

## EPIDEMICS INVESTIGATED

During the lifetime of CAREC staff members were called upon to investigate a variety of disease outbreaks, such as the periodic occurrence of yellow fever in Trinidad and pan Caribbean epidemics of dengue fever. Dengue indeed is endemic in CAREC Member Countries (CMCs) even though at one time the Cayman Islands was free of *Aedes aegypti*. Malaria is still present in some CMCs such as Belize, Guyana and Suriname. It is also present in Haiti. Food-borne illnesses were common due to the lack of proper hygienic standards and there were periodic outbreaks in the countries. Some of the outbreaks investigated are highlighted below.

### Yellow Fever

Yellow fever was once a scourge in the West Indies and has been documented since the 1600s. The disease, however, has been eradicated from all the Caribbean islands except Trinidad and Tobago where it has remained an enigma. There are two types of yellow fever – urban and jungle. In the urban cycle *Aedes aegypti* is the vector, but in the jungle the virus is maintained between *Haemagogus* sp. mosquitoes and monkeys (*Alouatta seniculus*). Humans become infected when they enter the forest where the virus is active. Monkeys have been long known to be associated with yellow fever. The famed English author, Charles Kingsley noted in his book “At Last: A Christmas in the West Indies” that the death of monkeys in the forest, followed by an outbreak of the disease in humans was a well-known folklore of the local people. Later Balfour noted an outbreak of yellow fever amongst oil drillers in the forests near La Brea where no *Aedes aegypti* was present. Dr Wilbur Downs, the first Director of the Trinidad Regional Virus Laboratory (TRVL), pointed out that these two episodes were the first suggestions that a “jungle yellow fever” existed. The



Fig. 6.1.1. A dead Howler monkey, *Alouatta seniculus* found on the forest floor at Fishing Pond, north-eastern Trinidad.  
Photo: Elisha Tikasingh

existence of “jungle yellow fever” was proven some 30 years later in Brazil. Dr T H G Aitken, entomologist at the TRVL, suggested the possibility of the existence of a 10-15 year cycle in the upsurge of yellow fever activity in Trinidad (Aitken 1991), if not in humans, certainly in monkeys.

The report of dead Howler monkeys (Fig. 6.1.1) in the Guayaguayare forests of south-eastern Trinidad in November 1978 set alarm bells ringing. A team of staff members of the Veterinary Public Health Unit, Insect Vector Control Division, Forestry Division and CAREC visited the area to determine the veracity of the reports. A dead Howler monkey was found, as well as other evidence to suggest more than one monkey had died.

Mosquito collections were made on this reconnaissance visit – 20 *Haemagogus* were collected from which the yellow fever virus was isolated. The recovery of that isolate marked a frenzy of activities, the first of which was intense surveillance of human febrile cases from hospitals and clinics by staff of the Ministry of Health. This intense surveillance resulted in the discovery of 18 cases which occurred in two phases: eight in the period December 1978 to March 1979, and 10 cases from August to September 1979. Seven of the eighteen died. Seventeen of the 18 had visited the forests and there was no record that they had been vaccinated. Yellow Fever virus was isolated from 14 of the 18 cases.

Meanwhile, there was also surveillance of sick and dying monkeys in the forests of Trinidad by workers of the Forestry Division of the Ministry of Agriculture and the Veterinary Public Health Unit of the Ministry of Health. Subsequent to the Guayaguayare epizootic, sick and dying monkeys were discovered westward to Moruga

and northwards through Biche to the Northern Range, and then again westward to the Chaguaramas Peninsula of Trinidad. This surveillance resulted in the collection of 32 sick and dead Howler monkeys which were brought to CAREC for processing for virus isolation. Sixteen monkeys yielded yellow fever virus.

It should be noted that species of *Cebus* monkeys also exist in Trinidad, but yellow fever virus is yet to be isolated from this species. It is not known whether they are affected by the virus.

