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INVESTIGATION OF A TYPHOID OUTBREAK ON DOMINICA[1]

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Investigation of a typhoid fever epidemic in Dominica suggests the disease was spread largely by handlers of contaminated food. This and related findings underscore the need for better sanitation, periodic screening of food handlers for Salmonella typhi, *and establishment of a special registry containing data on all known cases of typhoid fever.*

Introduction

Typhoid fever—an acute and often severe illness caused by *Salmonella typhi*—is characterized by fever, headache, apathy, cough, prostration, splenomegaly, maculopapular rash, and leukopenia. It is the classic example of enteric fever caused by salmonellae. The highest disease incidence occurs in children under 15 years of age, and about 10 per cent of the cases occur in children less than five years old (Beeson and McDermott, 1975).

Typhoid is an endemic disease on Dominica. On the average, 27 *Salmonella typhi* isolates per year were obtained from patients at the island's Princess Margaret Hospital during the period 1972-1976. This average does not include several cases diagnosed clinically and treated at the island's two other hospitals. In view of this endemicity, the possibility of typhoid should always be considered in differentially diagnosing patients with fever of undetermined origin.

Dominica has a population of just under 85,000 inhabitants. In the last quarter of 1977 a typhoid outbreak occurred in Coulibistrie, a small village on the west coast with a population of about 800 people. The first case was reported on 24 October 1977, and the outbreak continued until mid-February 1978. By 3 December eight cases had been detected, and *S. typhi* had been isolated from blood and stool cultures. These eight cases occurred in children under 13 years of age, all of whom attended the only school in the village. Three of the eight belonged to one household and two belonged to another; all eight had used the same water supply system at the school. Rises in antibody titers to "O" (somatic), "H" (flagellar), and "Vi" (envelope) antigens were demonstrated. Overall, 29 cases of *S. typhi* infection in this village were bacteriologically confirmed during the period October 1977-February 1978. Six of those infected were carriers.

Materials and Methods

Stools and rectal swabs were shipped to the laboratory in buffered glycerol saline or Cary and Blair Transport medium (Baltimore Biological Laboratories—BBL). The specimens were then plated onto MacConkey's agar No. 3 (Oxoid) and desoxycholate citrate medium (Oxoid). A fecal sample about the size of a pea was then inoculated into selenite enrichment broth (Oxoid), and all the cultures were incubated at 35°C for 18 to 24 hours. Bacteriologic analyses were also performed on samples of the village water supply before and after chlorination; on samples of "frozen joy," a local product (made by freezing a custard-base mixture in ice trays) that is sold by the cube to children; and on samples of the mixtures used to make "frozen joy."

Non-lactose fermenting colonies were picked out and inoculated onto Kligler iron

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agar, urea agar, and lysine iron agar (BBL). These media were then incubated for 18 to 24 hours at 35°C and the results were observed and recorded.

Anaerogenic organisms giving typical *Salmonelli typhi* reactions (acid butt, alkaline slant, and a dot of hydrogen sulphide at the point of inoculation on Kligler iron agar; no hydrolysis of urea; alkaline slant, alkaline butt, and a small quantity of hydrogen sulphide on lysine iron agar) were then examined for antigenic properties using salmonella-specific 9-O, d-H, and Vi antisera.

Organisms tentatively identified as *S. typhi* (those prompting agglutination with all three antisera or with 9-O and d-H) were then transferred to the following array of biochemical media: glucose, lactose, maltose, mannitol, sucrose, d-tartarate, indole, motility, and Simmons citrate. Identification of *S. typhi* was confirmed if there was acid production with no gas in the glucose, maltose, mannitol, and d-tartarate media; if indole was not produced; if citrate was not utilized; and if the organisms were motile.

Blood samples were obtained aseptically from patients being barrier-nursed. These samples were cultured in trypticase soy broth (BBL) with 5 per cent Grobax (sodium polyanethol sulphonate) (Roche) and anticoagulant for 18 to 24 hours. They were then inoculated into Blood Agar Base No. 2 (Oxoid) and were maintained under both aerobic and anaerobic conditions for 18 to 24 hours. Suspected blood agar colonies of *S. typhi* were treated like colonies arising from the stool and rectal swab specimens. All the blood cultures were subcultured whether or not there was turbidity after 24 hours, 5 days, and 2 weeks.

