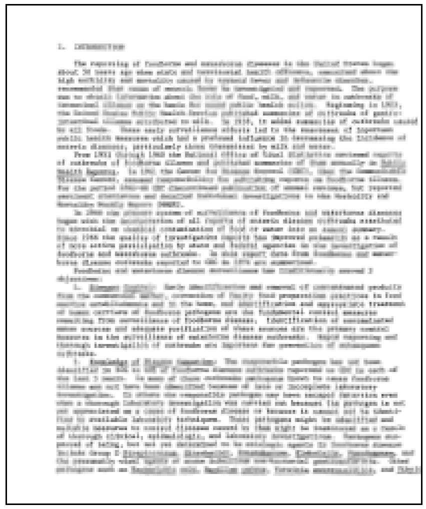


I. INTRODUCTION

The reporting of foodborne and waterborne diseases in the United States began about 50 years ago when state and territorial health officers, concerned about the high morbidity and mortality caused by typhoid fever and infantile diarrhea, recommended that cases of enteric fever be investigated and reported. The purpose was to obtain information about the role of food, milk, and water in outbreaks of intestinal illness as the basis for sound public health action. Beginning in 1923, the United States Public Health Service published summaries of outbreaks of gastro-intestinal illness attributed to milk. In 1938, it added summaries of outbreaks caused by all foods. These early surveillance efforts led to the enactment of important public health measures which had a profound influence in decreasing the incidence of enteric diseases, particularly those transmitted by milk and water.

From 1951 through 1960 the National Office of Vital Statistics reviewed reports of outbreaks of foodborne illness and published summaries of them annually in Public Health Reports. In 1961 the Center for Disease Control (CDC), then the Communicable Disease Center, assumed responsibility for publishing reports on foodborne illness. For the period 1961-66 CDC discontinued publication of annual reviews, but reported pertinent statistics and detailed individual investigations in the Morbidity and Mortality Weekly Report (MMWR).

In 1966 the present system of surveillance of foodborne and waterborne diseases began with the incorporation of all reports of enteric disease outbreaks attributed to microbial or chemical contamination of food or water into an annual summary. Since 1966 the quality of investigative reports has improved primarily as a result of more active participation by state and federal agencies in the investigation of foodborne and waterborne outbreaks. In this report data from foodborne and waterborne disease outbreaks reported to CDC in 1976 are summarized.

Foodborne and waterborne disease surveillance has traditionally served 3 objectives:

1. Disease Control: Early identification and removal of contaminated products from the commercial market, correction of faulty food preparation practices in food service establishments and in the home, and identification and appropriate treatment of human carriers of foodborne pathogens are the fundamental control measures resulting from surveillance of foodborne disease. Identification of contaminated water sources and adequate purification of these sources are the primary control measures in the surveillance of waterborne disease outbreaks. Rapid reporting and thorough investigation of outbreaks are important for prevention of subsequent outbreaks.

2. Knowledge of Disease Causation: The responsible pathogen has not been identified in 30% to 60% of foodborne disease outbreaks reported to CDC in each of the last 5 years. In many of these outbreaks pathogens known to cause foodborne illness may not have been identified because of late or incomplete laboratory investigation. In others the responsible pathogen may have escaped detection even when a thorough laboratory investigation was carried out because the pathogen is not yet appreciated as a cause of foodborne disease or because it cannot yet be identified by available laboratory techniques. These pathogens might be identified and suitable measures to control diseases caused by them might be instituted as a result of thorough clinical, epidemiologic, and laboratory investigations. Pathogens suspected of being, but not yet determined to be etiologic agents in foodborne disease include Group D *Streptococcus*, *Citrobacter*, *Enterobacter*, *Klebsiella*, *Pseudomonas*, and the presumably viral agents of acute infectious non-bacterial gastroenteritis. Other pathogens such as *Escherichia coli*, *Bacillus cereus*, *Yersinia enterocolitica*, and *Vibrio*

parahaemolyticus are known causes of foodborne illness, but the extent and importance of their role have not as yet been determined. The etiologic agent(s) responsible for the majority of waterborne outbreaks also awaits identification. In waterborne disease as in foodborne disease, the roles of a variety of viral and bacterial agents, e.g., Y. enterocolitica and parasitic agents, e.g., Giardia lamblia, remain to be clarified.

3. Administrative Guidance: The collection of data from outbreak investigations permits assessment of trends in etiologic agents and food vehicles and focuses on common errors in food and water handling. By compiling the data in an annual summary, it is hoped that local and state health departments and others involved in the implementation of food and water protection programs will be kept informed of the factors involved in food and waterborne disease outbreaks. Comprehensive surveillance should result in a clearer appreciation of priorities in food and water protection, institution of better training programs, and more rational utilization of available resources.

II. FOODBORNE DISEASE OUTBREAKS

A. Definition of Outbreak

For the purpose of this report a foodborne disease outbreak is defined as an incident in which 1) 2 or more persons experience a similar illness, usually gastrointestinal, after ingestion of a common food, and 2) epidemiologic analysis implicates the food as the source of the illness. There are a few exceptions; 1 case of botulism or chemical poisoning constitutes an outbreak.

In this report outbreaks have been divided into 2 categories:

1. Laboratory confirmed--Outbreaks in which laboratory evidence of a specific etiologic agent is obtained and specified criteria are met (see Section G).
2. Undetermined etiology--Outbreaks in which epidemiologic evidence implicates a food source, but adequate laboratory confirmation is not obtained. These outbreaks are subdivided into 4 subgroups by incubation period of the illnesses--less than 1 hour (probable chemical), 1 to 7 hours (probable Staphylococcus), 8 to 14 hours (probable Clostridium perfringens), and greater than 14 hours (other infectious agents).

