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Epidemic Shiga Bacillus Dysentery in Central America. II. Epidemiologic Studies in 1969

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Shigella dysenteriae type 1, the classic Shiga bacillus, has long been recognized as an organism of unusual virulence capable of causing widespread outbreaks of dysentery [1, 2]. In the late nineteenth and early twentieth centuries, numerous outbreaks with high morbidity and mortality were reported in most of the continents of the world. Since 1920, this microbe, for unknown reasons, has virtually disappeared from the world [3].

In an accompanying article, Mata et al. [4] describe the clinical manifestations and laboratory parameters of a regional epidemic of Shiga bacillus dysentery in Central America, which was recognized in Guatemala in 1969 and later in neighboring countries. This report describes epidemiologic studies for the delineation of the mode of transmission and the surveillance program established in Guatemala in 1969.

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Background

In Central America, as in most of the developing areas of the world, diarrheal diseases are among the most important causes of morbidity and mortality, especially in infants and children. Several bacterial and viral agents have been incriminated, especially various serotypes of the genus *Shigella*. Although *S. dysenteriae* 1 was rarely isolated in Central America before 1969, numerous reports, reviewed by Mata et al. [4], indicated that transmission of this organism was sporadic and at a low level. Occasional individual cases of diarrheal disease and small outbreaks since 1916 attested to the existence of a long-standing endemic focus, which has become epidemic. Reports of epidemic dysentery were first received by the Ministry of Health of Guatemala in late December 1968 from the department (state) of Chimaltenango in South Central Guatemala (figure 1). Throughout 1969 and early in 1970 an increasing number of villages, towns, and cities throughout Guatemala and neighboring countries appealed to their ministries of health for drugs and medical assistance to control widespread community outbreaks.

For the purpose of this investigation, dysentery is defined as diarrhea with blood and mucus in the stool. Although the disease has a wide spectrum of signs and symptoms, severe cases usually start abruptly with diarrhea, followed in 12–48 hr by blood and pus in the stool. From 10 to 40 daily evacuations occur at the height of illness. Fever, tenesmus, and/or cramps in the lower abdomen are very common. The duration of symptoms in most patients is 5–7 days, although a few patients have been ill for a period as short

Figure 1. Departments of Guatemala reporting outbreaks of dysentery by date, 1968–1969.

as 48 hr and others for months. Milder cases and asymptomatic infections have been recognized.

Many patients died in 1969, but the mechanism of death was not determined. Physicians and nurses accustomed to seeing sporadic cases of amebiasis understandably misdiagnosed the current malady as amebic dysentery. This confusion was widespread and lasted for months in each of the countries affected. Vigorous treatment of patients with the sometimes toxic antiamebic drugs contributed to the high mortality. The situation was complicated further by the resistance of the organism to chemotherapeutic drugs commonly used for treatment of bacillary dysentery [4]. Late in 1969 and early in 1970, as physicians generally became aware of the epidemic and its true etiology, appropriate treatment was instituted promptly and brought about earlier recovery and fewer deaths in spite of the increasing number of cases reported.

Method of Investigation

Transmission Studies

Epidemiologic studies were conducted in 2 Guatemalan communities, Pueblo Nuevo, a highland village in the department of Suchitepaquez, and El Coco, in the department of Jutiapa in the Pacific Coastal plain on the main highway to El Salvador. A third community, Tecun Uman, in the department of San Marcos on the Mexican border, was selected also for a serologic study of convalescent patients and household contacts (figure 1).

Pueblo Nuevo was selected because numerous cases were occurring at the time of a reconnaissance of the area in early November, 1969. It was 6 miles from the nearest paved road and served as a market place for surrounding villages. The Mayan Indian inhabitants were mostly farmers and foresters. Some homes had electricity, and approximately ⅓ had latrines, although they were poorly constructed. Most people defecated on the ground. Flies were not prevalent in October–November 1969, at the height of the epidemic. Breast-feeding of infants was the usual practice.

The first step in the study was to map the town and divide it into blocks. Every inhabited dwelling in each block was visited by an interviewer. A census was taken, and information was obtained concerning a history of bloody diarrhea, with date of onset, in family members. Inquiries were also made concerning travel by family members, toilet facilities, common gatherings, water, and food supply. About 86% of the community was included in the survey.