Serum agglutination tests were performed with paired sera taken within 12 days during the hospitalization period, using stained suspensions of O and H antigens (Wellcome Laboratories), and the respective titers were recorded. Agglutination tests using a stained suspension of Vi were also done, but there was great difficulty reading the results because of the sensitivity of the standard *S. typhi* antiserum.

All the *S. typhi* isolates were tested (on Oxoid diagnostic sensitivity test agar) for sensitivity to the following antibiotics: ampicillin (2 μg/ml), tetracycline (10 μg/ml), chloramphenicol (10 μg/ml), Co-trimoxazole[3] (25 μg/ml), penicillin G (1.5 units/ml), erythromycin (10 μg/ml), streptomycin (10 μg/ml) and Gantrisin (100 μg/ml).

Results

Table 1 shows the number of *S. typhi* isolates obtained in this manner during the period 1972-1977 at the Princess Margaret Hospital. The 1977 isolates shown in Table 1 were obtained from a total of 1,561 urine specimens, 898 stool specimens, and 498 blood specimens (a total of 350 Widal serologic tests were also done).

An initial blood sample (for use in serologic and blood culture tests) was obtained from each hospital patient on the day of admission,

[3]A combination of sulfamethoxazole and trimethoprim; also called Septra.

Table 1. *Salmonella typhi* isolates obtained at the Princess Margaret Hospital, Dominica, from urine, stool, and blood specimens, 1972-1977. Sera yielding positive agglutination titers with H and O antigens are also shown.

Year	Total no of isolates	No of isolates obtained from:			Agglutination titers with H and O antigens 1 160 or greater
		Urine	Stools	Blood	
1972	26	–	26	24	22
1973	28	–	28	28	26
1974	24	–	23	24	20
1975	30	–	30	30	24
1976	28	–	28	27	21
1977	55	2	55	53	39

and another was taken on the twelfth day. Agglutination tests yielding titers of 1:160 or greater with H and O antigens were considered positive. Such titers were obtained with sera from 71 per cent of the patients whose blood cultures were positive for *S. typhi.*

All the urine specimens cultured during the outbreak were obtained from hospitalized barrier-nursed patients; only two yielded cultures positive for *S. typhi.*

All the water and "frozen joy" samples tested showed evidence of fecal coliform contamination, but none were positive for *S. typhi.* Samples of stools, "frozen joy" mixtures, and "frozen joys" obtained from various food handlers who sell at or near the Coulibistrie school were negative for *S. typhi,* but there was heavy bacterial contamination in all food products sampled.

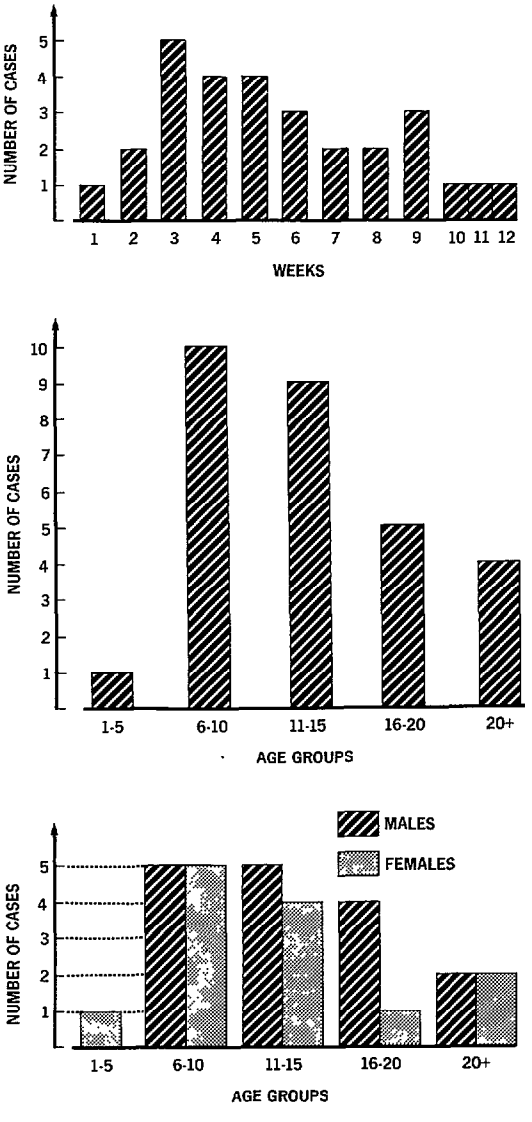
One of the suspected food handlers had a relative living with him who occasionally helped to prepare "frozen joys," some of which had been eaten by children who later developed typhoid. Using information obtained from the national typhoid registry, it was determined that this individual had been diagnosed as having typhoid in 1962. Because of these circumstances, eight consecutive stool examinations were performed on specimens from this person, the first seven being negative and the eighth positive for *S. typhi.*

