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. Their 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 gastrointestinal 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 liquid vehicles 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 1975 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, Yersinia enterocoliticus, Citrobacter, Enterobacter, Klebsiella, Pseudomonas, and the presumably viral agents of acute infectious non-bacterial gastroenteritis. Other pathogens such as Escherichia coli and Bacillus cereus 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. Yersinia enterocolitica, 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 planning.

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 staph), 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 the 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 F) 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, 1975

This report summarizes data on waterborne disease outbreaks reported to CDC in 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. No standard reporting form is used but one has recently been devised and is presently being field tested in 8 states (see Section E). In addition, the Water Supply Research Laboratory, Environmental Protection Agency (EPA), contacts all state water supply agencies to obtain information about additional outbreaks. Personnel from CDC and EPA work together in the evaluation and investigation of waterborne disease outbreaks. When requested by a state health department, CDC and EPA can offer epidemiologic assistance and provide expertise in the engineering and environmental aspects of water purification. Data obtained on outbreaks are reviewed and summarized by representatives from CDC and EPA. A line listing of reported waterborne disease outbreaks in 1975 is included (see Section F).

In this report municipal systems are public or investor owned water supplies that may serve either large or small communities. Individual water systems, generally wells or springs, are used exclusively by single residences in areas that are without municipal systems. Semi-public water systems, also found in areas without municipal systems, are developed and maintained for use by several residences (e.g. subdivisions), industries, camps, parks, resorts, institutions, hotels, and other establishments at which the general public is likely to have access to drinking water.

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 defieicncies in water systems that most frequently result in outbreaks. As in the past the pathogen(s) responsible for many outbreaks in 1975 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 1975, 24 waterborne disease outbreaks involving 10,879 cases were reported to CDC (Table 1). No etiologic agent was found for the 2 largest outbreaks: 1 in Sewickley, Pennsylvania, and 1 in Sellersburg, Indiana. The third largest outbreak, involving over 1,000 persons, occurred at Crater Lake National Park, Oregon. Toxigenic *Escherichia coli*, serotype O6:H16, was isolated from ill park residents and from the park's water supply.

Table 1

Waterborne Disease Outbreaks, 1972--1975

	1972	1973	1974	1975	Total
Outbreaks	29	24	28	24	105
Cases	1,638	1,720	8,413	10,879	22,650

Figure 1 shows the geographic distributions of outbreaks by state. Fourteen states and Puerto Rico reported at least 1 outbreak.

Figure 2 depicts the trend in reported waterborne disease outbreaks over the last 3 decades. Although the number of outbreaks reported in 1975 was less than in 1974, the number of cases has continued to increase (Table 1).

Table 2 shows the number of outbreaks and cases by etiology and type of water system. The category with the most outbreaks is designated "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." The 3 chemical outbreaks were due to fuel oil, herbicide, and ethyl acrylate. One outbreak each was caused by G. lamblia, S. sonnei, enterotoxigenic E. coli, and hepatitis A. There were no reported deaths associated with waterborne disease outbreaks in 1975.

Most outbreaks involved semi-public (67%) and municipal (25%) water systems, and fewer involved individual (8%) systems. Outbreaks attributed to water from municipal systems affected an average of 1,218 persons compared with 221 persons in outbreaks involving semi-public systems and 13 persons in outbreaks associated with individual water systems. Of the 16 outbreaks associated with semi-public water supplies, 11 (69%) involved visitors to areas used mostly for recreational purposes.

