An Outbreak of Malaria in Sta. Rosa, Laguna

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SUMMARY

An outbreak of malaria in Sta. Rosa, Laguna was recognized and subsequently controlled through the joint efforts of three agencies of the Department of Health in July 1988. Morbidity rates decreased from 52.8 to 6.2 after prompt intervention measures were instituted. Parasitological and entomological surveys indicated the preponderance of falciparum malaria, higher infection rates among adolescents and adults especially males, the occurrence of parasite resistance to the 4-aminoquinolines, notably amodiaquine, the presence of *Anopheles flavirostris* and necessity for continued surveillance in the context of primary health care. *[Phil J Microbiol Infect Dis 1988; 17(2):49-57]*

Key Words: malaria, *Plasmodium falciparum*, *Anopheles flavirostris*, outbreak

INTRODUCTION

Sta. Rosa (pop. 83,344), one of the municipalities of the province of Laguna on the western side of Laguna Lake, is presumed to be malaria-free. Those on the east bank adjacent to Quezon Province, on the other hand, are known endemic areas, Figure 1 This municipality is about 40 kms south of Manila and 12-15 kms from Alabang, Muntinlupa.

It is a plain with 98% of the total land area of 5,415 hectares having a slope of zero-2.5% making it suitable for both agriculture and urban development An irrigation network serves the area, Figure 2.

Figure 1. Map of the Province of Laguna

Figure 2. Map of the municipality of Sta. Rosa, Laguna

Pulong Sta. Cruz (pop. 3,942) is one of 18 barangays to which Sitio Coral na Bato (pop. 322) belongs. The latter is contiguous with a vast sugar cane plantation under the Canlubang Industrial Estate, a private corporation in the municipality of Calamba. There are 14 business establishments within the jurisdiction of Sta. Rosa. These include factories and a sub-station of the Manila Electric Company. The relevant health agencies are the Provincial Health Office in Sta. Cruz, the District Hospital in Calamba, a Rural Unit in Barangay Balibago, a Malaria Detection Post at Canlubang Industrial Hospital, two teaching hospitals in Biñan, and several private clinics in the vicinity of Sta. Rosa.

Early in July 1988, patients were referred to the Research Institute for Tropical Medicine (RITM) at Alabang, Muntinlupa by a private practitioner from the Poblacion (or town proper) of Sta. Rosa. Within two weeks eight cases of falciparum malaria were admitted and treated at RITM hospital. One of these cases was drug-resistant. Consequently, an epidemiological investigation was conducted together with the Malaria Control Service, the Provincial Health Office and the Regional Health Office IV.

This paper reports the results of that initial joint effort in the investigation and assessments made by the Malaria Study Group at RITM.

METHODS

Blood Examination

Peripheral blood smears (Giemsa stained) were taken by finger prick during active/passive case detection (ACD/ PCD) and mass blood survey (MBS). Parasite species and counts of asexual and gametocyte stages were recorded according to Bruce-Chwatt (1985).[1]

Spleen Examination

Spleen enlargement in children ages 2-9 years old was measured according to Hackett (1963).[2] The average enlarged spleen (AES) was calculated from the frequency distribution of various classes of spleens.

Geographic Reconnaissance

A household census was performed while noting affected domiciles and surrounding vegetation relative to malaria transmission. Data on the physical environment were obtained from the Municipal Office.

Entomological Survey

Larval mosquitoes were collected by dipping at various points of the irrigation system. Adult mosquitoes were caught at night from carabao-baited traps, CO_2 light traps and human baits.

Drug Sensitivity Assays

The susceptibility of *Plasmodium falciparum* isolates from patients was tested by the standard in vitro micro-technique of Rieckmann et al (1978).[3] The endpoints used for individual drugs were: 8 pmol (chloroquine), 4 pmol (amodiaquine), 256 pmol (quinine), 64 pmol (mefloquine), and 1000 pmol (sulfadoxine-pyrimethamine).

Hospital Records

The number of cases seen and treated at Canlubang Industrial Hospital was obtained from their medical records. These were confirmed at the Malaria Detection Post.