A survey of 38 contacts and 248 schoolchildren detected only two asymptomatic cases. This survey, which was done in collaboration with personnel of the PAHO/WHO Caribbean Epidemiology Center (CAREC), lasted two weeks. During this period (3-18 March 1978) three stool specimens from all the aforementioned contacts and schoolchildren were cultured.

Over the course of the entire outbreak, stool samples were obtained from 455 people in Coulibistrie (including the 286 survey subjects). Comparative data on the 29 Coulibistrie cases, by date of occurrence and the patients' age and sex, are shown in Figure 1.

The frequency with which *S. typhi* is found in specimens of blood, stool, and urine corre-

Figure 1. Distribution of the 29 Coulibistrie typhoid cases detected during the October 1977-February 1978 outbreak, by week of cases and age and sex of patients. The weekly breakdown runs from 15 November 1977 to 8 February 1978. (Although the first reported Coulibistrie case occurred on 24 October, it was only with the next isolation of *S. typhi* on 15 November that the makings of an outbreak were observed.)



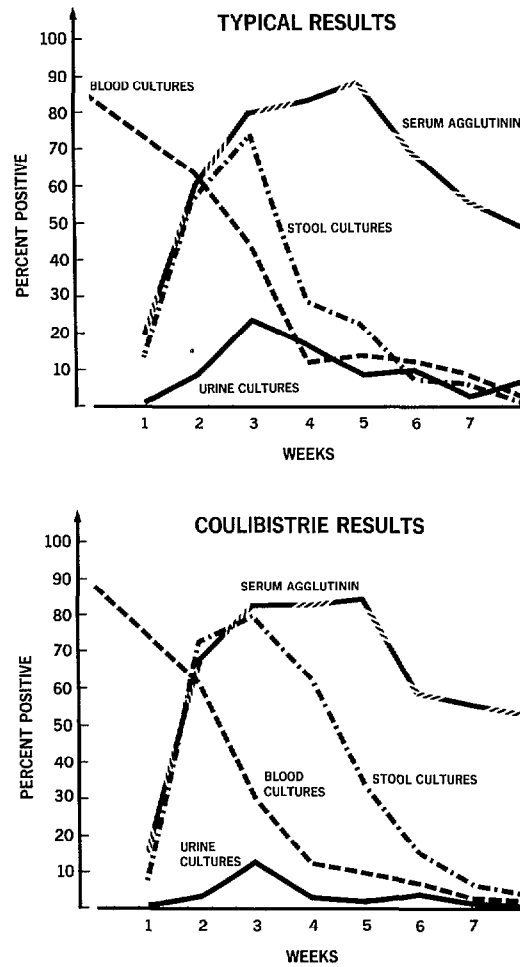
lates well with the pathogenesis of the disease. Blood cultures are most often positive early in the course of the disease, whereas urine and stool cultures become positive following secondary septicemia (Vaughn and McKay, 1975). Figure 2 (top) shows typical results of bacteriologic culture and serum agglutination tests conducted during a typhoid outbreak (Morgan, 1965), while Figure 2 (bottom) presents the results of tests performed during the Coulibistrie outbreak.