To determine the species of mosquito involved, captures were done where sick and dying monkeys were discovered. Adult mosquitoes were collected off human bait and in the laboratory, then sorted by species and pooled according to date and location of capture. A total of 19 isolations were made: 17 from *Haemagogus janthinomys* from six localities; and two from *Hg. leucocephalus* collected from one locality, Mamoral. The discovery of a case of sylvatic (or jungle) yellow fever resulted in mass immunisation programmes. The Government had declared Trinidad (but not Tobago) an infectious area for yellow fever and the Ministry of Health with CAREC and PAHO ordered sufficient vaccines for its population. In addition, 20,000 doses were ordered to assist the islands of the eastern Caribbean to facilitate travellers wishing to enter Trinidad.

The campaign started with the yellow fever vaccines in stock. Vaccination centres included schools, health centres, government offices and many other designated places. The Government of Colombia had also loaned five pedo-jet injectors to assist in the campaign. The Immunisation Officer at CAREC, Mr Henry Smith gave "crash courses", to government workers on how to operate the injectors.

These trainees were able to vaccinate as many as 500 persons per hour. Following the training they were sent out to centres with high-density populations. All individuals, one year and over, were vaccinated – a total of 868,066 persons. People vaccinated between 1972 and 1978 totalled 178,929 and were deemed to be protected. Thus a total of 1,046,995 people or 94.7% of the population were vaccinated.

The yellow fever cases were of the jungle type. However, those humans that were infected in the jungle came back to live at their homes where *Aedes aegypti* were known to occur and it was this species that had been responsible for the urban spread of yellow fever in earlier times. Accordingly, the Ministry of Health, Insect Vector Control Division with senior workers, Drs E Laurent, A Le Maitre and Mr Dave Chadee, adopted methods to prevent the spread of the virus in urban areas. Adult *Ae. aegypti* were collected through house searches in areas where suspect cases had occurred and were then forwarded to CAREC for possible isolations of the virus, but none yielded the virus.

Houses bordering the forests where there were cases or suspect cases were treated residually with 55% fenthion (EC) at 1.6gm/m<sup>2</sup> using Hudson sprayers. In high risk areas, aerosol spraying and ULV spraying applications were done. In the end, no urban case of yellow fever was reported.

One of the consequences of this episode of yellow fever was that the Trinidad and Tobago Government mandated that all children entering primary school must show a certificate of immunisation against yellow fever.

#### Transovarial Transmission Studies

Why is there periodic epizootic yellow fever activity in the forests of Trinidad? One theory is that it is passed on from generation to generation in mosquitoes, that is, transovarial transmission and when there is a susceptible population in monkeys the mosquitoes infect them. Such studies have already been demonstrated in the laboratory for *Aedes aegypti* and *Haemagogus equinus* mosquitoes. However, fieldwork was yet to be done for yellow fever although Drs Hull, Tikasingh, et al., had demonstrated such a possibility for dengue in field collected material. It seemed a good idea to attempt such a study in Trinidad when the yellow fever virus was active.

The attempts at this time were done with adult mosquitoes caught in the field, larvae collected from bamboo pots and reared to adults, as well as eggs and larvae collected from ovitraps (Fig. 6.2) and reared to adults. A total of 9,368 adult *Hg. janthinomys* and 5,964 *H. leucocephalus* were tested but the virus was not recovered.



**Fig. 6.1.2.** Bottles painted black containing a small amount of water with a wooden paddle about 15 cm long and 2 cm wide called ovitraps, were hung on trees to attract *Haemagogus* mosquitoes to lay their eggs. The mosquitoes find the moistened paddles attractive areas in which to lay their eggs. Photo: Elisha Tikasingh

During an outbreak, it was also possible to demonstrate the usefulness of a mosquito tissue culture derived from the larvae of *Aedes pseudoscutellaris* (AP-61) in the primary isolation of arboviruses. The traditional method of isolation of arboviruses had been by inoculation of infant mice. The AP-61 cell line was introduced to CAREC by Dr R Varma of the London School of Hygiene and Tropical Medicine. It was shown that the AP-61 cell line was more sensitive than infant mice: 11.7% of 725 specimens of the former and 7.9% of 725 specimens of the latter.