El Coco was first investigated in August, 1969, as part of a serologic survey of affected communities in Guatemala. It was known that many cases and deaths due to dysentery had occurred there. Because of the severity of the epidemic, the town was visited a second time in November, 1969, for a more definitive epidemiologic study. The same survey methods used in Pueblo Nuevo were applied in El Coco. Although the population was Spanish-speaking and primarily ladino (mestizo), the town was poorer than Pueblo Nuevo. There was no electricity and only 1 dwelling had a latrine. Water was scarce and had to be carried long distances from 2 surface springs. Both springs were unsanitary; bare-bottomed children waded freely in them. The men worked as farmers or as foresters on nearby ranches and plantations. Breast-feeding of infants was usual. In this community, flies were prevalent in the summer months at the height of the epidemic.

Tecun Uman was the site of a large outbreak early in 1969. A serologic survey was conducted among persons known to have had dysentery and their household contacts. Individuals who had no personal or family history of dysentery served as controls. The passive hemagglutination test was used to measure antibodies against *S. dysenteriae* 1 by the method described by Lee et al. [5].

Surveillance Studies

Mortality data were collected from death registers, initially from 18 communities comprising about 200,000 people, or 4% of the population of Guatemala, and later from other departments of that country. Each municipality records deaths in a bound register, with a standard format. For burial of a body in a cemetery, a death certificate is required. Before a certificate can be obtained, the death must be registered. A member of the family customarily relates the symptoms of the deceased person to a registrar, who then lists the cause of death. For many illnesses the records are subject to considerable error, but dysentery or "disentería" is a well-recognized entity, and deaths resulting from dysentery are readily differentiated from deaths due to other causes.

Counts of cases of dysentery in tourists from the United States were made by the Shigella Surveillance Program, based on weekly laboratory reports to the National Communicable Disease Center from the 50 states of *Shigella* isolates by serotype, name, sex, age, and residence of the patient. Patients infected with *S. dysenteriae* 1 were investigated with special emphasis on where the infection had been acquired.

Results

Transmission Studies

Pueblo Nuevo. Cases of dysentery in 1969 were plotted by 2-week periods (figure 2). Most cases in Pueblo Nuevo occurred between October 8 and November 5. Four patients died during this period. Attack rates were determined by block (table 1); dysentery was reported from 18 of 26 blocks. Seven blocks had attack rates of close to 10% or higher. Four of these (blocks 8, 9, 10, and 12) were contiguous; the other 3 (blocks 3, 17, and 26) were in different areas of the town and were not contiguous. Twenty-four of 25 cases of dysentery in the contiguous blocks occurred in the 2 peak 2-week periods. In the other blocks with high attack rates, only 8 of 13 occurred during this period.

Dysentery spared infants under 6 months of age. The attack rate was highest in the age group 7–23 months and was found more or less equally in other age groups (table 2) and equally in both

sexes. The mean age of index cases in families where index cases could be identified was 20 years. Attack rates did not differ consistently with size of family and families with and without young children were affected. Families with latrines had attack rates comparable to those without latrines.

Because of the clustering of cases in place and time, a common-source exposure was considered in the contiguous blocks. All persons questioned denied taking part in common gatherings, and they reported that family foods came from many sources and were generally well cooked. The water supply of Pueblo Nuevo was a protected well several miles from the community and at a higher elevation. Water was distributed by underground pipes to various parts of the town. Only in the contiguous blocks (8, 9, 10, and 12) with high attack rates were the water pipes above ground. In these 4 blocks, half of all families in which cases occurred had 2 or more cases with onsets within a 48–hr period. It is probable that rainwater contaminated with feces entered the distribution system at joints in the pipes, where pools of water were frequently seen. Person-to-person spread could not be ruled out in other parts of town, and the fact that housewives used the same sink for washing clothes (including diapers) and cooking utensils may have led to some common-source family outbreaks. Flies could be ruled out as a source of contamination of food or water because very few were seen before and at the peak of the epidemic.

El Coco. It was difficult for people to remember the date of onset of illness in El Coco because most cases had occurred several months before the survey. Cases of dysentery were therefore plotted by month (figure 3). More than 30 cases per month were reported over the 4-month period, May through August, 1969. There were 207 cases, including 16 deaths. The overall attack rate was 33.7% compared with an attack rate of 6.0% in Pueblo Nuevo. Attack rates were determined by block (table 3); 12 of 20 blocks had attack rates of more than 30%; 3 blocks had attack rates of 10% or less. All areas of the town were affected.

Dysentery affected all age groups except infants under 6 months (table 4). The attack rates for males and females were not appreciably different. Families of all sizes were involved, as were families both with and without young children. Rates of dysentery were not higher for individuals who had traveled away from the community.