Intervention Strategy

DDT indoor residual spraying of households was conducted between August 7 and 10, 1988 as per SOP of the Malaria Control Service with the help of the Canlubang Industrial Estate management. Intensive health information campaigns and informal meetings with barangay officials were held to promote preventive measures and consultation at the Rural Health Unit and/or the Malaria Detection Post. Children were examined and treated at Pulong Sta. Cruz Elementary School. Continuing dialogues with government and private health sectors as well as the community were initiated.

RESULTS

Sitio Coral na Bato is a small community of farmers living alongside a dirt road and irrigation ditch on the southwestern boundary of Sta. Rosa (Figure 3). Fifty-three percent (53%)of the population belong to the age group of 15 years and over (Table 1). Malaria was detected by active and passive case finding. The morbidity rate (per 1000 pop.) in Coral na Bato at the height of the epidemic in July was 52.8 (Table 2). This was immediately reduced to 6.2 after spraying operations in August. The over-all incidence of cases and parasitological indices showed a preponderance of falciparum infections and higher prevalence rates in adolescents and adults particularly males (Figure 4).

Table 1. Age and sex distribution of Sitio Coral na Bato residents

Age Group	Number		Total
	Male	Female	
0-11 mos	6	3	9
12-24	6	6	12
2-4 yrs	20	14	34
5-9	24	36	60
10-14	15	22	37
15 yrs and over	87	83	170
Total	158	164	322

M:F ratio = 0.96:1.00

Table 2. Prevalence of falciparum malaria at Sitio Coral na Bato, Sta. Rosa, Laguna in 1988

Date	No. Examined	No. Positive	Slide Positivity Rate (SPR)[a]	Morbidity Rate[b] (per 1000 pop)
14-15, 19 July[c]	98	17	17.3	52.8
24 August[c]	53	2	3.8	6.2
20-21 September and 6-7 October[d]	202	2	0.99	6.2

[a]SPR = No. Positive /No. Examined x 100
[b]Morbidity Rate = No. Positive/No. at Risk x 1000
[c]Active and Passive Case Detection
[d]Mass Blood Survey

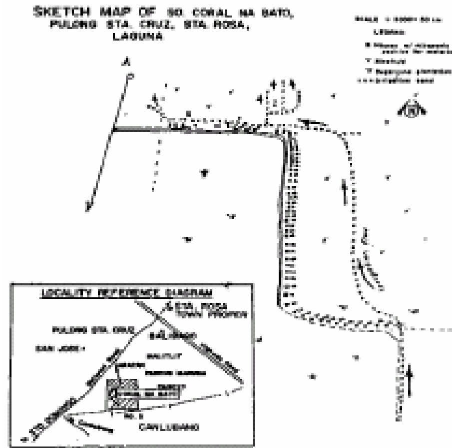

Figure 3. Geographic reconnaissance of Sitio Coral na Bato in Barangay Pulong Sta. Cruz, Sta. Rosa, Laguna

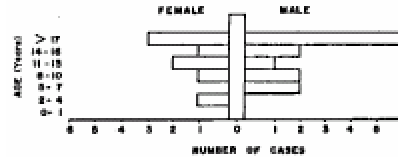

Figure 4. Age and sex distribution of malaria cases at Sitio Coral na Bato in 1988

The parasite density index for sexual forms was 5.9 representing a count of 801-1600 per mm^3 (ul) of blood (Table 3). The gametocyte index was 3.9 or a parasite load of 201.400 infective stages to mosquitoes (Table 4).

Malariometric surveys conducted in September and October 1988 revealed a remarkable decrease in infection rates in all age groups (Table 5). The slide positivity rate (SPR) was reduced to 0.99% in September from 17.3% in July (Table 2). The spleen rate in children 2-9 years of age was 10.5% reflecting mesoendemicity of malaria (Table 6). In vitro drug sensitivity assays of falciparum isolates from Sta. Rosa and Calauan where a similar flare-up occurred indicated resistance to the 4-aminoquinolines and the sulfadoxine-pyrimethamine combination (Table 7).

Nine species of anopheline mosquitoes were caught from carabao-baited traps, CO2 light traps and human baits (Table 8). These included Anopheles flavirostris, the principal vector of malaria in the Philippines. Larvae were recovered from an irrigation canal at Coral na Bato.