B. Source of Data

The general public and local, state, and federal agencies which have responsibility for public health and food protection participate in foodborne disease surveillance. Consumers, physicians, hospital personnel, and persons involved with food service or processing report complaints of illness to health departments or regulatory agencies. Local health department personnel (epidemiologists, sanitarians, public health nurses, etc.) carry out most epidemiologic investigations of these reports and make their findings available to state health departments. State agencies concerned with food safety frequently participate in the initial investigation of the outbreak and offer laboratory support. Occasionally, on special request, CDC participates in an investigation, particularly if the outbreak is large or involves products that move in interstate commerce. State or other officials eventually summarize the findings of the investigation on the standard CDC reporting form (see Section E) and send to CDC.

The 2 federal regulatory agencies which have major responsibilities for food protection, the Food and Drug Administration (FDA) and Department of Agriculture (USDA) report episodes of foodborne illness to CDC and to state and local health authorities. CDC and state and local health authorities, in turn, report to FDA or USDA any foodborne disease outbreaks which might involve commercial products. The U.S. Armed Forces also report outbreaks directly to CDC.

By special arrangement pharmaceutical companies immediately report all requests for botulinal antitoxin to CDC. This is sometimes the first communication of a botulism outbreak to public health authorities, although physicians are urged to promptly report all suspect botulism cases. In botulism outbreaks CDC works closely with physicians, state and local health authorities, and FDA or USDA representatives to provide diagnostic and therapeutic consultation and to rapidly identify the responsible food or foods.

III. WATERBORNE DISEASE OUTBREAKS, 1976

In 1976, 35 waterborne disease outbreaks were reported to the Center for Disease Control for the United States, an increase of 46% over 1975.

A. Definition of Outbreak

A waterborne disease outbreak is defined in this report as an incident in which 1) 2 or more persons experience similar illness after consumption of water, and 2) epidemiologic evidence implicates the water as the source of illness.

There is 1 exception; 1 case of chemical poisoning constitutes an outbreak if the water is demonstrated to be contaminated by the chemical. In most of the reported outbreaks, the implicated water source was demonstrated to be contaminated; only outbreaks associated with water used for drinking are included.

B. Sources of Data

Waterborne disease outbreaks are reported to CDC by state health departments. A standard reporting form that was pretested in 8 states is now being used (see Section E). In addition, the Health Effects Research Laboratory, Environmental Protection Agency (EPA), contacts all state water supply agencies to obtain information about waterborne disease outbreaks and these data are included in this report. Personnel from CDC and EPA work together in the investigation and evaluation of waterborne disease outbreaks. When requested by a state health department, CDC and EPA can offer epidemiologic assistance, provide expertise in the engineering and environmental aspects of water purification, and as indicated, provide large volume water sampling for isolation of viruses, parasites (Giardia), and specific bacterial pathogens. Data obtained on outbreaks are reviewed and summarized by representatives from CDC and EPA. A line listing of reported waterborne disease outbreaks in 1976 is included (see Section F).

In this report, municipal systems are defined as 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. Semipublic water systems are present systems in institutions, industries, camps, parks, hotels, service stations, etc., which have their own water system available for use by the general public. Individual water systems, generally wells and springs, are those used by single or several residences or by persons traveling outside of populated areas (e.g. back-packers).

C. Interpretation of Data

Data included in this summary of waterborne disease outbreaks have limitations similar to those outlined in the foodborne disease summary and must be interpreted with caution since they represent only a small part of a larger public health problem. These data are helpful in revealing the various etiologies of waterborne diseases, the seasonal occurrence of outbreaks, and the deficiencies in water systems that most frequently result in outbreaks. As in the past the pathogen(s) responsible for many outbreaks in 1976 remains unknown. It is hoped that 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 1976, 35 waterborne disease outbreaks, an increase of 46% from 1975 (24 outbreaks) and 5,068 cases, a decrease of 53% from 1975 (10,879 cases), were reported to CDC (Table 1). Increased reporting by certain states probably accounts for the increased number of outbreaks in 1976. Of 35 outbreaks, Pennsylvania reported 14 (40%), affecting 424 individuals (median of 21 per outbreak); 12 involved semipublic water and 2 individual water systems.

Figure 1 shows the geographic distributions of outbreaks by state. Sixteen states and Puerto Rico reported at least 1 outbreak. Figure 2 depicts the trend in reported waterborne disease outbreaks in the period 1938-1976.

Table 2 shows the number of outbreaks and cases by etiology and type of water system. Of 35 outbreaks 26 (74%) were designated as "acute gastrointestinal illness." This category includes outbreaks characterized by upper and/or lower gastrointestinal symptomatology for which no specific etiologic agent was identified. In previous years these outbreaks were grouped under the category "sewage poisoning." There were 9 (26%) outbreaks of known etiology: chemical (3), Giardia lamblia (3), Shigella (2), and Salmonella (1). In the 3 largest outbreaks an etiologic agent was found; Shigella sonnei in Puerto Rico (2,150 cases), Salmonella typhimurium in New York (750 cases) and Giardia lamblia in Washington (600 cases).

The 3 chemical outbreaks reported were due to lead (2.2 mg per liter in water samples), chlordane (a pesticide - 1,200 mg per liter in water samples) and polychlorinated biphenyls (pcb's - 900 mg per liter in water samples). In the 33 non-chemical outbreaks, microbiologic water sample results were reported in 28. Evidence of fecal contamination (total or fecal coliforms) or pathogens were found in water samples collected during 27 of the outbreaks. Salmonella typhimurium was isolated from water in the New York outbreak and Giardia cysts were isolated from water in outbreaks in Colorado, Vermont, and Washington. In outbreaks where pathogens were isolated from the water supply, coliforms were reported in only 1, an outbreak of giardiasis involving the use of untreated surface water where 23 coliforms per 100 ml (MPN) were found. The other outbreaks of giardiasis involved surface water sources that were disinfected, and it is possible that chlorination was sufficient to destroy indicator organisms such as coliforms but not Giardia cysts. The outbreak of salmonellosis was caused by a cross-connection, and it is not known if timely water sampling for coliforms was conducted in conjunction with the sampling for pathogens. It is important that an attempt be made to isolate pathogens from the water supply during an outbreak to help establish the etiology, but it is equally important to also document the presence of coliforms and document their relative importance as indicator organisms for use in routine surveillance of water supplies.