#### Yellow Fever in the Inter-epidemic and Inter-epizootic Years

There are periodic epizootics of the yellow fever virus involving Howler monkeys in Trinidad. The question arises: where does it go in inter-epizootic years? Is there a silent cycle involving other vertebrates? Is the virus transmitted transovarially, i.e. carried from adult infected mosquitoes through its progeny in succeeding generations? To answer some of these questions, CAREC obtained a grant from the International Development Research Centre (Ottawa) for a two-year study. The project was supervised by Barbara Hull and Elisha Tikasingh.

The areas chosen for the study were the areas where the yellow fever virus had been active in the previous year. In this study, 8059 *Haemagogus* sp and 34,300 other species of mosquitoes were processed for virus isolations. The yellow fever virus was isolated on two occasions from *Haemagogus* mosquitoes collected in July 1980, both times from the Chaguaramas area. These isolations were made four months after the last virus activity in the Chaguaramas area. Could these isolates be the result of transovarial transmission of the virus over the dry season or could it be that an infected adult mosquito survived the

dry season? Fifteen mammalian species were tested, but no virus was recovered. Likewise, in attempting to demonstrate transovarial transmission of the virus 42,815 larvae and adults were reared from field collected material; again, no virus isolations were made.

#### The 1988 – 1989 Epizootic

And yet another epizootic appeared in Howler monkeys in the Guayaguare forests in December 1988. It spread westward to Morgua and northwards to Fishing Pond. Through the Government's Veterinary Public Health Unit, a search for sick and dying monkeys was launched while the Insect Vector Control Division collected *Haemagogus* mosquitoes for possible virus isolation. A total of 36 pools of *Haemagogus janthinomys* were tested and five isolations of yellow fever virus were recovered. In another species of mosquito *Sabettus chloropterus* one isolate was made from eight pools tested. Of seven monkeys tested, two from the Moruga Forest and one from the Fishing Pond Forest were positive. Human surveillance was based upon a case definition of fever with a history of recent forest exposure. In addition, persons with jaundice, vomiting, anorexia and generalised pain were given priority in laboratory investigations. Thirty-six persons were investigated and none yielded the yellow fever virus. The fact that there were no human cases was attributed to the extensive immunisation coverage during the 1978-1979 outbreaks and the continuing vaccination of young children.

Following this episode, there were reports of epizootics in monkeys during in 1998 and October 2008-March 2009 in southern and south-eastern Trinidad. And again, monkey deaths were reported in the forests of south, east and north Trinidad. It is clear from the foregoing that epizootics

of yellow fever in Howler monkeys seem to occur every ten years. The following questions arise: Where is the virus in inter-epizootic periods? Is there a silent cycle which then erupts every ten years? Is there transovarial transmission of the virus through mosquitoes? A summary of the epidemics and epizootics between 1950 and 1980s titled, "Studies on the Natural History of Yellow Fever in Trinidad" was published by CAREC in 1991 as CAREC Monograph Series 1.16

#### Dengue Fever

Dengue fever is endemic in the Caribbean. The disease is characterised by sudden onset of fever with severe headaches, retro-orbital pain, and pain in the joints and muscles. Other symptoms include a maculopapular rash, lymph node enlargements and haemorrhagic manifestations. Dengue fever is caused by an arbovirus of the Flavivirus Group. The virus exists in four serological forms: Den-1, Den-2, Den-3 and Den-4 and these are transmitted by infected *Aedes aegypti* mosquitoes which breed around houses in the Caribbean. Humans are believed to be the vertebrate hosts for the virus.