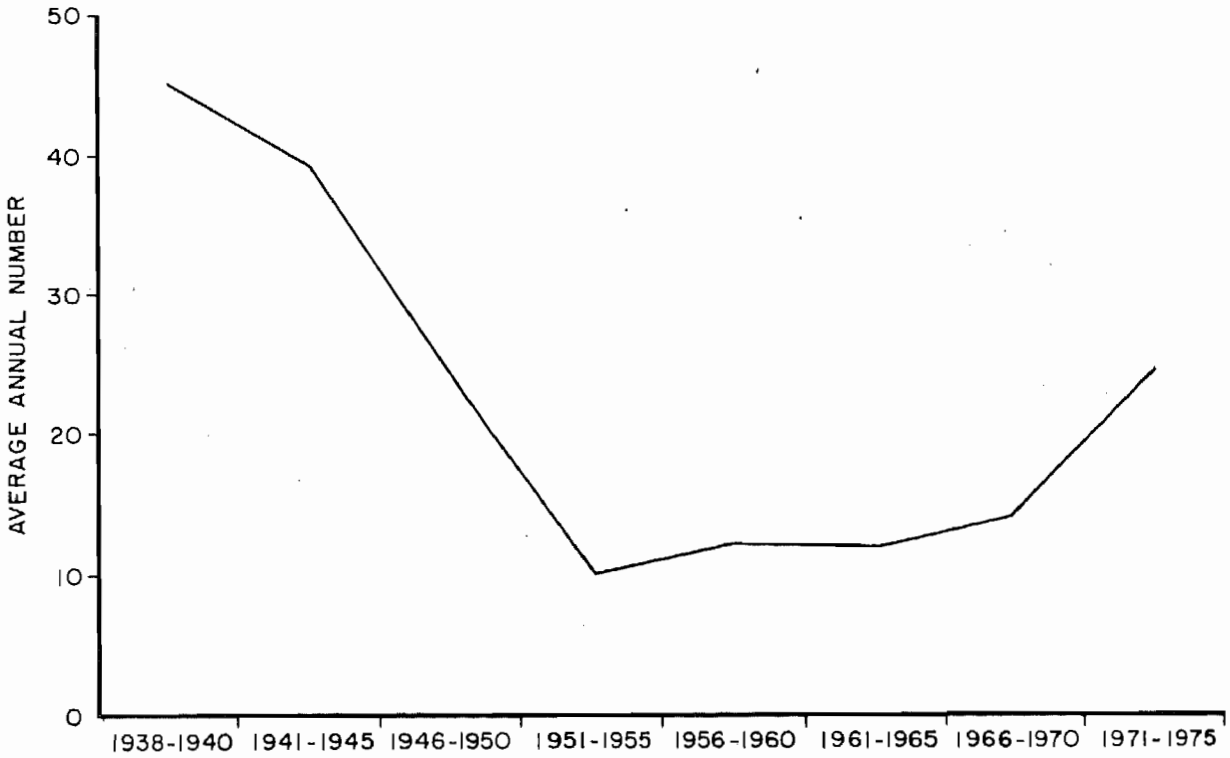
Fig. 1 WATERBORNE OUTBREAKS, 1975

Table 2

Waterborne Disease Outbreaks, by Etiology and Type of Water System, 1975

	MUNICIPAL		SEMI-PUBLIC		INDIVIDUAL		TOTAL	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
Acute gastro-intestinal illness	4	7,300	13	2,460	-	-	17	9,760
Chemical poisoning	2	11	1	26	-	-	3	37
Giardiasis	-	-	-	-	1	9	1	9
Shigellosis	-	-	1	56	-	-	1	56
Enterotoxigenic E. coli	-	-	1	1,000	-	-	1	1,000
Hepatitis	-	-	-	-	1	17	1	17
Total	6	7,311	16	3,542	2	26	24	10,879

Fig. 2 AVERAGE ANNUAL NUMBER WATERBORNE DISEASE OUTBREAKS, 1938-1975



In Table 3, outbreaks and cases are classified by type of water system and the system deficiency responsible for the outbreak. Treatment deficiencies were responsible for the most outbreaks, however, deficiencies in the distribution systems of 5 municipal water supplies were responsible for the highest number of cases.

Table 3

Waterborne Disease Outbreaks, by Type of System, and Cause of System Deficiency, 1975

	MUNICIPAL		SEMI-PUBLIC		INDIVIDUAL		TOTAL	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
Untreated surface water	-	-	1	7	2	26	3	33
Untreated ground water	-	-	5	774	-	-	5	774
Treatment deficiencies	-	-	8	2,695	-	-	8	2,695
Deficiencies in distribution system	5	6,961	-	-	-	-	5	6,961
Miscellaneous	1	350	2	66	-	-	3	416
TOTAL	6	7,311	16	3,542	2	26	24	10,879

The distribution of all outbreaks by month is shown in Table 4. As in the past, outbreaks tended to occur in the spring and summer; 17 (71%) of the outbreaks began in May, June, July, August, and September. All 11 outbreaks in recreational areas occurred in the spring and summer months, May to September (Table 5).

Table 4

Waterborne Disease Outbreaks, by Month of Occurrence, 1975

Month	Number of Outbreaks	Month	Number of Outbreaks
January	1	July	3
February	1	August	4
March	1	September	2
April	2	October	2
May	2	November	0
June	6	December	0
	Total 24		

Table 5

Waterborne Disease Outbreaks Involving Semi-Public Water Supplies, by Month and Population Affected, 1975

Month	Number of Outbreaks	Usual Population*	Visitors**
January	1	1	-
February	-	-	-
March	-	-	-
April	-	-	-
May	2	1	1
June	5	1	4
July	3	-	3
August	3	1	2
September	1	-	1
October	1	1	-
November	-	-	-
December	-	-	-
TOTAL	16	5	11

*Outbreaks affecting individuals using the water supply on a regular basis

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

In addition to outbreaks due to consumption of water, 2 outbreaks of leptospirosis were attributed to swimming in contaminated surface water. Seven children in Tennessee developed infection with Leptospira interrogans serotype grippotyphosa after swimming in a small local stream. Two persons in Louisiana became infected with leptospires of the serotype icterohaemorrhagiae after bathing in a man-made lake.