Most outbreaks involved semipublic (66%) and municipal (26%) water systems, and fewer involved individual (8%) systems (Table 3). This distribution is almost identical to 1975. Outbreaks attributed to water from municipal systems affected an average of 418 persons compared with 55 persons in outbreaks involving semipublic systems and 15 persons in outbreaks associated with individual water systems. Deficiencies in treatment (inadequately or untreated water) accounted for 29 (83%) of the outbreaks. Untreated water (surface or ground) accounted for 18 of the 29 outbreaks.

Of the 23 outbreaks associated with semipublic water supply systems, 17 (74%) involved visitors to areas used mostly for recreational purposes. Of these 17, 13 occurred in the summer months May through September (Table 4).

Comments

The 46% increase in the number of outbreaks reported in 1976 is probably due to more complete reporting. Diligent investigation, such as was done in outbreaks reported from Pennsylvania, can uncover relatively small waterborne outbreaks that often originate from semipublic water systems. It is hoped that similar investigation and reporting will be done by other states so that major deficiencies commonly affecting semipublic water systems, especially in recreational areas, can be better understood and ultimately corrected.

As in recent years outbreaks originating from semipublic water systems in recreational areas contributed significantly to the total number of waterborne outbreaks reported in 1976. Water systems used on a seasonal basis or those that do not usually have an overwhelming demand placed on them by large numbers of visitors are showing the strains of such pressure. Water supply systems in such areas, especially national, state, and local parks, must be routinely reappraised and monitored and corrections made to insure safe water under increased demands. The large outbreak (more than 1,000 cases) that occurred in 1975 in Crater Lake National Park underscores the actual and potential problems that can occur in recreational areas.

Coliform organism identification is used as an indication of fecal contamination of water supplies and is widely employed in routine surveillance programs. Negative results have usually been interpretated as providing assurance that the water is free of enteric pathogens. This interpretation must be reevaluated in light of data available from waterborne outbreaks of giardiasis. In the 2 outbreaks of giardiasis where disinfection was provided, Giardia cysts were found in the water supply in the absence of coliforms. Although adequate disinfection data are not currently available, it is felt that *Giardia* cysts are as resistent to chlorination as cysts of *Entamoeba histolytica*, and high concentrations of chlorine and long contact times would, therefore, be required for cyst inactivation. Almost all of the outbreaks of giardiasis documented in the U.S. since 1965 have occurred as the result of drinking untreated surface water or surface water whose only treatment was disinfection. Disinfection practices normally employed in these systems would not provide for high concentrations of chlorine or long contact times, and it's likely that *Giardia* cysts could survive the treatment whereas coliforms would not. The coliform test in these situations would not provide assurance that an outbreak of giardiasis would be prevented.

The giardiasis outbreak in Washington is the first documented waterborne outbreak of giardiasis involving a filtered water supply. Treatment for the surface water source consisted of a mixed-media pressure filter and disinfection; no sedimentation was employed prior to filtration. In the outbreak, failure of the chlorination equipment occurred, and a number of deficiencies were noted in the installation and operation of the pressure filters, including ineffective pretreatment or conditioning of filters with appropriate chemicals. Water filtration theory indicates that organisms the size of *Giardia* cysts should be removed by conventional sand filters; however, effective pretreatment of the water prior to filtration must be accomplished. Conventional treatment of surface water generally includes coagulation/flocculation and settling prior to filtration or if the settling process is not used the addition of appropriate chemicals for conditioning of the filter media. Pressure filters are generally utilized for iron and manganese removal and for a number of reasons are generally not considered effective for microbiological treatment. The data to date would indicate that well operated conventional treatment plants employing coagulation/flocculation, settling, and filtration are successful in preventing outbreaks of this disease.