Dengue 2 was the first strain to be isolated in the Western Hemisphere in 1953 by the TRVL, the forerunner of CAREC. Subsequently, the other 3 types were isolated by other laboratories in the Caribbean. Dengue 3 appeared in the Caribbean in 1963 and was isolated in Puerto Rico during an outbreak; other islands were also affected. It is worth noting that Trinidad and Tobago was not affected because the twin island state was free of *Aedes aegypti* at that time, although not certified free by the WHO. In 1977, a Pan-Caribbean epidemic due to Den-1 first appeared in Jamaica. All countries in the Caribbean were affected

with the exception of the Cayman Islands where the vector mosquito *Aedes aegypti* was eliminated. PAHO/WHO organised and sponsored a meeting of health workers in the countries of the Caribbean which was held in May 1978 in Jamaica to discuss and

record various aspects of the epidemic. A report on the proceedings of this conference was subsequently published in 1979 by PAHO as "Dengue in the Caribbean" (PAHO Scientific Publication No. 375).

Following the 1977-78 Pan Caribbean epidemic of dengue, there have been periodic outbreaks of the disease in the countries as shown in Table 6.1.

**Table 6.1.** Outbreaks of dengue fever including types (where known) and number of cases in the Caribbean.

Date	Countries	Types (when known) and Cases
1977 – 1978	Pan Caribbean	Den-1
1981	Pan Caribbean	Den 4 noted for the first time
1982	Antigua	
	Barbados	54 cases
	Belize	473 cases
	Jamaica	
	St Lucia	
	Suriname	25 cases
	Trinidad and Tobago	
1983	Antigua and Barbuda	
	Barbados	
	Belize	
	Jamaica	
	Anguilla	
	Grenada	
	Trinidad and Tobago	2 and 4
1984	Trinidad and Tobago	1, 2 and 4
1985	Puerto Rico	

Date	Countries	Types (when known) and Cases
1986	Dominica	
	Grenada	
	St Lucia	
	Barbados	2
	Suriname	2
	Trinidad and Tobago	2
1987	Barbados	
	St Lucia	2
	Suriname	2
	Trinidad and Tobago	2
1988	Barbados	2
	British Virgin Islands	2
	Trinidad and Tobago	2
1989	Bahamas	2
	Jamaica	
1990	Trinidad and Tobago	
	Barbados	1
	Dominica	1
	Grenada	1 and 2
	St Vincent	1
	Trinidad and Tobago	1, 2 and 4

EPIDEMICS INVESTIGATED (*continued*)

**Table 6.1.** Outbreaks of dengue fever including types (where known) and number of cases in the Caribbean. (*continued*)

Date	Countries	Types (when known) and Cases	Date	Countries	Types (when known) and Cases
1995	1855 cases with 56 DHF in 24 CMCs.	1, 2 and 4	2006	The 2006 figure could not be compared with data of other years because there was no distinction between 'suspected' and 'confirmed' cases.	2 and 4
1996	Trinidad and Tobago	3,983 cases. 1 predominated	2007	Guyana	
1997	Trinidad and Tobago	1, 2 and 4. There were 13 confirmed DHF/DSS with 2 deaths		Grenada	4
	Jamaica	1		Trinidad	3
	St Vincent, Barbados	2	2008	Most CMCs	2
	Belize	3		St Kitts-Nevis	4
2000	Suriname	In November 1999, the hospital Nickerie on the west coast reported an increase of compatible dengue cases from 8 per 1,000 to 50 per 1,000 in December 2000.	2009	Aruba, Belize	
2001	Belize	Type 3 for the first time since 1997.	2010	Bahamas, Dominica, Grenada, St Kitts and Nevis St Lucia, St Vincent and the Grenadines, Suriname	1
	13 CMCs	4,999 cases of dengue of which 106 cases were DHF/DSS.		Bahamas, Cayman Islands, Grenada, Jamaica St Kitts and Nevis, St Lucia, and St Vincent	2
2002	Barbados, Guyana, St Vincent and the Grenadines, Suriname and Trinidad and Tobago.	8231 cases, 97.2% occurred in countries listed in Column 2. There were 303 DHF/DSS cases.		St Lucia and Suriname	4
2003	Ninety one per cent of the cases occurred in Barbados, Suriname, and Trinidad and Tobago.	Trinidad/Tobago alone had 2464 cases.	2011	Suriname	2 and 4
2005	There was an outbreak of dengue fever in Suriname with 2853 cases	Mainly of 2 and 3	2012	Barbados, Jamaica	1
	Belize reported 380 cases	Mainly of 1, but also of 2 and 3			
	St Lucia	4			