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

Pretest

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

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 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

F. Line Listing of Waterborne Disease Outbreaks, 1975

State	Month	Disease	Cases	Type of System	System Deficiency*
Arkansas	June	Acute gastrointestinal illness	500	Semi-public	3
Arkansas	August	Acute gastrointestinal illness	23	Semi-public	3
California	May	Acute gastrointestinal illness	80	Semi-public	3
California	June	Acute gastrointestinal illness	900	Semi-public	3
California	July	Acute gastrointestinal illness	19	Semi-public	3
Idaho	September	Giardiasis	9	Individual	1
Indiana	April	Acute gastrointestinal illness	1,400	Municipal	4
Louisiana	May	Fuel oil poisoning	26	Semi-public	5
Massachusetts	February	Hepatitis	17	Individual	1
Minnesota	June	Acute gastrointestinal illness	136	Semi-public	3
Montana	August	Shigella sonnei	56	Semi-public	2
New Jersey	January	Acute gastrointestinal illness	390	Semi-public	2
New Jersey	April	Acute gastrointestinal illness	350	Municipal	5
New Jersey	June	Lawn herbicide	4	Municipal	4
Ohio	June	Acute gastrointestinal illness	140	Semi-public	2

Oregon	June	Enterotoxigenic *Escherichia coli*	1,000	Semi-public	3
Oregon	September	Acute gastrointestinal illness	7	Semi-public	1
Pennsylvania	July	Acute gastrointestinal illness	88	Semi-public	2
Pennsylvania	August	Acute gastrointestinal illness	37	Semi-public	3
Pennsylvania	August	Acute gastrointestinal illness	5,000	Municipal	4
Pennsylvania	October	Acute gastrointestinal illness	100	Semi-public	2
Puerto Rico	March	Acute gastrointestinal illness	550	Municipal	4
South Carolina	October	Ethyl acrylate	7	Municipal	4
Tennessee	July	Acute gastrointestinal illness	40	Semi-public	5

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

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 1975.

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 1) 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, environmental, and patient specimens. The Quarantine Division evaluated 5 additional incidents with medical log reviews and environmental inspections only.

Table 1

Outbreaks of Gastrointestinal Illness on Cruise Ships, 1975

Vessel	Date	Port	Length Of Cruise (Days)	Number of Passengers	Percent of Passengers Ill	Etiology	Vehicle
A	February	Miami	7	742	42	Unknown	Unknown
B	February	Port Everglades	12	734	61	Vibrio parahaemolyticus	Shrimp
C	September	Miami	14	612	44	Unknown	Unknown
D	September	San Juan	7	559	31	Unknown	Unknown
E	November	Port Everglades	12	365	29	Unknown	Water
F	December	Honolulu	7	332	9	Unknown	Unknown
G	December	Los Angeles	52	62	43	Unknown	Unknown
H_1	December	Miami	4	836	Unknown	Escherichia coli 025	Unknown
H_2	January (76)	Miami	4	904	31		

B. Analysis of Data

In 1975 diarrhea outbreaks were investigated on 8 ships (Table 1) and 1 aircraft. Two successive voyages (H_1 and H_2) of 1 ship were involved in 1 outbreak. Seven of the 8 shipboard outbreaks were on Caribbean trips. The 1 outbreak on an aircraft took place after a stop in Alaska where the responsible food was prepared.

In most ship outbreaks neither the vehicle of transmission nor the etiology could be determined (Table 1). On vessel B Vibrio parahaemolyticus spread by contaminated shrimp caused the outbreak. On vessel H an enterotoxigenic Escherichia coli serotype 025 caused the outbreak; however, the vehicle was not determined. Staphylococcus aureus caused the aircraft outbreak.

Details of the V. parahaemolyticus outbreak were included in the 1974 Annual Summary. The following information on 2 ship outbreaks (vessels E and H) and the aircraft outbreak has been excerpted from the Morbidity and Mortality Weekly Report.

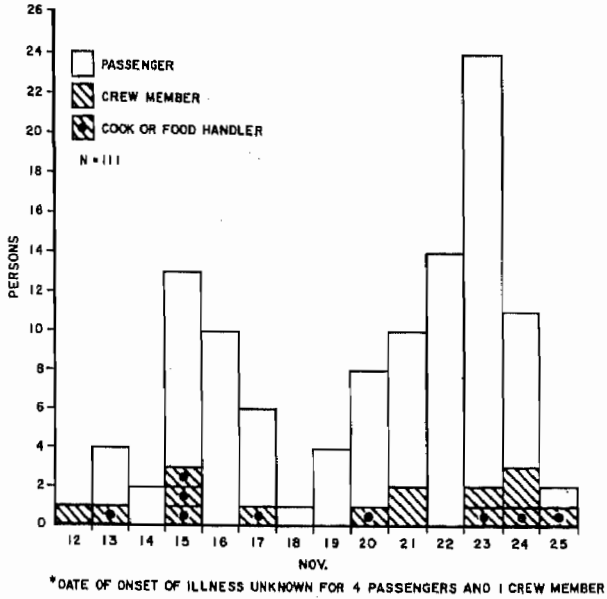
Diarrheal Illness Aboard a Cruise Ship
(MMWR 24(49):419, 1975)