All subjects in the field yielding positive cultures were hospitalized, and a special ward was provided at the Princess Margaret Hospital so that the patients could be barrier-nursed. Twenty patients one to 15 years of age who yielded positive cultures were treated exclusively with chloramphenicol, regardless of laboratory reports. Five subjects in this age group were subsequently readmitted with relapses. These five cases were then treated with ampicillin and/or Co-trimoxazole and were finally discharged after culturing of six stool specimens yielded negative results. There was no readmission among the older patients, who received treatment in accordance with laboratory antibiotic sensitivity testing. The asymptomatic cases, obviously carriers, were treated with ampicillin or Co-trimoxazole. It has been reported that for strains not sensitive to chloramphenicol (the drug of choice), ampicillin and Co-trimoxazole are of proven value (Benenson, 1975). The standard chloramphenicol dosage used in this hospital was 500 mg I.M. every four hours for five days, followed by 500 mg orally every six hours for 10 days. The ampicillin dosage was 500 mg orally for two weeks; and the Co-trimoxazole dosage was two tablets (each containing 80 mg of trimethoprim and 400 mg of sulfamethoxazole) three times a day for five days and two tablets twice a day for 10 days.

Table 2 shows the in-vitro sensitivity to six antibiotics of the 29 Coulibistrie *S. typhi* isolates, as indicated by testing with the multodisc (Oxoid) method.

Fifteen of the *S. typhi* isolates (13 from Coulibistrie and two from other areas) were sent to the British Public Health Laboratory Services, Division of Enteric Pathogens, Central Public Health Laboratory, Colindale Avenue, London, for Vi phage typing.[4] These yielded the results shown in Table 3.

Figure 2. Bacteriologic culture and serum agglutination test results. Top: typical results of tests conducted during a typhoid outbreak. Bottom: the results of tests performed during the Coulibistrie outbreak.



[4]These first isolates were the only ones on hand as of 16 December 1977, when a courier bound for a hospital near the Central Public Health Laboratory became available.

Table 2. Results of testing the Coulibistrie *S. typhi* isolates for antibiotic sensitivity by the multo-disc (Oxoid) method.

Antibiotics tested	No. of *S typhi* isolates found to be		
	Resistant	Partially sensitive	Sensitive
Ampicillin	4	4	21
Penicillin G	29	0	0
Erythromycin	29	0	0
Tetracycline	0	0	29
Chloramphenicol	2	2	25
Co-trimoxazole	0	2	27
Streptomycin	29	0	0
Sulphafurazole	29	0	0

Table 3. Results of Vi phage typing of 14 *S. typhi* isolates.

Isolate's laboratory number	Area where specimen was obtained	Vi phage type
3515/77	Coulibistrie	E.1
3356/77	"	E.1
3361/77	"	E.1
3444/77	"	E.1
3559/77	"	E.1
3570/77	"	E.1
3681/77	"	E.1
51/78	"	E.1
82/78	"	E.1
157/78	"	E.1
3366/78	"	E.1
3366/78	Wesley	Degraded Vi strain
3556/77	Dublanc	Degraded Vi strain 14
3601/77	Coulibistrie	Vi negative variant
99/78	Coulibistrie	Vi negative variant

Discussion and Conclusions

This investigation detected six carriers in the one village (Coulibistrie) where 50 per cent of the inhabitants were screened. Taking this village as representative of the whole of Dominica, it appears likely that a number of carriers exist throughout the island community, and that these could cause explosive epidemics sometime in the future unless they are identified, registered, and treated.

Because health is often treated as a "non-productive expenditure item" in the less-developed countries, it tends to be given very low priority, and the funds allotted for providing health services may be less than what is needed to cope with minimal demands for environmental sanitation and patient care. Within that context, this typhoid outbreak underlines the importance of personal and public sanitary practices that are almost non-existent in most villages—namely, proper sanitary disposal of human waste; hand-washing after defecation; and adequate sanitary supervision of the processing, preparation, and serving of confectionary products such as "frozen joy."

The outbreak has also served to demonstrate the importance of screening all food handlers, including part-time helpers, to eliminate typhoid carriers. Testing of one stool specimen per year cannot be expected to serve as a reliable method of detecting the infrequent excretor. What is needed is a typhoid registry—so that all known cases of typhoid will be registered on individual cards, and so that individuals seeking initial or annual licensing as food handlers can be cross-checked against this register. When an individual has previously been listed as having typhoid, a series of consecutive stool examinations should be made.