Table 3. Malaria prevalence and parasite density (P. falciparum asexual forms) at Sitio Coral na Bato according to age, July-September, 1988

	Age Group (Years)						
Parasite Density (Class)[a,c]	0-11 mos	12-24 mos	2-4	5-9	10-14	>15	Total[b]
0	4	13	49	82	50	143	341
1						1	1
4						1	1
5					1	1	2
6				1		1	2
7			1				1
8						2	2
9			1				1
Total examined	4	13	50	84	51	202	351
Total positive	0	0	1	2	1	6	10
Prevalence Rate	0	0	2.0	2.4	1.96	2.97	2.85

[a]No subjects under classes 2, 3, and 10
bExcluding one or two with species diagnosis but without parasite counts
[c]Parasite Density Index 59/10 = 5.9

The results of blood smear collection by locality as reported by the Malaria Detection Post indicated the spill-over of infection from Canlubang to the adjacent environs of Sta. Rosa and Cabuyao in 1988 as well as a seasonal transmission in the hot summer months from March to July, Figure 5. Records of cases seen at the Canlubang Industrial Hospital substantiated the

occurrence of an epidemic in 1988 vs. 1987, Figure 6. The peak in Canlubang occurred in April preceding that in Sta. Rosa in July, Table 9.

Table 4. Malaria prevalence and parasite density (P. falciparum gametocytes) at Sitio Coral na Bato according to age, July-September, 1988

	Age Group (Years)						
Parasite Density (Class)[a,c]	0-11 mos	12-24 mos	2-4	5-9	10-14	>15	Total[b]
0	4	13	49	82	47	145	340
1				1		1	2
2			1		1	1	3
4				1		3	4
5					2		2
7						1	1
Total examined	4	13	50	84	51	150	352
Total positive	0	0	1	2	4	5	12
Prevalence Rate	0	0	2.0	2.4	7.8	3.3	3.4

[a]No subjects under classes 3,6,8,9, and 10.
[b]Excluding one or two with species diagnosis but without parasite counts
[c]Parasite Density Index = 47/12 = 3.91

Table 5. Mass blood survey at Sitio Coral na Bato, September and October, 1988

			No. Positive			
Age group	Population	No. examined	Pf	Pv	SPR[a] (%)	PR[b]
0-11 mos	9	4	0	0	0	0
12-23 mos	12	10	0	0	0	0
2-4 years	34	27	1	0	3.7	2.9
10-14	60	51	0	0	0	0
5-9	37	25	0	0	0	0
15 and over	170	85	1	0	1.2	0.6
Total	322	202	2	0	0.99	0.62

[a]Slide positivity rate (SPR) = No. positive/No. examined x 100
[b]Parasite rate (PR) = No. positive/No. people in pop. x 100

Table 6. Spleen examination of children 2-9 years old at Sitio Coral na Bato, September and October 1988

	Spleen Class		
Ages	0	1	Total
2	8	1	9
3	11	0	11
4	7	1	8
5	10	0	10
6	7	1	8
7	12	2	14
8	4	2	6
9	9	1	10
Total	68	8	76

Total no. of children 2-9yrs. of age = 94
Total no. of children examined,2-9yrs. of age _ 76 (80%)
Spleen rate = 8/76 = 10.5% (Mesoendemic)
Average Enlarged Spleen (AES) = 8/8 = 1

Based on the interviews and reports of the Malaria Detection Post the initial case was that of a security guard, an employee of the Industrial Estate and a resident of Pulong Sta. Cruz, who died of falciparum malaria in April, 1988. On July 7, 1988 an 11 year old semi-comatose male was admitted at RITM hospital with fever. Peripheral blood smears were positive for *P. falciparum.* With an admitting diagnosis of cerebral malaria, the patient was given quinine for 7

days and subsequently discharged asymptomatic and negative for malaria parasites. The boy, attending school at Pulong Sta. Cruz, did not travel in the last 6 months prior to illness. On July 17, 7-year old boy whose mother was likewise confined at RITM for malaria presented with an RIII level of resistance to chloroquine. The patient responded favorably to oral quinine.