On the November 13-25 cruise of Vessel E, 100 of 343 passengers (29.2%) and 16 of 256 crew members (6.3%) experienced a diarrheal illness. According to questionnaires

these 599 individuals answered at the completion of their journey, symptoms included abdominal cramps (49%), headache (35%), nausea (34%), vomiting (25%), and fever (17%). The median duration of illness was approximately 2 days. Twenty-nine percent of the ill passengers consulted the ship's medical staff, and 29% were confined to their cabins for at least 1 day because of illness.

One crew member became ill on November 12, the day before the cruise began. Three additional crew members and 9 passengers became ill before the ship's first stop on November 15 (Figure 1). Nine of the 16 crew members who developed diarrhea were food handlers; all but 1 of them continued to work in the kitchen while ill. The questionnaire, completed by 94% of the passengers, demonstrated a statistically significant association between illness and consumption of water aboard the ship (Table 2).

Fig. 1 ONSET OF ILLNESS AMONG PASSENGERS AND CREW, BY DATE, VESSEL E, NOVEMBER 1975



*DATE OF ONSET OF ILLNESS UNKNOWN FOR 4 PASSENGERS AND 1 CREW MEMBER

Cultures of rectal swabs obtained from ill and well passengers and crew on November 25 were negative for salmonellae, shigellae, and pathogenic vibrios. No coliform bacteria were found in samples from the ship's water distribution and storage system; however, the system had recently been chlorinated.

On October 20, 1975, the Center for Disease Control had conducted a routine sanitation inspection of the ship's facilities and found that the ship did not meet the minimum standards recommended by CDC. Multiple deficiencies were found in the potable water system. Among these were that: 1) the water was not chlorinated when it was pumped into the ship; 2) no free chlorine was detectable in the water distribution system; and 3) some potable water faucets were not adequately equipped to prevent back siphonage. The findings and recommendations of the inspection team were given to the ship's captain, the ship's agent, and the shipping company. On November 13, the day the cruise started on which the outbreak occurred, a follow-up inspection revealed that the deficiencies had not been corrected. The deficiencies were again called to the attention of the ship's captain.

Table 2

Association Between Illness and Average Daily Water Consumption Among Passengers, Vessel E, November 13-25, 1975

Glasses per Day	Ill*	Well	% Ill
0	7	41	14.6
≥1	91	164	35.7

Fishers 2-tail test p = .004

*Ill passengers were asked how much water they drank before the onset of illness.

A follow-up inspection conducted on December 6, 1975, before the Vessel E resumed its cruise schedule, revealed that the major deficiencies in the water system had been corrected, and the remaining items were being repaired.

Editorial Note

Epidemiologic investigation found an association between diarrheal illness and consumption of drinking water on board the ship. The multiple deficiencies in the water system noted on 2 previous inspections may have contributed to this outbreak.

Food

Diarrheal Illness on a Cruise Ship Caused by Enterotoxigenic Escherichia coli
(MMWR 25(29):229, 1976)

An outbreak of diarrheal illness occurred aboard Vessel H on 2 successive 4-day cruises from December 26, 1975, to January 2, 1976. A non-motile enterotoxigenic strain of Escherichia coli serotype 025 producing only heat-labile enterotoxin was isolated from passengers and crew on both cruises.

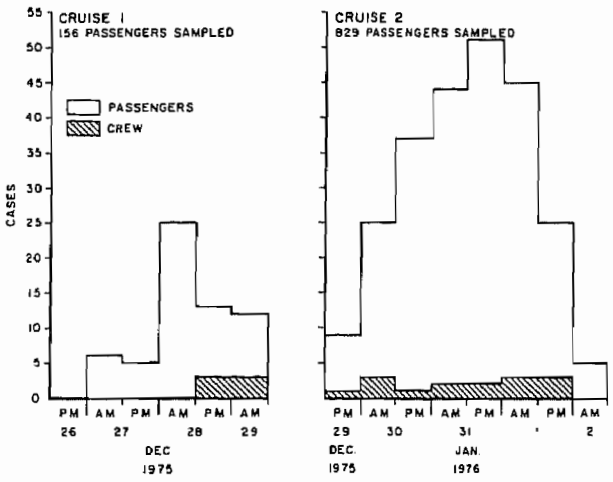
A limited survey of 156 (18%) of 863 passengers on voyage 1 and a more complete survey of 829 (92%) of 904 passengers on voyage 2 revealed that at least 64 passengers on voyage 1 and 259 (31%) passengers on voyage 2 had experienced a diarrheal illness during the voyage. Other symptoms experienced by the passengers included headache, nausea, vomiting, abdominal cramps, and fever (Table 3).