Fig. 1 WATERBORNE DISEASE OUTBREAKS, 1976

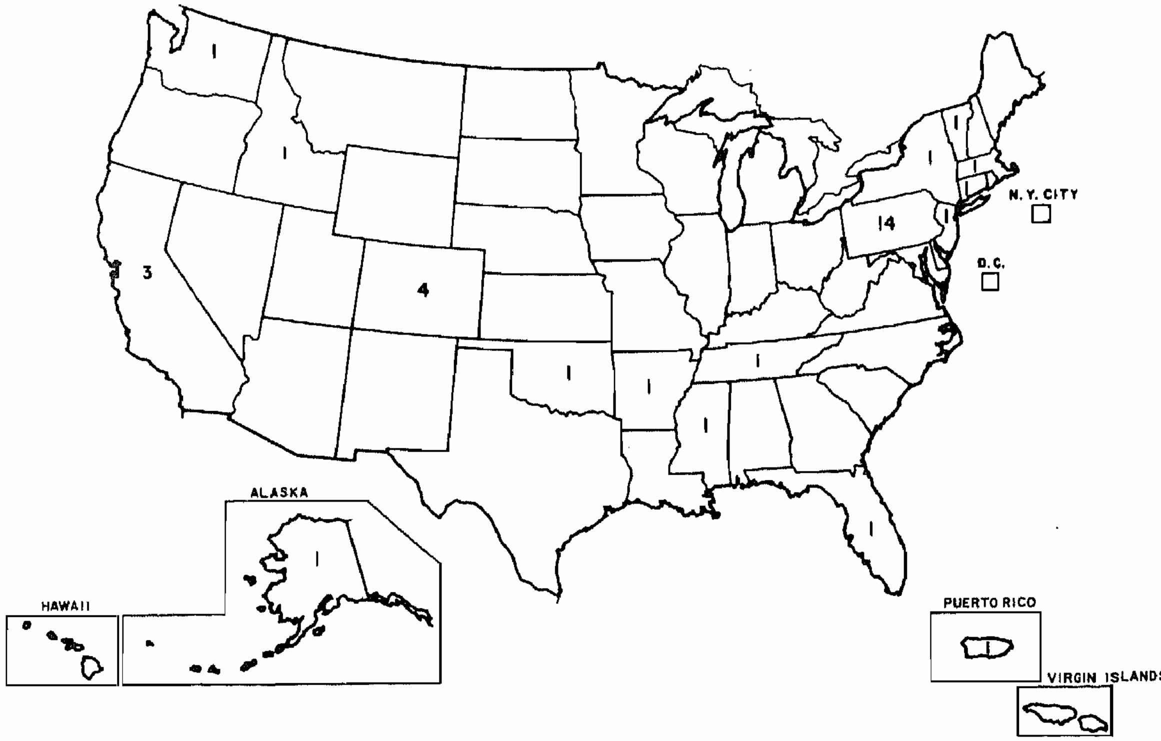
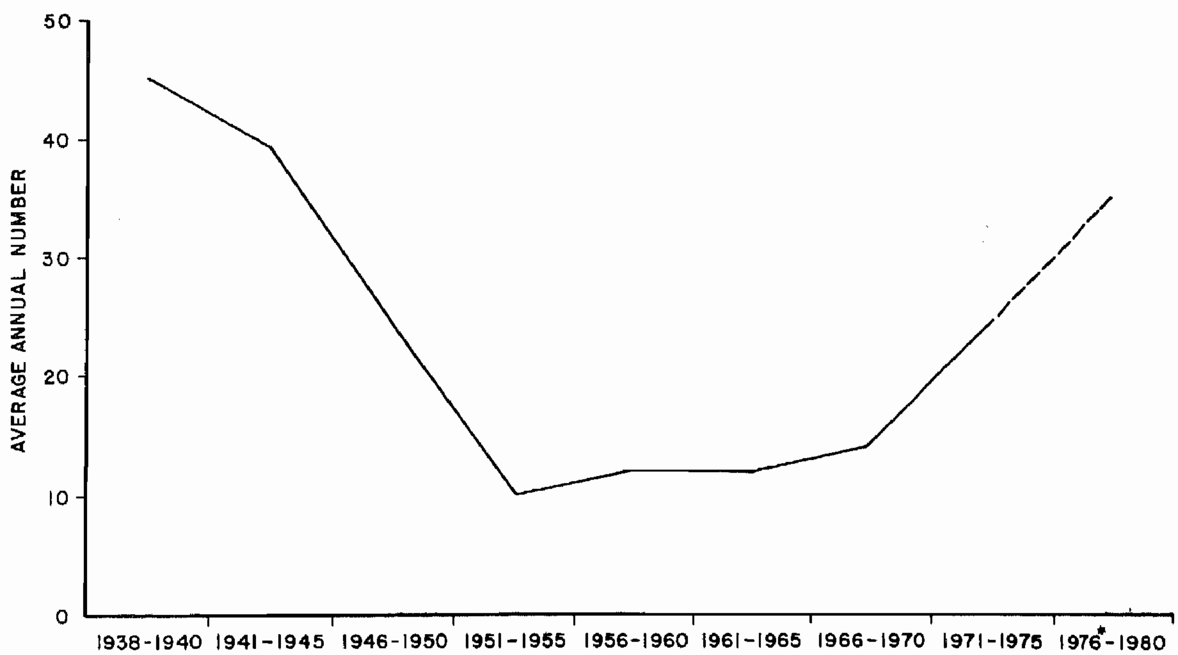


Fig. 2 AVERAGE ANNUAL NUMBER WATERBORNE DISEASE OUTBREAKS, 1938 - 1976



*NUMBER CASES FOR 1976 ONLY

Table 1

Waterborne Disease Outbreaks,
1972--1976

	1972	1973*	1974*	1975	1976	Total
Outbreaks	29	26	25	24	35	139
Cases	1,638	1,774	8,356	10,879	5,068	27,715

*Revised totals

Table 2

Waterborne Disease Outbreaks, by Etiology and
Type of Water System, 1976

	MUNICIPAL		SEMIPUBLIC		INDIVIDUAL		TOTAL	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
Acute gastro-intestinal illness	4	229	21	1,216	1	24	26	1,469
Chemical poisoning	1	13	0	0	2	22	3	35
Giardiasis	1	600	2	39	0	0	3	639
Shigellosis	2	2,175	0	0	0	0	2	2,175
Salmonellosis	1	750	0	0	0	0	1	750
Enterotoxigenic *E. coli*	0	0	0	0	0	0	0	0
Hepatitis	0	0	0	0	0	0	0	0
TOTAL	9	3,767	23	1,255	3	46	35	5,068

Table 3

Waterborne Disease Outbreaks, by Type of System, and Cause
of System Deficiency, 1976

	MUNICIPAL		SEMIPUBLIC		INDIVIDUAL		TOTAL	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
Untreated surface water	1	25	2	39	1	24	4	88
Untreated ground water	2	77	11	790	1	20	14	887
Treatment deficiencies	3	2,900	8	362	0	0	11	3,262
Deficiencies in distribution system	2	763	1	60	1	2	4	825
Miscellaneous	1	2	1	4	0	0	2	6
TOTAL	9	3,767	23	1,255	3	46	35	5,068

Table 4

Waterborne Disease Outbreaks Involving Semipublic Water Supplies, by Month, and Population Affected, 1976