Table 7. In vitro drug susceptibility assays

Patient No.[a]	Chloroquine	Amodiaquine	Quinine	Mefloquine	Sulfadoxine-pyrimethamine
1	R[b]	R	S	-[d]	-
2	S[c]	S	S	-	-
3	S	R	S	-	-
4	S	R	S	S	S
5	S	R	S	S	S
6	S	R	S	S	S
7	S	R	S	S	S
8	S	R	S	S	R

[a]Patients 1-3 from Sta. Rosa and patients 4-8 from Calauan, Laguna
[b]R = resistant
[c]S = sensitive
[d]Not done

Table 8. Entomological survey of two barangays at Sta. Rosa, Laguna, July, 1988

	Barangay Pulong Sta. Cruz, Sitio Coral na Bato		Barangay Malitlit Sitio Pasong Mangga			
Mosquito Species	CBT[a]	CO_2 light trap	CBT	Bare leg catches	CO_2 light trap	Total
Subgenus Cellia						
Anopheles annularis	34	2	28	1	0	65
An. filipinae	1	0	0	0	0	1
An. flavirostris[b]	2	0	0	0	0	2
An. ludlowae	7	1	0	0	0	8
An. subpictus	5	3	13	0	0	21
An. tesselatus	13	3	20	0	0	36
An. vagus	242	243	117	0	0	602
Subgenus Anopheles						
An. lesteri	69	38	20	4	0	131
An. peditaeniatus	263	62	127	11	5	468
Total	636	352	325	16	5	1334

[a]Carabao-baited trap [b]Primary vector of malaria in the Philippines

Table 9. Seasonality of malaria at Sta. Rosa, Laguna in 1988*

Month	Parasite Pf	Species Pv	Total Positive	Total Examined	SPR %
Jan	-	-	-	-	-
Feb	1	0	1	10	10.0
Mar	0	0	0	6	0
Apr	14	0	14	469	3.0
May	2	17	19	52	36.5
Jun	6	0	6	23	26.1
Jul	61	4	65	257	25.3
Aug	3	4	4	161	2.5
Sept	0	0	0	198	0
Oct	0	0	0	30	0

*Active/passive case detection and mass blood survey; data from Malaria Detection Post, Canlubang Industrial Hospital.

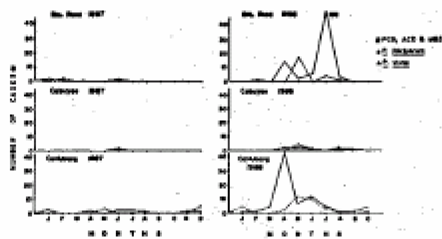

Figure 5. Malaria transmission in the vicinity of the sugar cane plantation at Canlubang

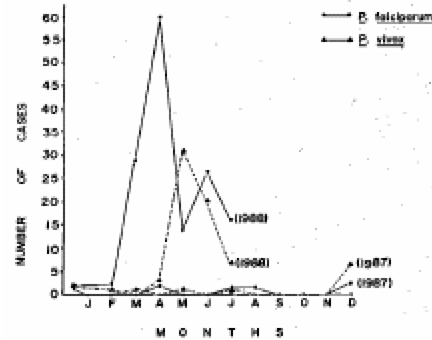

Figure 6. Malaria cases seen at the Canlubang Industrial Hospital, Calamba, Laguna, 1987 and 1988

Cases were also seen from Aratan, Himedez, Pasong Mangga, and Pagoyo. Most Of the families living in the study area have been there in the past 10-20 years. Suspecting an outbreak in a hitherto unrecognized endemic focus, the incidence of these cases was reported to the Rural Health Unit at Barangay Balibago, thence, to the Provincial Health Office and Regional Health Office IV. Teams from these agencies were organized to investigate the epidemic.

As a remedial measure indoor residual spraying of houses with DDT was implemented with the help of spray-men from the Canlubang Industrial Estate under the supervision of the Malaria Detection Post. A total of 562 houses with an estimated population of 3,387 were sprayed between August 7 and 10. Simultaneous malariometric survey and health information campaign established the occurrence of malaria at Sitio Coral na Bato and henceforth, its timely control.