There are no vaccines for dengue fever so that control efforts were directed to the control of the mosquito. The habitat of this species of mosquito is peri-domestic and it breeds in clean water so that any water holding container around one's house is a potential breeding site. Since there is an inadequate pipe borne, potable water supply in many CMCs, people resort to storing water in barrels, drums, cisterns, tanks and nearly anything that can hold water (Fig. 6.2.1.).

### Malaria

Malaria has been eradicated from the Caribbean, except for Haiti. However, it is still present in CMCs on the mainland – Belize, Guyana and Suriname. In March 1978, CAREC received blood films from two persons in Grenada suspected of having malaria. One had been ill for months. The two blood films showed the presence of *Plasmodium malariae* parasites. Since neither of the individuals had ever left the island, there was a suspicion that there might have been a resumption of malaria transmission in the area of their residence. The Ministry of Health of Grenada, with the assistance from CAREC conducted mass thick blood films surveys at Westerhall (Fig. 6.3.1), the focus of the first two cases, and other places where it was possible for transmission to occur. Of the 362 blood films examined, 67 were positive for *P. malariae*. In addition to the blood films, capillary blood on absorbent paper was collected for testing by the indirect fluorescent antibody test (IFAT), by Dr C C Draper at the London School of Hygiene and Tropical Medicine. Dr Draper found 30 more cases using the IFAT. He subsequently introduced the test to the CAREC Parasitology laboratory. The outbreak was controlled

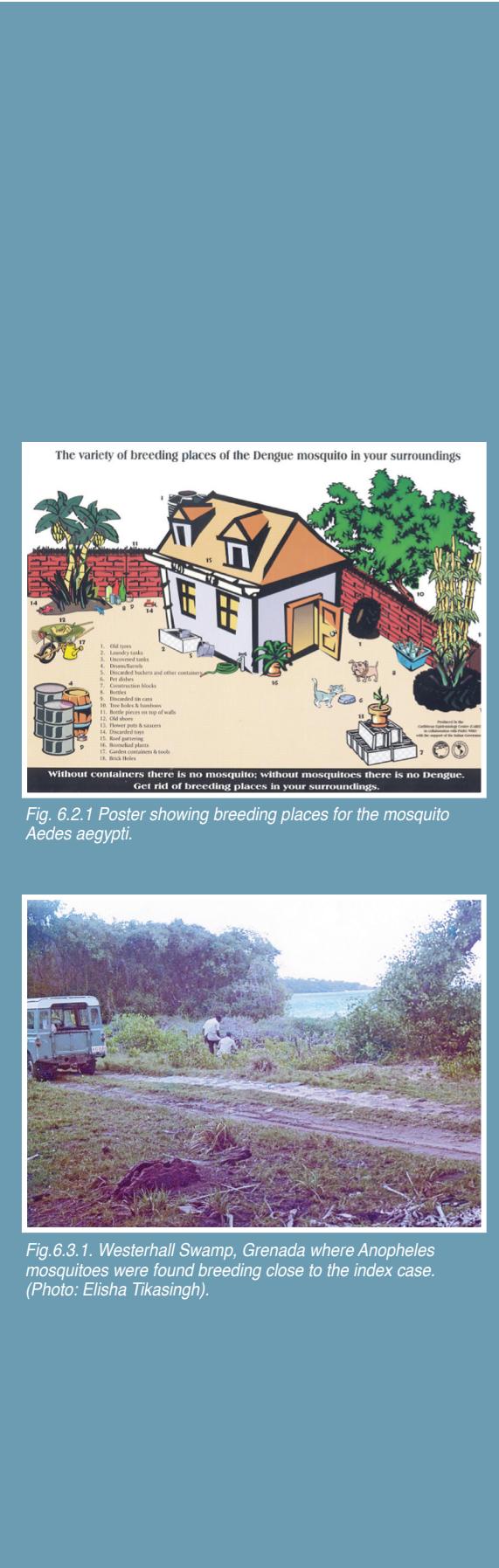


Fig. 6.2.1 Poster showing breeding places for the mosquito *Aedes aegypti*.