Table 3

Symptoms Associated with Diarrhea in Passengers on 2 Cruises, December 26, 1975 - January 2, 1976

Symptoms	Cruise 1 n=64	Cruise 2 n=259
Abdominal cramps	87%	83%
Nausea	81%	55%
Headache	60%	44%
Vomiting	39%	19%
Fever (subjective)	33%	25%

FIGURE 2. Diarrheal illness among passengers and crew, Vessel H*



*339 crew sampled

The median duration of illness on both cruises was 2 days; however, many passengers were still ill at the time of the surveys. Illnesses began as early as 12 hours after boarding and both outbreaks peaked in 36-48 hours (Figure 2).

Crew members were not surveyed on cruise 1; however, 4 members were treated for diarrhea by the ship's physician. Twenty-six (7.7%) of 339 crew members surveyed on cruise 2 reported diarrhea; 5 of the crew members handled food or beverages while ill.

Passengers on cruise 2 were asked about food and water consumption during the first 24 hours of the cruise. Analysis revealed an association between diarrhea and eating crabmeat cocktail ($p<.001$). Consumption of 1 or more glasses of water per day was also associated with illness ($p<.05$). On cruise 1, no association between ship's water or ice and illness could be demonstrated. An environmental survey revealed numerous deficiencies in food handling practices.

Non-motile enterotoxigenic Escherichia coli, serotype 025, producing heat-labile (LT) enterotoxin, was isolated from 29 (83%) of 35 ill passengers and 6 (40%) of 15 well passengers from the 2 voyages ($p<.01$). Two of 8 culture-positive passengers had a 4-fold rise in LT enterotoxin antibody titer when acute and convalescent sera were tested. Fourteen (88%) of 16 ill crew were infected with E. coli 025 compared with 1 (7%) of 14 well crew members ($p<.0001$).

Salmonella senftenberg was isolated from 2 passengers (who did not have E. coli 025) on cruise 1 and from liver pate and cooked lobster on the same cruise. Water, ice, environmental cultures, and food specimens were negative for E. coli.

To correct the deficiencies in food and drink handling practices, the line employed a sanitarian to institute and supervise proper food handling practices. Investigation also revealed that refrigeration on the vessel was deficient and that freshly distilled water was not being chlorinated, although the main water distribution system was adequately chlorinated. After refrigeration facilities were improved and an automatic chlorinator for the distillation system was installed, the vessel sailed on its next voyage on January 3. No outbreaks of diarrhea have been reported in subsequent cruises of the vessel.

Editorial Note

Enterotoxigenic Escherichia coli is a well documented cause of diarrheal illness; however, this is the first reported outbreak caused by E. coli producing only LT enterotoxin. The mode of transmission in this outbreak is unclear.

S. senftenberg possibly contributed to the outbreak on cruise 1. The most likely vehicle of transmission was contaminated food since the same organism was recovered from 2 food items that were eaten without additional cooking.

Outbreak of Staphylococcal Food Poisoning Aboard an Aircraft
(MMWR 24(7):57, 1975)

On February 2, 1975, 196 (57%) of 343 passengers and 1 of 20 crew members aboard a chartered commercial aircraft flying from Tokyo to Copenhagen, with an interim stop in Anchorage, developed a gastrointestinal illness characterized by diarrhea (88%), vomiting (82%), abdominal cramps (74%), and nausea (68%). The illness began occurring shortly before the plane landed in Copenhagen after an 8½ hour flight from Anchorage. One hundred forty-three (73%) of the ill passengers and the 1 crew member were hospitalized in Copenhagen. Approximately 30 passengers required intravenous fluids, but there were no deaths or serious sequelae.

A snack was served aboard the flight approximately 1 hour after the plane left Anchorage; breakfast was served approximately 5½ hours later, 1½-2 hours before the plane landed in Copenhagen. Four galleys were used to prepare food and all passengers received the same food.

Epidemiologic investigation revealed that 115 (86%) of 133 passengers sitting in the front of the plane and served food prepared in galleys 1 and 2 were ill, compared with 81 (39%) of 210 passengers sitting in the area served food prepared in galleys 3 and 4 ($p<.001$). Food specific attack rates demonstrated a statistically significant association between illness and consumption of ham at the breakfast meal (Table 4). The ham had been served on top of cheese omelettes. Cases occurred 30 minutes to 5½ hours after eating the breakfast meal with a mean of about 2.5 hours (Figure 3).