Month	Number of Outbreaks	Usual Population*	Visitors**
January	-	-	-
February	1	1	-
March	-	-	-
April	3	2	1
May	3	1	2
June	7	2	5
July	5	-	5
August	1	-	1
September	-	-	-
October	1	-	1
November	1	-	1
December	1	-	1
TOTAL	23	6	17

*Outbreaks affecting individuals using the water supply on regular basis

**Outbreaks affecting individuals not using the water supply on a regular basis

Table 5

Waterborne Disease Outbreaks, by Month of Occurrence, 1976

Month	Number of Outbreaks	Month	Number of Outbreaks
January	0	July	7
February	2	August	2
March	2	September	0
April	4	October	3
May	5	November	2
June	7	December	1

TOTAL 35

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
BUREAU OF EPIDEMIOLOGY
ATLANTA, GEORGIA 30333

E. INVESTIGATION OF A WATERBORNE OUTBREAK

FORM APPROVED
OMB NO. 68-R557

1. Where did the outbreak occur?

State ____________ (1-2) City or Town ____________ County ____________

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)

6. Duration of illness (hours):

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)*: (62-65)

- ☐ Well
- ☐ Spring
- ☐ Lake, pond
- ☐ River, stream

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

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

10. Point where contamination occurred: (66)

☐ Raw water source ☐ Treatment plant ☐ Distribution system

*See HSM 4.245 (NCDC) 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 4.461
2-75

This report is authorized by law (Public Health Service Act, 42 USC 241) and is also recommended by the Conference of State and Territorial Epidemiologists. While your response is voluntary, your cooperation is necessary for the understanding and control of the diseases.

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 roc
- ☐ 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. (Attach 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 Center for Disease Control, Atlanta, Georgia 30333.

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

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

CDC 4.461 (Back)
2-75

F. LINE LISTING OF WATERBORNE DISEASE OUTBREAKS, 1976

F. Line Listing of Waterborne Disease Outbreaks, 1976

State	Month	Disease	Cases	Type of System	Location of Outbreak	System Deficiency*
Alaska	August	*Shigella flexneri*	25	Municipal	Residence	1
Arkansas	July	Acute gastrointestinal illness	51	Semipublic	Camp	3
California	May	Acute gastrointestinal illness	60	Semipublic	Camp	4
California	May	Acute gastrointestinal illness	46	Municipal	Resort	2
California	July	Acute gastrointestinal illness	2	Municipal	Sewage Plant	5
Colorado	February	Giardiasis	12	Semipublic	Office, Residence	1
Colorado	May	Acute gastrointestinal illness	10	Semipublic	Restaurant	2
Colorado	June	Giardiasis	27	Semipublic	Camp	1
Colorado	December	Acute gastrointestinal illness	110	Semipublic	Camp	3
Connecticut	June	Acute gastrointestinal illness	300	Semipublic	Country Club	2
Florida	November	Acute gastrointestinal illness	31	Municipal	Residence	2
Idaho	June	Acute gastrointestinal illness	100	Semipublic	Camp	2
Massachusetts	July	Acute gastrointestinal illness	18	Semipublic	Park	2

Mississippi	October	Polychlorinated Biphenyls (PCB's)	20	Individual	Residence	2
New Jersey	October	Acute gastrointestinal illness	104	Semipublic	Restaurant	2
New York	March	Salmonella typhimurium	750	Municipal	Resort	4
Oklahoma	April	Acute gastrointestinal illness	65	Semipublic	School	2
Pennsylvania	April	Acute gastrointestinal illness	4	Semipublic	Recreational area	5
Pennsylvania	April	Acute gastrointestinal illness	30	Semipublic	Country Club	3
Pennsylvania	April	Lead poisoning	2	Individual	Residence	4
Pennsylvania	May	Acute gastrointestinal illness	35	Semipublic	Country Club	3
Pennsylvania	June	Acute gastrointestinal illness	10	Semipublic	Recreational area	2
Pennsylvania	June	Acute gastrointestinal illness	26	Semipublic	School, Church	3
Pennsylvania	June	Acute gastrointestinal illness	34	Semipublic	Camp	3
Pennsylvania	June	Acute gastrointestinal illness	5	Semipublic	Recreational area	2
Pennsylvania	July	Acute gastrointestinal illness	10	Semipublic	Restaurant	3
Pennsylvania	July	Acute gastrointestinal illness	150	Semipublic	Restaurant	2

*(1) Untreated surface water (2) Untreated ground water (3) Treatment deficiencies (4) Distribution system deficiencies (5) Miscellaneous

State	Month	Disease	Cases	Type of System	Location of Outbreak	System Deficiency*
Pennsylvania	July	Acute gastrointestinal illness	18	Semipublic	Restaurant	2
Pennsylvania	August	Acute gastrointestinal illness	10	Semipublic	Restaurant	2
Pennsylvania	October	Acute gastrointestinal illness	24	Individual	Residence	1
Pennsylvania	November	Acute gastrointestinal illness	66	Semipublic	Restaurant	3
Tennessee	March	Chlordane (pesticide)	13	Municipal	Residence	4
Vermont	February	Acute gastrointestinal illness	150	Municipal	Residence	3
Washington	May	Giardiasis	600	Municipal	Residence	3
Puerto Rico	July	*Shigella sonnei*	2,150	Municipal	Residence	3

*(1) Untreated surface water (2) Untreated ground water (3) Treatment deficiencies (4) Distribution system deficiencies (5) Miscellaneous

G. Selected Waterborne Outbreak Articles, 1976, Taken from Morbidity and Mortality Weekly Report

Waterborne Giardiasis Outbreaks--Washington, New Hampshire (MMWR 26(21):169, 1977

Two waterborne outbreaks of giardiasis have been reported to CDC in the past year. One occurred in Camas, Washington (pop. 6,000), in the spring of 1976; in this outbreak 128 people had laboratory-confirmed giardiasis. The other outbreak, still ongoing, is in Berlin, New Hampshire (pop. 15,000), where 205 people to date have developed confirmed giardiasis.