Fig. 6.3.1. Westerhall Swamp, Grenada where Anopheles mosquitoes were found breeding close to the index case.  
(Photo: Elisha Tikasingh).

using a combination of chloroquine and primaquine to treat persons with positive blood films.

Towards the end of 1981, two cases of malaria (*Plasmodium falciparum*) were detected in the Bahamas, a country considered by WHO as "Never malarious or malaria eradicated without specific attack measure." The two persons with malaria had never travelled outside of the Bahamas and local transmission was suspected. CAREC was asked to assist the government and house-to-house surveys were conducted taking blood smears from people about one half-mile radius from each of the two cases. From New Providence Island, blood smears were made from 1,158 persons with six persons being positive for *P. falciparum*. During this survey, blood spots on filter paper for IFAT serology were done and 36 of these were per positive with high titres. On Grand Bahama, there were two positives by microscopy and an additional four by serology from 92 fever cases. Control measures consisted of radical treatment of positive cases and residual spraying with one 1% Baytex 4 and two cycles of fogging with 90% malathion. Another small outbreak occurred in February 1998. The initial cases were fatal and were classified as imported. Subsequent screening surveys utilising thick and thin blood films for microscopy, as well as blood spots for IFAT, identified four additional cases, which were classified as indigenous.

### Typhoid Fever

Typhoid fever is a systemic bacterial disease caused by the bacillus *Salmonella typhi* and transmitted by food and water. It is characterised by fever, which may be insidious, and sometimes sustained headaches, anorexia, malaise,

constipation or diarrhoea and cough. Typhoid fever occurs worldwide and it is endemic in some countries in the Caribbean. While typhoid is generally under control in CMCs, epidemics occur from time to time and CAREC's staff has usually been asked to help in investigating these epidemics. The first of these was at Coulibistrie and Woodford Hill in Dominica and at Niagara, Jamaica in 1979. By 1984, 11 of 19 countries were reporting increased numbers of cases. However, most of these were investigated and brought under control by local workers. In 1986, increased cases were noted for Jamaica and St Lucia. In the former, a smouldering epidemic increased after heavy flooding. Again, in 1990, Jamaica experienced a large epidemic which occurred in two waves: 26 cases and three deaths in July - August and 158 cases and four deaths in September - October at Westmoreland. Problems in this area include inadequate water supplies and faecal disposal systems, a high water table and many poorly controlled food vendors. A CAREC epidemiologist, at the Jamaica Government's request, visited the area and conducted case control studies. There was positive and significant association with the use of the rivers/canals, buying vegetables at the market, and eating ice/ice cream cake from vendors.

Where there was the occasional report or epidemic in some of the countries, these were investigated and brought under control by local staff. A good example of where local staff investigated an outbreak of typhoid fever entirely by themselves occurred in St Lucia in 2003. The national epidemiologist and team investigated an outbreak in Babonneau where 100 people attended a party of which 60 attendees were traced and investigated. *Salmonella typhi* was isolated from eight persons. Two of the eight persons from whom *S. typhi* was isolated were the cooks for the party and it was noted that on the day of the party there was an intermittent water supply.