Except for the 1 crew member who ate ham, none of the crew aboard the aircraft, including the pilots, became ill. Since it was suppertime for the crew, which had boarded in Anchorage, they were served a steak dinner instead of the breakfast meal. Some of the crew ate the same snack as the passengers.

The snack and breakfast were prepared in Anchorage by a catering company owned by the airline. Three cooks were involved in the preparation of the ham and omelettes. Cooks No. 1 and No. 2 and assistant No. 1 worked from 11:00 a.m. to 1:30 p.m. on February 1. They first cracked and mixed 120 dozen eggs. Cook No. 2 then made 133 omelettes for use in galleys 1 and 2, and cook No. 1 placed ham slices on these omelettes. This ham had been sliced and fried the previous day by assistant No. 1 and refrigerated overnight. Cook No. 1 then made 72 omelettes for use in galleys 3 and 4, and cook No. 2 put ham slices on these omelettes.

Table 4

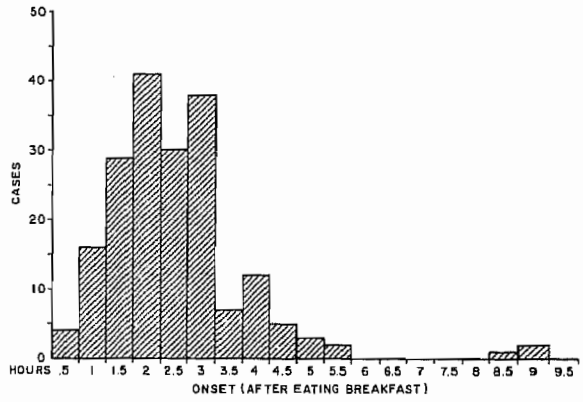
Food Specific Attack Rates

Food	Persons Eating Food			Persons Not Eating Food		
	Ill	Not Ill	Percent Ill	Ill	Not Ill	Percent Ill
Snack:						
Tuna	125	119	51	67	28	71
Roast	148	127	54	44	20	69
Chicken	127	120	51	65	27	71
Shrimp	163	128	56	29	19	60
Choc. Cake	115	104	53	77	43	64
Breakfast:						
Omelette	169	133	56	23	14	62
*Ham	190	139	58	2	8	20
Yogurt	147	98	60	45	49	49
Roll	166	135	55	26	12	68
Butter	137	130	51	55	17	76
Cheese	103	94	52	89	53	63

*Fisher's two-tail P = .023

Cook No. 3 and assistant No. 2 worked from 2:00 p.m. to 5:00 p.m. Cook No. 3 made omelettes for the remaining passengers served by galleys 3 and 4, and assistant No. 2 placed ham slices on these omelettes. The ham and omelettes were stored at room temperature during the 6 hours required for preparation. Following preparation, this food was placed for 14½ hours in a holding room where the temperature was measured at 10°C (50°F) before and after the outbreak. Beginning about 7:30 a.m. the next day, the snack and breakfast food were loaded onto the plane. The snack was refrigerated, but the breakfast food was stored at room temperature in the galley ovens until it was heated just prior to serving.

Fig. 3 FOODBORNE OUTBREAK ON AN AIRCRAFT, FEBRUARY 1975



Coagulase-positive Staphylococcus aureus lysed by group III phages 53 and 83a was isolated from an inflamed lesion on a finger on the right hand of Cook No. 1, from fecal and other specimens from 5 ill patients, from 3 leftover ham samples, and from 2 leftover omelette samples. S. aureus with the same phage pattern was also isolated from the wrist of cook No. 3 and the nose of assistant No. 2. S. aureus lysed by group 1 phages 29, 52, 80, 81, and 85 was isolated from 1 patient, from 1 of the omelette samples, and from the nose of cook No 2. Assistant No. 1 was negative for S. aureus. The antibiogram patterns of the 2 S. aureus phage types were different. At the U.S. Food and Drug Administration Laboratories the phage group III strain was found to produce type D enterotoxin, while the phage group I strain did not produce enterotoxin. Type D enterotoxin was isolated from leftover ham and omelette.

Editorial Note

This large foodborne outbreak resulted from ham that had been handled by a cook who had an inflamed finger lesion from which S. aureus was cultured. The ham was then held at room temperature for a sufficient amount of time to allow growth of S. aureus

and enterotoxin production. Staphylococcal enterotoxin is heat stable and not readily destroyed at ordinary cooking temperatures (1). S. aureus carriage may be found in up to 50% of foodhandlers and is especially high in persons with skin infections; however, this outbreak probably would not have occurred had the food been handled properly. Food served aboard aircraft should be refrigerated prior to heating and serving. Food handlers on the ground and crew members who work in aircraft galleys should be educated in proper foodhandling techniques and particularly in the risks involved in storing food at room temperature for prolonged periods.

