 24-March 3. The survey, completed by 93% of passengers, implicated turkey and macaroni salad from the evening buffet on February 24 as vehicles of transmission. Stool cultures were obtained from 21 ill passengers and 6 well passengers before the ship docked; S. heidelberg was isolated from 17 (81%) of the ill and 4 (67%) of the well passengers. The same Salmonella serotype was cultured from 7 of 35 different food samples taken from the ship's galley on March 1 and 2; however, the original turkey and macaroni salad from the evening buffet of February 24 were no longer available. Stool specimens were obtained from 269 food handlers and tested for salmonellae; more than 60 were positive for Salmonella group B. The food handlers are the employees of Apollo caterers, a Miami-based firm that caters cruise ships.

The following recommendations were made: 1) remove and destroy leftover foods, 2) completely clean and sanitize the galley, 3) screen food handlers for Salmonella and remove all those who are positive, 4) make structural improvements in the kitchen's refrigeration systems and dishwashing areas, and 5) provide better supervision and education of galley crew to improve food handling practices. Since these changes would take at least 1 week to implement, the PHS recommended that the company cancel the March 3-10 cruise. The company accepted and agreed to implement these recommendations.

On March 10, the T.S.S. sailed again with a large number of new galley crew members replacing those who had positive Salmonella cultures. A small outbreak of gastrointestinal illness occurred during this cruise, and S. heidelberg was isolated from 1 passenger. During the subsequent cruise, which began March 17, only 1 of more than 1,100 passengers reported to the ship's doctor with diarrhea.

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Editorial Note: While shipboard outbreaks of gastrointestinal illness occur yearly (27-28), this is the first time since 1973 that CDC has recommended that a cruise be cancelled because of an outbreak (29). The epidemiologic data and the isolation of S heidelberg from food handlers and food specimens suggested that the ship's principal problems were in the preparation and storage of food.

According to quarantine regulations, the master of a vessel is required to report to the Quarantine Station, within 24 hours before arriving in port, the number of passengers and crew who were seen by the ship's physician for the treatment of diarrhea. CDC usually conducts an epidemiologic and environmental investigation when 3% or more of passengers and crew members experience a diarrheal illness.

The Quarantine Division routinely inspects and rates cruise ships for their adherence to sanitation codes. The results of sanitation inspections on individual cruise ships as well as a monthly summary of the results of the most recent inspections of all cruise ships sailing from or calling at a U.S. port may be otained from the U. S. Public Health Service, 1015 North American Way, Room 107, Miami, Florida 33132.

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The State Epidemiologists are the key to all disease surveillance activities, and their contributions to this report are gratefully acknowledged. In addition, valuable contributions are made by State Laboratory Directors.

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