Although these findings suggest person-to-person spread in a poor population without sanitary facilities and with limited supplies of water, a continually contaminated common source such as the water supply could not be ruled out. Flies,

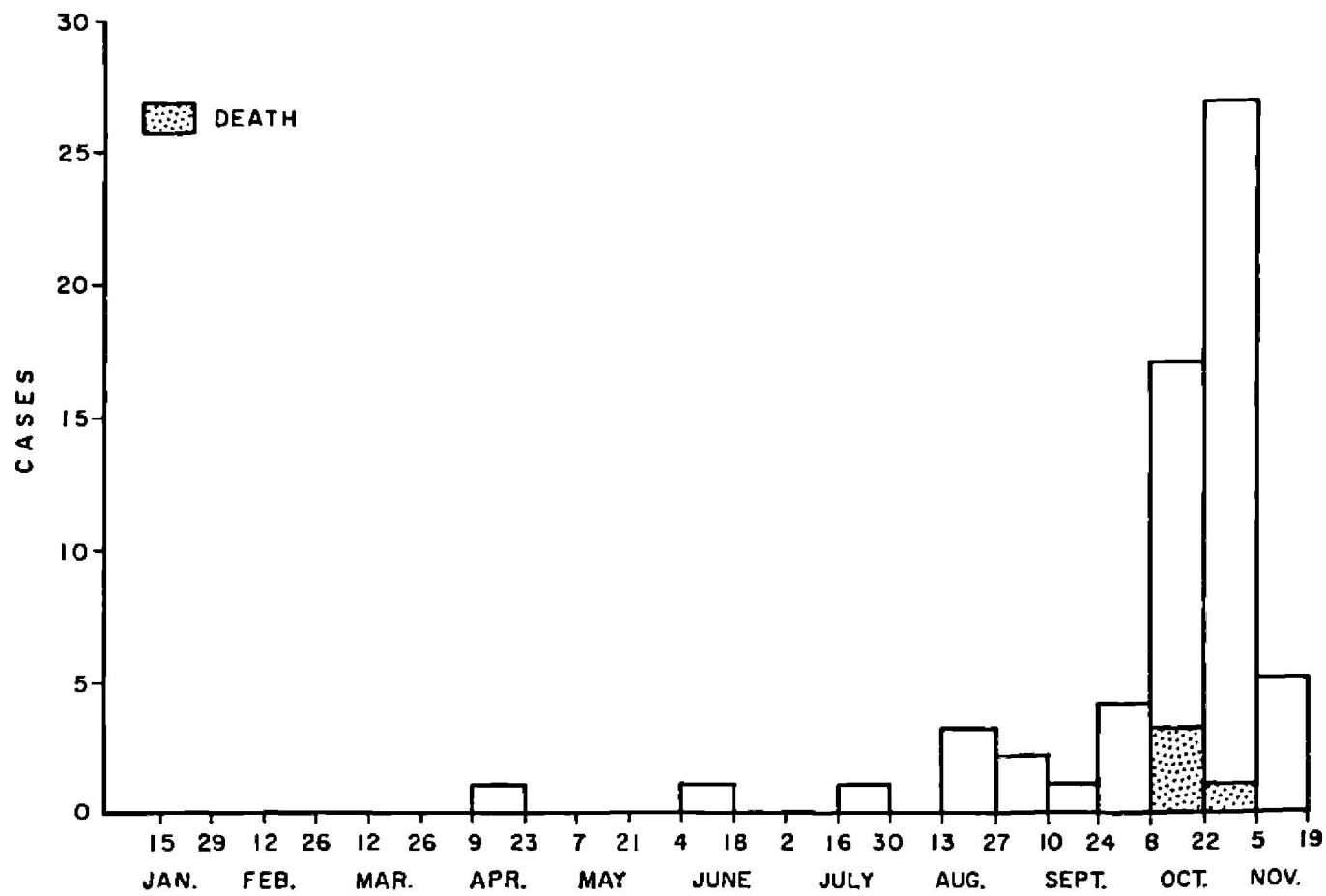

Figure 2. Cases of dysentery, by 2-week period, Pueblo Nuevo, 1969.

Table 1. Village of Pueblo Nuevo, attack rates of dysentery by block, 1969

Block no.	Census	No. ill	Attack rate (%)
1	65	0	0
2	89	5	5.6
3*	19	2	10.5
4	52	0	0
5	41	2	4.9
6	26	0	0
7	65	1	1.5
8†	15	2	13.3
9†	69	13	18.8
10†	61	6	9.8
11	24	1	4.2
12†	9	4	44.4
13	17	0	0
14	45	2	4.4
15	51	2	3.9
16	57	3	5.3
17*	29	3	10.3
18	33	0	0
19	76	4	5.3
20	22	1	4.5
21	30	2	6.7
22	35	0	0
23	28	0	0
24	20	0	0
25	16	1	6.3
26*	40	8	20.0
Total	1,034	62	6.0

* In these 3 noncontiguous blocks, only 8 of 13 cases occurred in October, the peak month of the epidemic.