This outbreak emphasizes the importance of serving pilots different food from that of the passengers and each other just before and during a flight.

Reference

1. Bergdoll MS: Enterotoxins: Microbial Toxins. Volume III: Bacterial Protein Toxins, Edited by Montie TC, Kadis S, Ajl SJ: New York and London, Academic Press, 1970, p 265

V. REFERENCES

GENERAL

1. Foodborne Infections and Intoxications, Riemann H (ed). Academic Press, NY, 1969
2. Food Research Institute: Annual Report for 1974, University of Wisconsin-Madison, Wisconsin
3. Bryan FL: Emerging foodborne diseases. I. Their surveillance and epidemiology. II. Factors that contribute to outbreaks and their control. J Milk Food Technol 35:618-625, 632-638, 1972
4. Craun GF, McCabe LJ: Review of the causes of waterborne disease outbreaks. J Am Water Work Assoc 65:74-84, 1973

BACTERIAL

Bacillus cereus

1. Goepfert JM, Spira WM, Kim HU: Bacillus cereus: Food poisoning organism. A review. J Milk Food Technol 35:213-227, 1972
2. Mortimer PR, McCann G: Food poisoning episodes associated with *Bacillus cereus* in fried rice. Lancet 1:1043-1045, 1974

Brucella

1. Spink WW: The Nature of Brucellosis. Minneapolis, Lund Press, Inc., 1956

Clostridium botulinum

1. Center for Disease Control: Botulism in the United States, 1899-1973. Handbook for Epidemiologists, Clinicians, and Laboratory Workers, CDC, Atlanta, June 1974, pp 7-11
2. Cherington M: Botulism. Ten-year experience. Arch Neurol 30:432-437, 1974
3. Koenig MG, Drutz DJ, Mushlin AI, et al: Type B botulism in man. Am J Med 42:208-219, 1967
4. Koenig MG, Spichard A, Cardella MA, et al: Clinical and laboratory observations of type E botulism in man. Medicine 43:517-545, 1964

Clostridium perfringens

1. Bryan FL: What the sanitarian should know about *Clostridium* foodborne illness. J Milk Food Technol 32:381-389, 1969
2. Lowenstein MS: Epidemiology of *Clostridium perfringens* food poisoning. N Engl J Med 286(19):1026-1027, 1972

Escherichia coli

1. Marier R, Wells JG, Swanson RC, Callahan W, Mehlman IJ: An outbreak of enteropathogenic *Escherichia coli* foodborne disease traced to imported French cheese. Lancet 2:1376-1378, 1973
2. Sack RB: Human diarrheal disease caused by enterotoxigenic *Escherichia coli*. Annual Review of Microbiology 29:333-353, 1975

Salmonella

1. Aserkoff B, Schroeder SA, Brachman PS: Salmonellosis in the United States--A five-year review. Am J Epidemiol 92:13-24, 1970

2. Bryan FL: What the sanitarian should know about salmonellae and staphylococci in non-dairy foods. II. Salmonellae. J Milk Food Technol 31:131-140, 1968

Shigella

1. Donadio JA, Gangarosa EJ: Foodborne shigellosis. J Infect Dis 119: 666-668, 1969

Staphylococcus

1. Bryan FL: What the sanitarian should know about salmonellae and staphylococci in non-dairy foods. I. Staphylococci. J Milk Food Technol 31:110-116, 1968
2. Merson MH: The epidemiology of staphylococcal foodborne disease. Proceedings of the Staphylococci in Foods Conference, Pennsylvania State University, University Park, Pennsylvania, 1973, pp 20-37
3. Minor TE, Marth EH: Staphylococcus aureus and staphylococcal food poisoning. J Milk Food Technol 34:21-29, 77-83, 227-241, 1972, 35:447-476, 1973

Group A Streptococcus

1. Hill HR, Zimmerman RA, Reid GVK, Wilson E, Kitton RM: Foodborne epidemic of streptococcal pharyngitis at the United States Air Force Academy. N Engl J Med 280:917-921, 1969

Vibrio cholerae

1. Finkelstein RA: Cholera. CRC Critical Reviews in Microbiology 2(4):553-623, 1973
2. Gangarosa EJ, Mosley WH: Epidemiology and surveillance of cholera: Cholera, edited by Barua D, Burrows W. Philadelphia, London, Toranto, WB Saunders Co., 1974, p 381

Vibrio parahaemolyticus

1. International Symposium on Vibrio parahaemolyticus, September 17-18, 1973, Fujino, Sakaguchi G, Sakazaki R, Takeday, (ed). Saikon Publishing Co., Ltd., Tokyo, Japan, 1974
2. Barker WH: Vibrio parahaemolyticus outbreaks in the United States. Lancet 1:551-554, 1974