The sporadic nature of the outbreak tends to rule out transmission by water, pointing more to transmission via food or food handlers. The culture results did not show any actual food handlers or vendors to be carriers, but a positive result was obtained (after seven negative ones) with a stool specimen from the closest asymptomatic contact and part-time helper of the most popular school-area vendor. This main carrier's Vi phage type was E.1, the same as 83 per cent of those phage-typed from Coulibistrie.

Relapses occurred in five patients between one and 15 years of age. It has been reported (Vaughn and McKay, 1975) that relapses occur in up to 10 per cent of those not treated with antibiotics but in twice that percentage of those who receive chloramphenicol. Chloramphenicol is the drug of choice; but in dealing with strains insensitive to it, two other antibiotics (ampicillin and Co-trimoxazole) are generally administered.

Serious complications are associated with the use of tetracycline, especially in children, and this tends to preclude its pediatric use irrespective of the in-vitro sensitivity of *S. typhi*. Despite this, however, the cost factor may weigh in favor of its use in poor countries.

Overall, this experience demonstrates the importance of having bacteriologic back-up services available for the hospital practice. The fact that no deaths occurred as a result of this outbreak is evidence of the effective teamwork and cooperation that existed between the district medical services, the Public Health Division, the CAREC staff, the designated epidemiologist, and the medical, pediatric, and bacteriology departments of the Princess Margaret Hospital.

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SUMMARY

Typhoid fever is endemic on Dominica. In October 1977 a typhoid epidemic struck the island's west coast village of Coulibistrie. Overall, 29 cases of *Salmonella typhi* infection were bacteriologically confirmed among Coulibistrie residents between that time and the end of the epidemic in February 1978. Rises in serum titers to O, H, and Vi antigens were also noted. Many of the cases occurred among children attending the village's only school.

Besides subjecting blood and stool specimens to bacteriologic analysis, an effort was made to detect *S. typhi* in the village water supply and in samples of "frozen joy," a local frozen-custard confection sold to children in the school area. All the *S. typhi* isolates obtained were tested for sensitivity to various antibiotics, and 15 isolates (13 from Coulibistrie and two from other areas) were sent to London for Vi phage typing.

No *S. typhi* were found in water or "frozen joy" samples, but heavy bacterial contamination was found in the latter. Furthermore, one person who occasionally helped prepare "frozen joy" for sale was found to be an *S. typhi* carrier. The *S. typhi* isolated from this person's stools were of Vi phage type E.1, as were 83 per cent of the phage-typed isolates from Coulibistrie. The sporadic nature of the outbreak tends to rule out transmission by water, pointing more to transmission by food handlers. Taken as a whole, the available evidence suggests that a number of carriers are spread through the island community, and that these could cause explosive epidemics in the future unless they are identified, registered, and treated.

In addition, the outbreak described here demonstrated the importance of personal and public sanitary practices (including hand-washing after defecation, sanitary disposal of human waste, and hygienic food-handling procedures) that are almost nonexistent in most villages. It also underscored the need to screen all food-handlers for *S. typhi* and to establish a typhoid registry containing data on all known cases of the disease.

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RABIES IN THE UNITED STATES

A total of 5,150 laboratory-confirmed rabies cases were reported in the United States and its territories in 1979. This total was 67 per cent higher than the average annual total for the preceding five years and was 1,852 cases over the total reported for 1978. Forty-eight states and Puerto Rico reported infected animals in 1979; only the District of Columbia, Idaho, Guam, Hawaii, and the Virgin Islands reported no cases. Seven kinds of animals accounted for 98 per cent of the reported cases. These were skunks (59 per cent), bats (15 per cent), raccoons (10 per cent), cattle (4 per cent), dogs (4 per cent), cats (3 per cent), and foxes (3 per cent). Wild animal species accounted for 87.6 per cent of the total reported cases, domestic animals accounted for 12.3 per cent, and humans accounted for 0.1 per cent.

The general trend was one of across-the-board increases vis-a-vis 1978. For example, there were five human cases (versus four in 1978), 636 domestic animal cases (versus 469 in 1978), and 4,509 wild animal cases (versus 2,285 in 1978). However, cases among skunks exhibited the sharpest reported leap, increasing from 1,657 to 3,031 cases—a rise of 67 per cent over 1978.

Source: Morbidity and Mortality, vol. 29, no. 37, 1980.