† In these 4 contiguous blocks, 24 of 25 cases occurred in October.

which were abundant during the epidemic, could have played a role in transmission.

Survey in 3 communities. The serologic survey conducted in Pueblo Nuevo, El Coco, and Tecun Uman showed that asymptomatic household contacts of clinical cases had elevations in titer of antibody comparable to those seen in clinical cases (table 5), an observation suggesting that asymptomatic infections were at least as common as clinical cases.

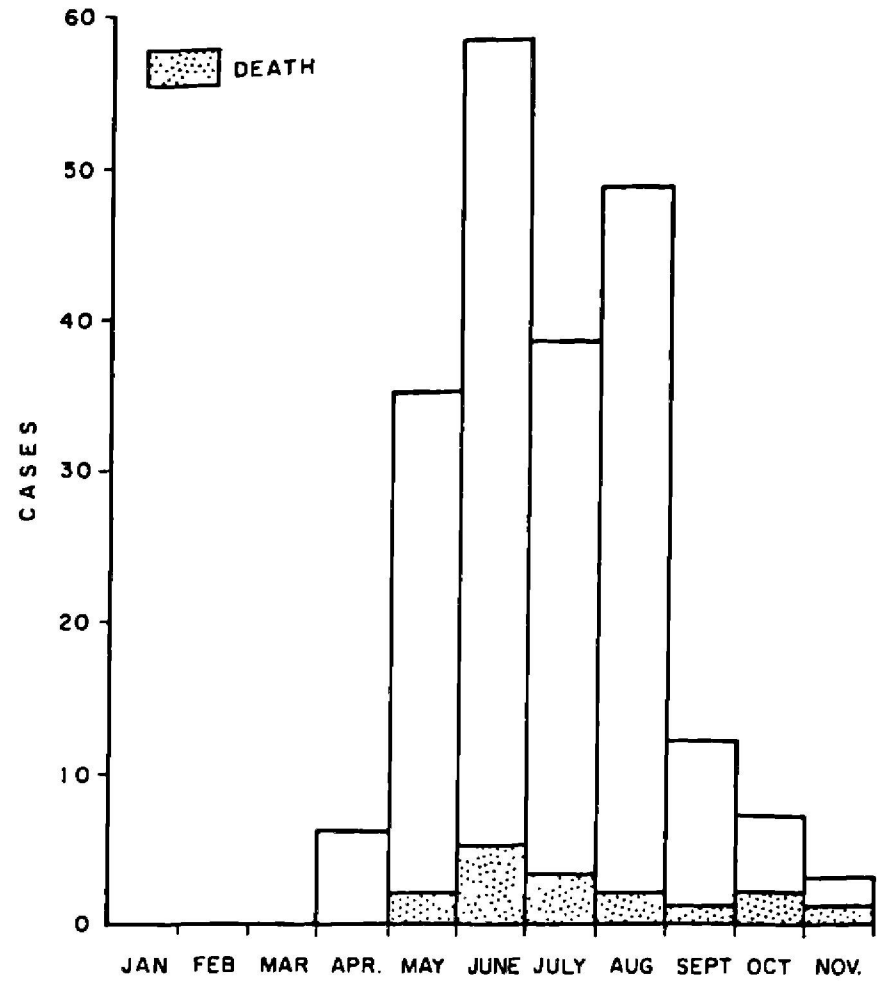

Figure 3. Cases of dysentery, by month, El Coco, 1969.

Surveillance Studies

Analysis of mortality registers in Guatemala. The mortality data collected from death registers are shown in table 6. Thirteen of the 18 communities surveyed had approximately 4-fold or greater increases in their death rate due to dysentery between 1968 and 1969. In 5 of these 13 communities no outbreak had been reported. If

Table 2. Village of Pueblo Nuevo, attack rate of dysentery by age and sex, 1969

	Male			Female		
Age	Census	No. ill	Attack rate (%)	Census	No. ill	Attack rate (%)
0–6 months	10	0	0	3	0	0
7–23 months	29	4	13.8	19	2	10.5
2–5 years	66	4	6.1	72	4	5.5
6–15 years	159	13	8.2	167	12	7.2
16–45 years	172	6	3.5	202	14	6.9
46+ years	62	3	4.8	61	0	0
Unknown	7	0	0	5	0	0
Total	505	30	5.9	529	32	6.0

these communities were representative of the country as a whole, approximately 8,300 deaths from dysentery occurred in Guatemala from January to October, 1969. Deaths during this period may actually have exceeded 10,000, as suggested by data presented in figure 4, which depicts deaths recorded in mortality registers in 205 of 325 municipalities comprising about ⅔ of the population. On the basis of an analysis of the case-fatality ratio in Pueblo Nuevo and El Coco, there were at least 112,000 clinical cases in the country during this same time.