CHEMICAL

Heavy Metal

Cadmium

1. Baker TD, Hafner WG: Cadmium poisoning from a refrigerator shelf used as an improvised barbecue grill. Public Health Rep 76:543-544, 1961

Copper

1. Hopper SH, Adams HS: Copper poisoning from vending machines. Public Health Rep 73:910-914, 1958
2. Semple AB, Parry WH, Phillips DE: Acute copper poisoning: An outbreak traced to contaminated water from a corroded geyser. Lancet 2:700-701, 1960

Tin

1. Barker WH, Runte V: Tomato juice-associated gastroenteritis. Washington and Oregon, 1969. Am J Epidemiol 96:219-226, 1972

Zinc

1. Brown MA, Thom JV, Orth GL, et al: Food poisoning involving zinc contamination. Arch Environ Health 8:657-660, 1964

Ichthyosarcotoxin

Ciguatoxin

1. Barkin RM: Ciguatera poisoning: A common-source outbreak. South Med J 67(1): 13-16, 1974
2. Halstead BW, Courville DA: Poisonous and venomous marine animals of the world. Vol 2 - Vertebrates. Washington, GPO, 1967, pp 63-330

Puffer Fish (tetrodotoxin)

1. Halstead BW, Courville DA: Poisonous and venomous marine animals of the world. Vol 2 - Vertebrates. Washington, GPO, 1967, pp 679-844
2. Torda TA, Sinclair E, Ulyatt DB: Puffer fish (tetrodotoxin) poisoning: Clinical record and suggested management. Med J Aust 1:599-602, 1973

Scombrotoxin

1. Halstead BW, Courville DA: Poisonous and venomous marine animals of the world. Vol 2 - Vertebrates. Washington, GPO, 1967, pp 639-668
2. Kimata M: The histamine problem: Fish as Food, edited by Borgstrom E, New York, Academic Press, 1961, pp 329-352
3. Merson MH, Baine WB, Gangarosa EJ, Swanson RC: Scombroid fish poisoning: Outbreak traced to commercially canned tuna fish. JAMA 228:1268-1269, 1974

Monosodium Glutamate

1. Schaumburg HH, Byck R, Gerstl R, Mashman JH: Monosodium L-glutamate: Its pharmacology and role in the Chinese restaurant syndrome. Science 163:826-828, 1969

Mushroom Poison

1. Wieland T, Wieland O: The toxic peptides of Amanita species. Vol 8 - Fungal Toxins: Microbial Toxins, edited by Kadis S, Ciegler A, Ajl SJ, New York and London, Academic Press, 1972, pp 249-280
2. Benedict RG: Mushroom toxins other than Amanita. Vol 8 - Fungal Toxins. In Microbial Toxins, edited by Kadis S, Ciegler A, Ajl SJ, New York and London, Academic Press, 1972, pp 281-320
3. Tyler VE: Poisonous mushrooms: Progress in Chemical Toxicology. Vol 1, edited by Stolman A, New York, Academic Press, 1963, pp 339-384

Paralytic and Neurotoxic Shellfish Poison

1. Music SI, Howell JT, Brumback CL: Red tide: Its public health implications. J Fla Med Assoc 60:27-29, 1973
2. Halstead BW, Courville DA: Poisonous and venemous marine animals. Vol 1 - Invertebrates. Washington, GPO, 1965, pp 157-240

PARASITIC

Anisakidae

1. Chitwood MD: Nematodes of medical significance found in market fish. Am J Trop Med Hyg 19:599-602, 1970

T. spiralis

1. Gould SE: Trichinosis in man and animals. Springfield, Ill., Charles C. Thomas, 1970
2. Zimmerman WJ, Steele JH, Kagan IG: Trichinosis in the U.S. population 1966-1970--prevalence and and epidemiologic factors. Health Services Rep 88:606-623, 1973

G. lamblia

1. Petersen H: Giardiasis (lambliasis). Scand J Gastroenterol 7 (Suppl 14): 1-44, 1972
2. Schultz MG: Giardiasis. JAMA 233(13):1383-1384, 1975

T. gondii

1. Kean BH, Kimball AC, Christensen WN: An epidemic of acute toxoplasmosis. JAMA 208:1002-1004, 1969

VIRAL

Hepatitis A

1. Cliver DO: Implications of foodborne infectious hepatitis. Public Health Rep. 81:159-165, 1966
2. Gravelle CR, Hornbeck CL, Maynard JE, et al: Hepatitis A: Report of a common-source outbreak with recovery of a possible etiologic agent. II. Laboratory studies. J Infect Dis 131:167-171, 1975
3. Leger RT, Boyer KM, Pattison CP, et al: Hepatitis A: Report of a common-source outbreak with recovery of a possible etiologic agent. I. Epidemiologic studies. J Infect Dis 131:163, 1975

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