Camas: On May 6, 1976, the laboratory section of the Washington State Department of Social and Health Services contacted CDC to report a large number of Giardia-positive stools from Camas. Only 2 people from Camas had been stool-positive for Giardia in 1975, whereas the same laboratory had reported 32 positives in April and May of 1976. The 32 patients' residences were scattered throughout the town, and they had limited interpersonal contact, suggesting waterborne transmission. Therefore, an area of the city where half of the residents received Camas city water and the other half used private well water was chosen for a preliminary survey. Six of the 38 users of city water compared to none of 40 users of private water had an illness compatible with giardiasis ($p=0.01$), implicating waterborne transmission. A larger study was undertaken to define the extent and character of the outbreak.

Two mutually exclusive groups were investigated: those people who were ill and spontaneously sought medical care (hereafter called confirmed cases) and those people who were interviewed during a survey and found to be ill (clinical cases). The confirmed cases consisted of 128 people who voluntarily contacted their physicians reporting a diarrheal illness and were stool-positive for Giardia. Analysis of data obtained from confirmed cases and their medical records revealed that diarrhea for 10 or more days was the single statistically significant symptom. Among confirmed cases, the outbreak began during the first week in April and peaked the first week in May. The outbreak spontaneously declined on May 10, and on May 15 the city switched to well water exclusively to prevent any further exposures by surface water.

The second group consisted of the respondents to a randomized community questionnaire survey administered to 496 Camas residents and 318 residents in an adjacent control town (receiving only well water). Because diarrhea of 10 or more days was characteristic of confirmed cases it was used as the case definition to interpret the survey questionnaires. Nineteen people (4%) of Camas respondents fit the case definition for giardiasis; none did in the control town ($p=0.01$). Thus, at least 240 persons (clinical cases) were ill with giardiasis in Camas. The stools of 18 people - 9 well and 9 ill with any diarrheal illness - were examined; no viral or bacterial pathogens were found. Two of the ill persons (22%) and 1 of the not ill (11%) were stool-positive for G. lamblia. Giardiasis was not associated with pet ownership, travel, or recreational activities such as swimming which involve raw water.

Camas has 2 water sources - a pair of mountain streams and a set of deep wells. Those residents living in areas receiving less than 70% surface water (more than 30% well water) reported no cases, while those receiving more than 70% surface water had an attack rate of 4.7%. Giardia cysts were recovered from the raw surface water entering the city's water treatment plant. Because the city chlorinated and filtered its surface water supplies in a closed pressurized system, flocculation efficiency was marginal. Sedimentation could not be used. Giardia cysts were also recovered from 2 reservoirs holding water which had already passed through the water treatment facility (finished water). Deep well water used by the city was not contaminated. An investigation of the watershed revealed 2 remote mountain streams in a fenced area with no evidence of human contamination. Several animals near the watershed were trapped. Trapping yielded 9 negative animals (including coyote, opossum, nutria, porcupine, and beaver) and 3 positive beavers. The beavers lived in a pond bordering a heavily used state park, but were within foraging distance of the water intakes for Camas.

Berlin: On April 19, 1977, a medical technologist at a local hospital in Berlin called CDC to report that 10 cases of giardiasis had been diagnosed in the past 9 days. By April 26, New Hampshire had reported a total of 90 cases in comparison to no cases of giardiasis reported in Berlin in the previous 5 years. Because cases were randomly distributed throughout the community, waterborne transmission was suspected.

Again, 2 groups were investigated: those people who were ill, voluntarily sought medical care, and were stool-positive (confirmed cases) and those people who were interviewed during a survey and were found to be ill (clinical cases). As of May 20, there were 205 confirmed cases. The outbreak began on April 8 and peaked on April 25. On April 22, Berlin residents were instructed to boil drinking water, and the city increased its level of chlorination. However, approximately 5 people per day continue to be diagnosed as stool-positive for G. lamblia.

A randomized community questionnaire survey was done in Berlin (692 surveyed) and in an adjacent control town (286). One hundred sixty-five people (24%) in Berlin and 31 people (11%) in the control town reported diarrheal illness. However, because analysis of confirmed cases is not yet complete, the case definition for giardiasis in this outbreak has not been established. Therefore, the percentage of diarrheal illness attributable to Giardia infection has not yet been determined.

Berlin uses 2 rivers for its water supply: The Amonoosuc and the Androscoggin. People receiving Amonoosuc River water and those receiving Androscoggin River water had similar attack rates of diarrheal illness (23% vs. 27%, respectively). Giardia cysts have been recovered from the raw water from both rivers. Giardia cysts were recovered from 3 sites within the distribution system, including the regional hospital.

An investigation of the watershed revealed that the Amonoosuc River is a small stream located in the White Mountain National Forest. However, access is not restricted, and an estimated 3,000 people used the area for recreational activities during October, November, and December 1976. The water is chlorinated and filtered under pressure without sedimentation or flocculation. The physical plant is 30 years old, and 3 of its filters were badly worn. The Androscoggin River receives untreated sewage effluent from a number of homes in 2 communities upstream from Berlin. Because of the known sewage contamination of the Androscoggin, a new water treatment plant was put in service on March 10, 1977. However, because of cross connections secondary to faulty construction and difficulty creating the proper weight floc, the new plant was ineffective. The town is repairing the plant.

Editorial Note: An outbreak of giardiasis in Rome, New York, in the spring of 1975 was the first laboratory-documented epidemic of waterborne giardiasis in the United States; it affected over 4,800 people (MMWR 24:(43), 1977). The outbreak the following spring in Camas, where at least 240 people developed giardiasis, again demonstrated the ability of Giardia organisms to cause citywide outbreaks of diarrhea. Significant morbidity was demonstrated, as the illness produced was characterized by prolonged diarrhea ($\geq$ 10 days).