Table 3. Village of El Coco, attack rates for dysentery by block, 1969

Block number	Census	No. ill	Attack rate (%)
1	10	5	50.0
2	29	4	13.8
3	15	0	0
4	25	7	28.0
5	10	0	0
6	53	23	43.4
8	47	13	27.7
9	69	19	27.5
10	17	9	52.9
10a	28	16	57.1
11	64	27	42.2
12	38	15	39.5
13	10	1	10.0
14	13	3	23.1
15	30	13	43.3
16	44	13	29.5
17	24	8	33.3
18	43	14	32.6
19	4	2	50.0
20	42	15	35.7
Total	615	207	33.7

Reports of laboratory isolates in the United States. The United States Shigella Surveillance Program has had reports of a number of cases of dysentery in tourists returning from the infected area. *S. dysenteriae* 1 was an extremely rare serotype, accounting for only a fraction of a percent of all isolates reported in the United States prior to 1969. A significant increase in the number and relative frequency of isolates became apparent late in 1969. In 1964–1968 only 8 isolations were reported. In 1969, there were 14, 11 of which were in the third quarter. During the first 5 weeks of 1970, there were 5 isolations (figure 5).

Travel and clinical histories were obtained from 16 persons who had onset of dysentery in 1968, 1969, or 1970 and from whom *S. dysenteriae* 1 had been isolated. Fifteen persons had become ill after traveling to Mexico and one after visiting in Central America. Seven of those who had traveled

Table 4. Village of El Coco, attack rates for dysentery by age and sex, 1969

	Male			Female		
Age	Census	Total ill	Attack rate (%)	Census	Total ill	Attack rate (%)
0–6 months	2	0	0	4	0	0
7–23 months	18	8	43.4	14	7	50.0
2–5 years	49	31	63.3	48	19	39.6
6–15 years	112	39	34.8	84	22	26.2
16–45 years	105	31	29.5	112	28	25.0
46+ years	36	8	22.2	29	12	41.4
Unknown	1	1	100.0	1	1	100.0
Total	323	118	36.5	292	89	30.5

Table 5. Serologic responses of Guatemalan villagers following exposure to *Shigella dysenteriae* type 1 in 1969

Name of community	Degree of exposure	Number studied	Number with titers ≥ 1:40	Percentage
Tecun Uman:	Cases	17	5	29
	Contacts	21	7	33
	Controls	11	0	0
Pueblo Nuevo:	Cases	28	10	36
	Contacts	15	4	27
	Controls	10	0	0
El Coco:	Cases	37	18	49
	Contacts	38	8	21

Table 6. Comparison of dysentery mortality in 1968 and 1969 in 18 Guatemalan communities

Community	Population	Dysentery deaths		Deaths/10,000	
		1968	1969*	1968	1969*
San Raimundo	11,000	3	19	2.7	17.0†
Villa Nueva	18,000	1	2	5.5	11.0
Amatitlán	15,000	1	23	0.7	15.0†
La Democracia	12,000	0	1	0	8.3
Palín	10,000	2	10	2.0	10.0†
Tecún Umán	3,000	1	13	3.3	43.0†
San Carlos	20,000	10	38	5.0	19.0†
Pueblo Nuevo	1,200	0	4	0	33.0†
Patulul	18,000	9	43	5.0	24.0†
Mazatenango	35,000	14	64	4.0	18.0†
Pochuta	10,443	11	33	10.0	36.0†
Asunción Mita	4,500	11	6	2.4	1.3
Aqua Blanca	10,474	0	1	0	1.0
Santa Catarina Mita	13,000	2	10	1.5	7.7†
Jutiapa	10,000	11	41	11.0	41.0†
Jalpataqua	1,600	1	11	6.2	69.0†
San Andrés	1,000	0	1	0	10.0
Flores	4,500	0	7	0	16.0†
Total	198,717	77	332	3.9	17.0

NOTE.—Observations: (*1*) Percentage of total population surveyed $\frac{198{,}717}{5{,}000{,}000} = 4\%$. (*2*) Estimated national mortality from January to October, 1969 = 8,300. (*3*) Estimated number of cases in Guatemala for the first 10 months of 1969 based on a case-fatality ratio of 7.4% as determined by house-to-house surveys in 2 communities is 112,000.