### Food-borne Illnesses and Gastroenteritis

Very early in the life of CAREC, staff were called upon to assist with outbreaks of food-borne and water-borne illnesses as well as acute gastroenteritis. In 1976, for example, CAREC investigated an outbreak of gastroenteritis in a rural county of Trinidad and another outbreak in 1977 also in Trinidad caused by the organism, *Salmonella arechevalata*. Later, in 1979, the Principal Medical Officer of Health (Epidemiology) in Trinidad when stationed at CAREC on an attachment, along with other CAREC staff, investigated an outbreak of *Salmonella typhimurium*, among paediatric patients in a Port of Spain hospital. There have

been subsequent outbreaks of food-borne and water-borne illnesses in the Caribbean, some of which were as follows:

- 1981 - CAREC was asked to investigate an outbreak of gastroenteritis in a large hotel where 40 per cent of the guests fell ill. Investigations revealed that a cross-connection between the potable water system and a sewage recycling water system intended for garden irrigation and the flushing of toilets was the cause of the problem. Subsequently, CAREC was asked to undertake an independent assessment of food processing operations associated with a previous report of food-borne illness.
- 1983 - There was a food-borne outbreak of *Salmonella typhi* in Grenada, but this was investigated by Grenadian staff members.
- 1984 - An outbreak of *Campylobacter jejuni* in another large hotel in the Caribbean among two groups of tourists who had stayed at the hotel in consecutive weeks. CAREC investigated this outbreak and found that there were serious defects in a chicken-processing plant where the chilling of carcasses provided multiple opportunities for cross-contamination.
- An outbreak of cryptosporidiosis occurred in another country involving 80 tourists who had developed diarrhoea on returning to the USA.
- 1997 - The Medical Officer of Health in Antigua and Barbuda reported to CAREC an outbreak of gastroenteritis due to rotavirus in which 4,000 persons were affected.
- 1998 - An outbreak of viral gastroenteritis involving 400 persons in a hotel. It was found that the hotel's drinking water was contaminated with sewage. Norwalk-like virus was identified as the causative agent.
- 2001 - In Trinidad, an outbreak due to *Salmonella enteritidis* where more than 100 persons became ill after eating dessert (called Tiramisu) made with raw eggs.

Also in the Turks and Caicos Islands, 78 persons from Canada, USA and the United Kingdom became ill while staying in a hotel. *Shigella sonnei* was isolated from 15 persons.

In another hotel, one guest, on her return to her home, E. coli 0157:H7 was isolated. In Tobago, two hotels had 72 cases of gastroenteritis. Investigations started late so no pathogens were isolated.

**Table 6.2.** Summary of the larger outbreaks of food-borne illnesses in the Caribbean.

Date	Food-borne illness	Country	Date	Food-borne illness	Country
1979	<i>Staphylococcus</i>	Trinidad	2001	<i>Salmonella enteritidis</i>	Trinidad and Tobago
		Montserrat			Jamaica
1984	<i>Campylobacter</i>		2001	<i>Salmonella enteritidis</i>	Suriname
1987	<i>Campylobacter</i>	Barbados	2002	Gastroenteritis	Cruise Ship
	Gastroenteritis	St Kitts		Food-borne illness	Turks and Caicos
		Bermuda	2003	Gastroenteritis	Cruise Ship
		Dominica			Jamaica
		St Vincent	2004	Shigellosis	Tobago
		St Lucia	2005	Gastroenteritis (Enterobacter)	Turks and Caicos
		Bahamas		<i>Salmonella oranienburg</i>	Aruba
		Barbados		Norwalk-like	Turks and Caicos
		Trinidad and Tobago		Campylobacter	Bahamas
		Jamaica		<i>Salmonella enteritidis</i>	Jamaica
1988	Food poisoning	Barbados			St Vincent
1991	Food poisoning	Bahamas			Grenada
1992	Gastroenteritis (Rotavirus)	Anguilla		Gastroenteritis	Dominica
	Gastroenteritis	Grenada	2005	Gastroenteritis (Norwalk-like virus)	Bermuda
		Jamaica		Gastroenteritis	British Virgin Is.
	<i>Salmonella</i>	Cruise Ship		Gastroenteritis ( <i>Salmonella</i> group D)	Jamaica (Dec.)
	Shigellosis	Cruise Ship		Gastroenteritis	St Vincent and the Grenadines
1997	Gastroenteritis (Rotavirus)	Antigua and Barbuda	2006	Gastroenteritis	Anguilla
1998	Gastroenteritis (Rotavirus)	Bermuda		Gastroenteritis (aetiology undetermined)	Dominica
2000	<i>Salmonella enteritidis</i>	Jamaica		Enterococcal infection	Bahamas
	Gastroenteritis (Norwalk virus)	Bermuda			
	Food-borne illness ( <i>Salmonella oranienburg</i> )	Tobago			