In Rome, the absence of filtration and optimum chlorination left the city unprotected against waterborne giardiasis. In Camas and in Berlin (on the Amonoosuc), pressure filters without sedimentation and proper flocculation failed to remove Giardia cysts. The Androscoggin water treatment plant in Berlin has sedimentation flocculation and rapid sand filters; however, flocculation difficulties and cross connections between unfiltered and finished water decreased the plant's effectiveness. Nevertheless, it has been shown that properly functioning sedimentation, flocculation, and filtration will remove particles the size of Giardia cysts from water, and thus can provide safe drinking water in distribution systems utilizing surface water (1).

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Probable Viral Gastroenteritis--Colorado
(MMWR 26(3):13, 1977)

An outbreak of probable waterborne viral gastroenteritis occurred during the week before Christmas among vacationers at a winter resort near Granby, Colorado. Over 700 persons were registered at the camp during the outbreak. Of 208 surveyed thus far, 53% reported symptoms of nausea, vomiting, or diarrhea. Secondary transmission appears to have occurred.

Most visitors left the camp on December 22 or 23 aboard charter buses with final destinations in Arkansas, Colorado, Mississippi, Missouri, Nebraska, and Texas. Explosive diarrhea and vomiting aboard the buses caused some groups to seek medical attention in hospital emergency rooms along the way. One group from Jackson, Mississippi, stopped in Dallas, Texas, where 60 members were seen in a single emergency room within several hours. A Beaumont, Texas, group stopped in a Denver, Colorado, hospital with approximately half its members ill with gastroenteritis. Six of the emergency room nurses caring for this group developed similar symptoms within 24 hours.

The only complete data gathered to date have been obtained from a questionnaire survey of camp personnel to which over 90% responded. The attack rate among them was 51%, with a sharp peak in the number of cases on December 23 (Figure 3). No significant differences were found between males and females. Meals consumed in the 3-camp dining rooms, serviced by a central kitchen, could not be implicated. The most common symptoms were vomiting (77%) and diarrhea (66%). Nausea without vomiting occurred in 14% (Table 6). There was no mortality. The secondary attack rate among family members of camp staff appeared to be greater than 25%. Numerous stool specimens were negative for common bacterial enteric pathogens.

Because of the widespread nature of the epidemic in the 2,500-acre camp, the occurrence of most cases over a 48-hour period, and the lack of correlation with food consumption, waterborne disease was considered. The camp is supplied with water by a natural spring in a meadow at low elevation. Water is pumped from the spring upward to the camp, and finally to a reservoir which is at still higher elevation. During heavy usage periods, the reservoir is capable of supplying water to 30 cabins by gravity. The pump house over the spring is located at the base of a small hill on top of which is located a private cabin with an attached septic tank, installed in 1959. Interviews with maintenance personnel revealed that on December 22 they discovered malfunctioning of the chlorinator and subsequently turned it off for several hours while making repairs.

On January 6 a survey of 100 guests at the camp revealed an incidence of gastroenteritis of 14% over the preceding 4-day period. Fluorescein dye flushed into the cabin sewage system rapidly appeared in the spring and in the camp tap water. The septic tank, covered by 2 feet of soil and set in fractured shale and decomposed granite, was subsequently unearthed, and a 3" x 4" hole was found in the leaching pipe several feet from its exit from the tank and directly above the pump house, at a distance of about 50 feet.

On the next day it was recommended that the camp's main water system (derived from the spring) be shut off and an auxiliary well chlorinated to provide potable water to the core buildings. All of the outlying cabins were closed. The septic tank was removed and daily monitoring of coliform count and chlorine residual was instituted.

The investigation is continuing to characterize the disease among visitors and to determine the extent of secondary transmission. Viral laboratory studies are also pending.

Editorial Note: Investigation of waterborne outbreaks of gastroenteritis often does not reveal an etiologic agent. From 1961 through 1972, gastroenteritis unassociated with known pathogens accounted for 45% of 49 municipal waterborne outbreaks investigated by CDC. The 1968 outbreak of gastroenteritis in Norwalk, Ohio, was theorized on epidemiologic grounds to be waterborne (1). In 1971 the causative agent, a parvovirus, was identified by electronmicroscopy after transmission to volunteers. However, waterborne viral gastroenteritis has not been documented by recovery of virus from primary cases or from water.