* Based on January–October data only.

† Number of communities surveyed with increased mortality in 1969 vs 1968 = 13/18.

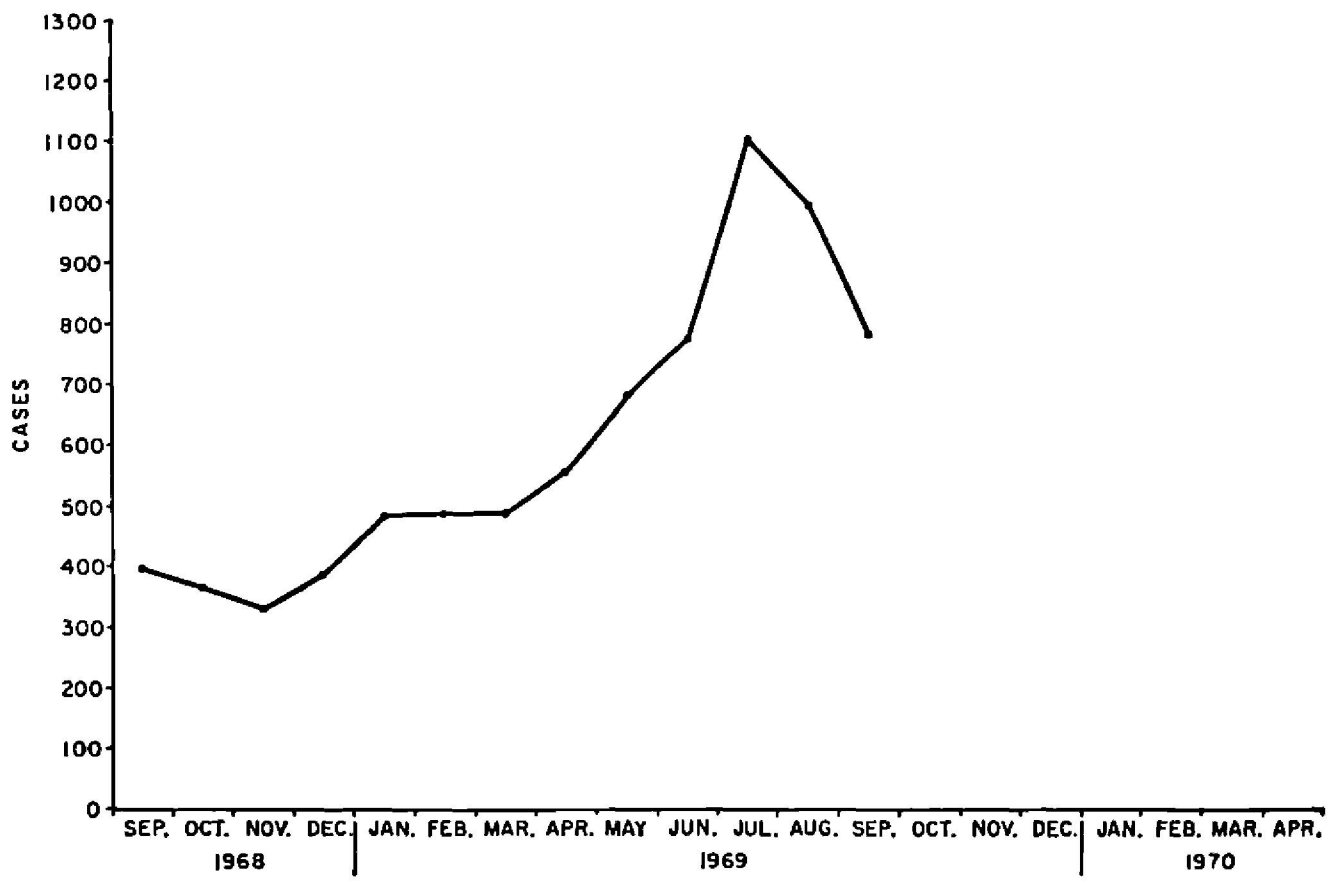

Figure 4. Deaths due to dysentery recorded in mortality registers in 205 of 325 municipalities of Guatemala, 1968–1969.