The RITM group continued to visit the area to monitor parasitological and entomological indices and to encourage community participation in surveillance and long-term vector control. Residents began clearing the waterways of surrounding vegetation to destroy natural mosquito harborages and to accelerate the flow of water in the irrigation system. Volunteers were trained in the preparation of blood smears and to coordinate with the Rural Health Unit in case finding and treatment.

DISCUSSION

There is a need to look into the yearly influx of migrant sugar cane workers or "tabaseros" from hyper-endemic areas elsewhere in Luzon. These men are brought to Canlubang in batches as contractual laborers starting October and stay throughout the harvest season in summer. As many as 200 persons at a time are housed in barracks near vector mosquito habitats. There was a breakdown in surveillance and strict-enforcement of mass blood screening and anti-malaria measures in the past year.

The medical practitioners and residents of Sta. Rosa were not aware of malaria in their midst before the epidemic. Cases were usually diagnosed as enteric fever or hepatitis and referred to the District Hospital Calamba. In retrospect a number of these were eventually brought to San Lazaro Hospital in terminally ill conditions. These could have been averted if the disease was recognized earlier together with adequate knowledge of possible drug-resistance and appropriate management of severe and complicated malaria.

Higher infection rates among adolescents and adults, especially males, implicate outdoor transmission more than indoor transmission. Younger children and women were more likely to stay inside houses, probably asleep, during the biting peak period of 2330-0230 hours of *Anopheles flavirostris*.[4] The infant parasite rate was surprisingly nil. Pre-school and school

children may wander about the yard to play in the early evening hours hence, a considerable number were infected and accounted for the spleen rate of 10.5%.

As early as 1968, there were already reports of amodiaquine-resistance including cases where parasitemia never cleared i.e., RII and Rill levels.[5,6] These preceded reports of chloroquine resistance. Because amodiaquine has been available and used widely since the 1950's the emergence of resistance to this drug may be attributed to selective drug pressure. Studies conducted by NAMRU-2 researchers demonstrated increasing resistance to the 4-aminoquinolines, amodiaquine and chloroquine.[7,8] The finding of resistance to other drugs e.g. sulfadoxine-pyrimethamine reminds us that we are approaching multi-drug resistance in malaria as seen in neighboring Southeast Asian countries.[9,10]

CONCLUSION

The potential for malaria epidemics exists wherever anopheline vectors are present, disease surveillance and control measures are discontinued and people are moving in from highly endemic areas. Because of its protean nature the disease is not usually suspected in previously malaria-free areas. Thus, prompt diagnosis and treatment are lifesaving in falciparum malaria, which could readily progress to severe and complicated conditions such as cerebral malaria, renal failure, pulmonary edema, and hemolytic anemia especially in children.

Failure to recognize drug resistance within the first 48 hours of treatment with anti-malarials lead to unmanageable levels of parasitemia and irreversible pathophysiological processes. Drug-resistant malaria is therefore both a clinical and public health problem that needs to be tackled and contained. While emergency procedures such as insecticidal vector control help to curb epidemics, long-term prevention should in the final analysis be the desired target of intervention. The Sta. Rosa experience shows the importance of concerted community efforts and inter-agency cooperation. People are not refractory to change. The goal is to explore all possible venues and to find relevant solutions that are well within the capabilities of the people who will implement them.

Acknowledgements

We thank the Philippine Council for Health Research Development for partial support of this study. Special thanks are due to the following: Dr. Edilberto Fernando, Dr. Mediadora C. Saniel, Dr. Francisco P. Tabia, Dr. Rolando A. Poblete, Dr. Raul A. Edralin, Dr. Crispin P. Echiverri, Dr. Jimmy Chua, Dr. Leonard I. Ortega; Ms. Felisa Guballa, Mr. Jess Vosotros, Mr. Nic Reyes, Mr. Rey Lota, Mr. Isidro L. Gesmundo, Ms. Florence Panganiban, Mr. Miguel Rivera, Mr. Watawat M. Cueto, Mr. Albert Oyco, Ms. Rosario P. Vacal, Dr. Mary Elizabeth G. Miranda, and Ms. Marflu Carrera who made this work possible.

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