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Fig. 3 PROBABLE VIRAL GASTROENTERITIS, COLORADO, DECEMBER 1976

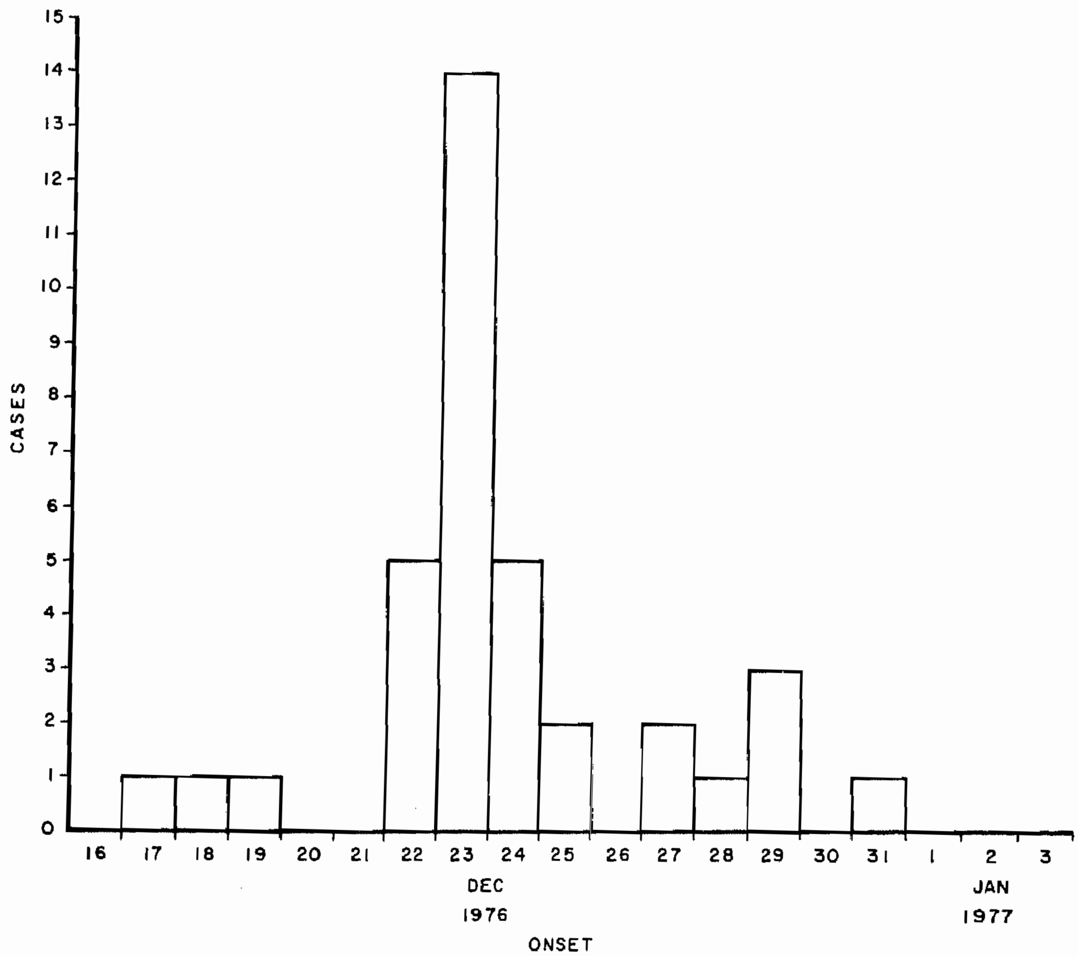

Table 6

Clinical Symptoms in 36 Camp Staff with Gastroenteritis

Symptoms	% Ill
Vomiting	77
Diarrhea	66
Muscle Aches	49
Headache	43
Dizziness	40
Abdominal Cramps	37
Fever	34
Chills	31
Nausea Without Vomiting	14
Bloody Diarrhea	0

IV. OUTBREAKS ON CRUISE SHIPS AND AIRCRAFT

This report summarizes data on outbreaks of gastrointestinal illness on cruise ships or aircraft that were reported to CDC in 1976.

A. Definition of Outbreak

Diarrheal illness on passenger vessels (vessels with 13 or more passengers) are reported by the Quarantine Stations to the Enteric Diseases Branch if 1) three percent or more of passengers or crew are ill; 2) one or more passengers or crew members is ill and the vessel has been in a cholera-infected area within the previous 5 days; 3) there has been a death or hospitalization aboard the vessel in a person who had a diarrheal illness.

After such an incident is reported, the need for a full investigation is determined by the severity, timing, and magnitude of the problem. The outbreaks tabulated in this report (Table 7) are the incidents that have been fully investigated by CDC. These investigations usually included questionnaire surveys of passengers and crew, detailed evaluation of sanitation, and laboratory analysis of food, water, environment, and patient specimens. The Quarantine Division evaluated 6 additional incidents with medical log reviews and environmental inspections only.

Table 7

Outbreaks of Gastrointestinal Illness on Cruise Ships, 1976

Vessel	Date	Port	Length of Cruise (Days)	Number of Passengers	Percent of Passengers Ill	Etiology	Vehicle
A	June	Miami	14	745	35%	Unknown	Unknown
B	September	Miami	14	582	56%	Unknown	Water

B. Analysis of Data

In 1976 diarrhea outbreaks were investigated on 2 cruises (Table 7) and 1 aircraft (Table 8). The shipboard outbreaks occurred on the same ship during 2 separate Caribbean cruises (June and September). The investigation of the September cruise demonstrated coliform bacteria (TNTC) in the potable water system. Sewage contamination of the bunkered potable water had occurred. Potable water samples taken both before and after passing the U.V. light purifying system were found contaminated with coliform bacteria. There was no direct explanation for the coliform bacteria in the potable water system immediately after it passed through the U.V. system. Two possible explanations for this contamination were: 1) undiscovered cross connections existed in the potable water lines that by-passed the U.V. system (unlikely), or 2) coliform bacteria survived passage through the U.V. system.

Table 8

Outbreaks of Gastrointestinal Illness Aboard Aircraft, 1976

Aircraft	Date	Point of Embarkation	Point of Disembarkation	Number of Passengers	Percent of Passengers Ill	Etiology	Vehicle
A	6-20	Rio de Janeiro, Brazil	New York City, New York	185	15	Staphylococcal enterotoxin type D	Chocolate eclairs

The 1 reported outbreak on an aircraft took place on an American carrier enroute from Rio de Janeiro, Brazil, to New York City. Chocolate eclairs, consumed aboard the flight, were found to be contaminated with type D staphylococcal enterotoxin; they were prepared in Rio de Janeiro, and had been left unrefrigerated for 10 hours before being placed aboard the aircraft. A diversionary stop in San Juan, Puerto Rico, was necessary to discharge ill passengers.

The marked decline in cruise vessel diarrheal outbreaks (8 in 1975) may be attributed to the cruise vessel sanitary inspection program which has been rigorously administered since 1974. All vessels with a home port in the United States receive a semiannual inspection. Vessels failing to meet the U.S. Public Health Service Standards are reinspected frequently until standards are achieved. Vessels meeting the standards have unscheduled spot inspections between semiannual inspections to insure that high sanitary standards are maintained.

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