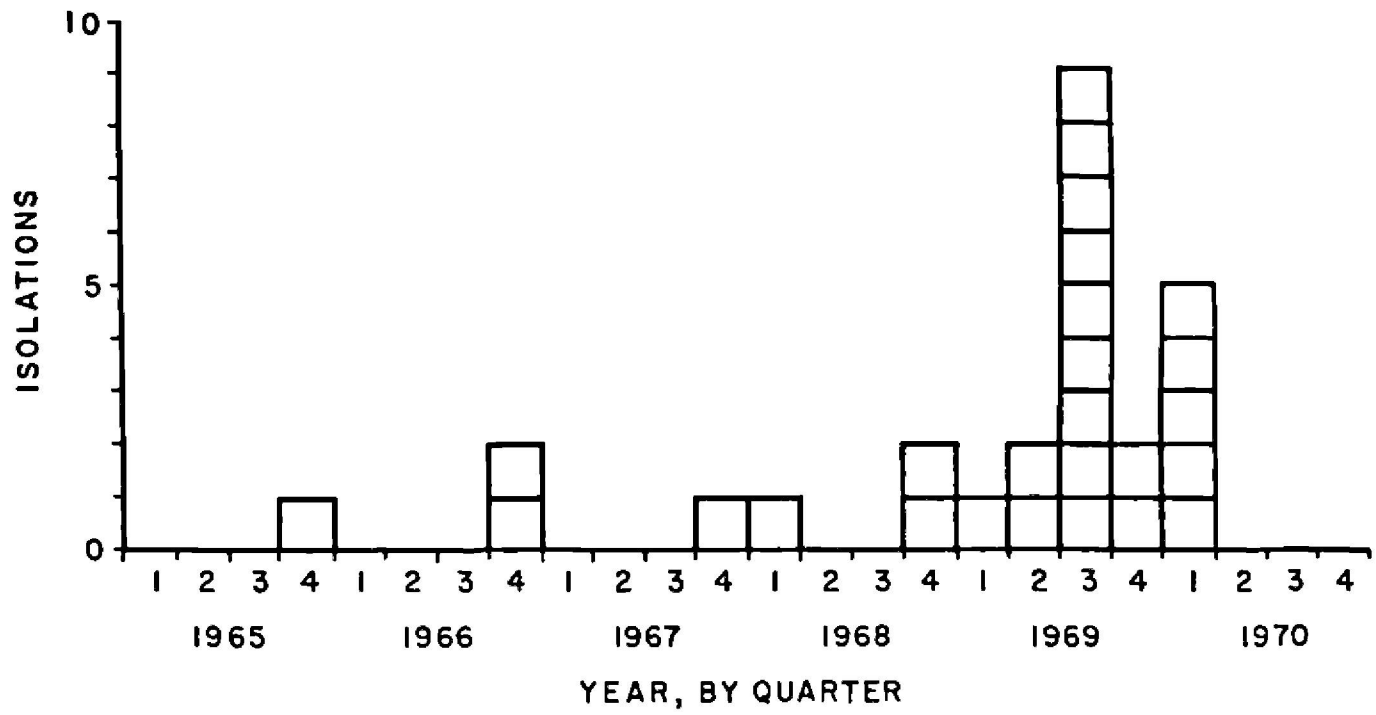

Figure 5. Isolations of *Shigella dysenteriae* type 1, in the United States, January, 1965–March, 1970.

to Mexico indicated they had visited Acapulco and other cities; 1 tourist who became ill had been only to Acapulco. There were no reports of secondary spread among household contacts in the United States in 1969.

Discussion

Although the precise means of spread could not be determined in the studies reported here, transmission can be defined in a general way. The occurrence of outbreaks in widely separated communities that did not share common water or food supplies tends to rule out the possibility of a common vehicle of transmission for the infected area as a whole. In the 2 community outbreaks investigated, the epidemic curves were different. In 1 community, Pueblo Nuevo, the clustering of cases in place and time and the presence in some families of 2 or more index cases suggested a common source of contamination. Water was probably the vehicle of transmission; the system of water distribution was defective only in the 4 blocks where attack rates were highest and where there were multiple index cases. The source of contamination was apparent; throughout the area, stool deposits were found on the ground close to where water-pipe connections rested in pools of rainwater. In El Coco, the site of the second community study, either person-to-person spread or continued contamination of the unsanitary water supply could explain the occurrence of cases over months. Flies could be ruled out as an important source of contamination in Pueblo Nuevo because they were so rare, but in El Coco they were abundant during the time cases were occurring and could have played a role in transporting the organism from feces to food or water.