**Table 6.2.** Summary of the larger outbreaks of food-borne illnesses in the Caribbean. (continued)

Date	Food-borne illness	Country
2007	<i>Salmonella enteritidis</i> , <i>S. Rubislaw</i> , <i>S. Welteveren</i> ; <i>Shigella sonnei</i> ; <i>Norovirus</i>	Barbados, Bahamas, St Lucia, Jamaica, Suriname, Trinidad and Tobago and Turks and Caicos Islands
2008	<i>Norovirus</i>	Barbados, St Lucia
2010	<i>Norovirus</i>	Dominica
	Ciguatera, <i>Shigella dysenteriae</i> , <i>Shigella sonnei</i> , <i>Salmonella Group D</i>	Jamaica
2011	<i>Norovirus</i>	Barbados
2012	<i>Norovirus</i>	Barbados, Bermuda, Turks and Caicos Islands

### Other Epidemics Investigated

Apart from the foregoing epidemics, CAREC was called upon to investigate a wide variety of disease outbreaks some of which included non-communicable diseases. Indeed, one such episode occurred when CAREC was one year old and it was asked to investigate an insecticide poisoning episode in Jamaica. This occurred in January 1976 when 79 persons were acutely poisoned by the organophosphate insecticide parathion. There were 17 deaths. Dr P Diggory investigated this episode and followed the trail to a Western European port where insecticides and foodstuffs were stored in the same building and where the contamination most likely occurred.

The following Table 6.3 shows some of the types of epidemics investigated and countries involved.

**Table 6.3.** Other epidemics investigated by CAREC's staff

Date	Epidemics investigated	Country
1976	Parathion poisoning	Jamaica
1978	Tetanus	Trinidad and Tobago
	Diphtheria	
	Measles	
1986	Start of HIV/AIDS programme	
1987	Jaundice	Antigua Barbuda
	Thallium intoxication (false positive)	Guyana
	Scabies	Trinidad
	Rabies	Belize
1988	Hepatitis A	Trinidad
	Influenza	St Vincent
	Scabies	Trinidad
1990	Measles	British Virgin Islands
		Jamaica
		Tobago
1991	Pertussis	Bahamas
1992	Cholera	Belize
		Guyana
1993	Hepatitis A	Turks and Caicos
1996	Legionnaire's disease	Antigua
1996	Acute Renal failure	Haiti
1998	Nosocomial septicemia	Dominica
2000	Eosinophilia meningitis	Jamaica
	<i>Klebsiella pneumoniae</i>	Guyana
	Legionellosis	Barbados

**EPIDEMICS INVESTIGATED (continued)**

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**Table 6. 3.** Other epidemics investigated by CAREC's staff (continued)

Date	Epidemics investigated	Country
2001	Anthrax threat	Trinidad
	West Nile Virus	Cayman Islands
2002	Illness amongst health workers	Dominica
2003	Acute haemorrhagic conjunctivitis	
	West Nile Virus	Bahamas
2005	<i>Pseudomonas</i>	Dominica
2005	Leptospirosis	Jamaica
2006	Haemorrhagic disease of newborns	Belize
2006	Leptospirosis	Guyana
2007	Malaria due to <i>Plasmodium falciparum</i>	Bahamas

In investigating all outbreaks CAREC used the opportunities presented to assist local staff in developing surveillance and investigation capabilities and thus helped to build local capacity in outbreak investigation. Over the years, staff of CMCs were able to do their own outbreak investigation, depending only on telephone consultations with CAREC when necessary. In some instances CAREC also assisted with providing supplies needed for the investigations.