The epidemiologic pattern of this epidemic was very different from the epidemiologic pattern characteristic of the endemic diarrheal diseases so common in the countries of Central America. Shigellosis caused by strains other than *S. dysenteriae* 1 is especially prevalent in the area [6]. The "syndrome of acute diarrheal disease," probably a composite of several etiologies, described by Gordon et al. [7], accounts for a large part of these diarrheal problems in Guatemalan villages and probably elsewhere. In this syndrome, typical attack rates are highest for the age group 6 months–2 years. Usually, the index case in a family outbreak is a preschool child. Multiple index cases are rare. Diarrhea in older children and adults is uncommon, an observation suggesting actively acquired immunity to the prevailing agents. In most villages, epidemics of diarrhea occur every few years. They evolve slowly and continue for many months, without the high peak that is characteristic of most common-source outbreaks. Transmission of these diseases is thought to be predominantly by person-to-person contact.

In contrast, no one in the places affected by the current epidemic could recall outbreaks of such severity and so widespread within families, neighborhoods, and communities.[1] The high attack

[1] C. A. Mendizábal-Morris, L. J. Mata, E. J. Gangarosa, and G. Guzmán, "Epidemic Shiga Bacillus Dysentery in Central America. III. Magnitude of the out-

rates indicated a nonimmune population. All ages were affected, although mortality was higher in older infants and children. The mean age of index cases in family outbreaks in 1 typical community outbreak was 20 years. The frequent clustering of cases in place and time and the presence of multiple index cases in many families suggested that common-source outbreaks, probably waterborne, were common, although person-to-person spread may also have played an important role.

Because of the serious confusion regarding etiology encountered in each of the countries affected [4] nationwide surveillance, ideally, should be based upon reports of laboratory isolations of *S. dysenteriae* 1. Another precise method of surveillance already employed in a limited way [4] is serologic testing by the hemagglutination test. Unfortunately, in 1969–1970 few laboratories in Central America were capable of isolating this organism and even fewer had mastered serologic methods.

The systematic, frequent reporting of cases diagnosed as dysentery in treatment centers and by practicing physicians is still another useful basis for surveillance. This method has proved highly successful in El Salvador in 1970,[2] but in most of the countries of the area, the art of surveillance has not attained this level. A more practical means of surveillance, readily adaptable to existing health administrations, is an analysis of existing mortality data. Mortality registers are readily available even in small communities, and the data are reliable because dysentery is so easily recognized.

In Guatemala, epidemiologic analysis based on this reporting system proved to be highly practical, economically feasible, accurate, and conservative. The rapid analysis of reported data from whatever source and its timely dissemination in the form of a weekly or monthly newsletter sent to physicians, laboratory workers, and others with a need to know was an essential part of this surveillance. Excess deaths due to dysentery could be the basis of regional surveillance.

The danger that this epidemic will spread to other countries, neighboring and distant, is real. Importations by air travelers has already been documented in the United States of America [8]. These travelers are not so dangerous to the public health, because most are sophisticated in their sanitary habits; however migrant workers and others in the lower socioeconomic group could introduce the disease into poverty areas [9] and cause new epidemic foci. The need for surveillance for shigellosis has never been so great.

break and mortality in Guatemala, 1969," manuscript in preparation.

[2] L. B. Reller, E. N. Rivas, R. Masferrer, M. Bloch, and E. J. Gangarosa, "Epidemic Shiga Bacillus Dysentery in Central America. IV. Evolution of the Outbreak in El Salvador," manuscript in preparation.

Summary

After a long absence from the world, epidemic Shiga bacillus (*Shigella dysenteriae* 1) dysentery reappeared in 1969–1970 in populous Central America. Epidemic investigation of 2 community outbreaks suggested that transmission may have occurred by contaminated water in 1 community, where cases were clustered in a short period of time, and by person-to-person spread in another community, where cases occurred over a longer period of time. The high attack rates noted in nearly all age groups indicated a highly susceptible population. Serologic surveys in 3 communities indicated that asymptomatic infections were at least as common as clinical cases. A survey of mortality registers in 18 communities in Guatemala, where the disease was first recognized, documented excess mortality, a stigma of the severity and extent of spread of the disease; an estimated 112,000 cases of dysentery and 8,300 deaths occurred in Guatemala in the first 10 months of 1969. Surveillance based on deaths due to dysentery recorded in mortality registers proved practical and inexpensive and complemented reports of clinical cases, laboratory isolations of the organism, and serologic surveys. Surveillance for shigellosis in the United States readily identified an increase in cases of dysentery due to Shiga bacillus late in 1969 in tourists after they had returned from infected areas. Rapid spread of the disease into countries adjoining Guatemala in late 1969 and early 1970 has ominous public health implications.

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