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MALARIA PROGRAM IN BRAZIL'S AMAZON REGION

Amazonia accounts for 73 per cent of the malarious area of Brazil (see Figure 1), but it contains only 20 per cent of the total Brazilian population. Eradicating malaria from the Amazon region is considered a long-term undertaking, owing to factors that make it difficult to control the disease and that favor transmission.

The obstacles to malaria control include low demographic density, dispersion of the population, existence of nomadic groups, difficult access to areas close to the tributaries and subtributaries of major rivers during the dry period in the second half of the year, and flooding of fields in the second half of the year. Continuous migratory flows from areas free of transmission to Amazonia are assuming considerable importance in the epidemiology of malaria and are responsible for the heightening of the endemia in various parts of the region.

The factors that favor malaria transmission are associated with environmental conditions propitious to the maintenance of the endemia—such as temperature, humidity, and rainfall—which influence the life and development of the vectors. In this regard, special mention should be made of the ramshackle construction of houses in the region, which allows the entry of man-biting mosquitoes, thereby contributing to transmission and maintenance of the endemia.

Technical Problems

Technical malaria control problems in Amazonia are associated with parasites, vectors, and people.

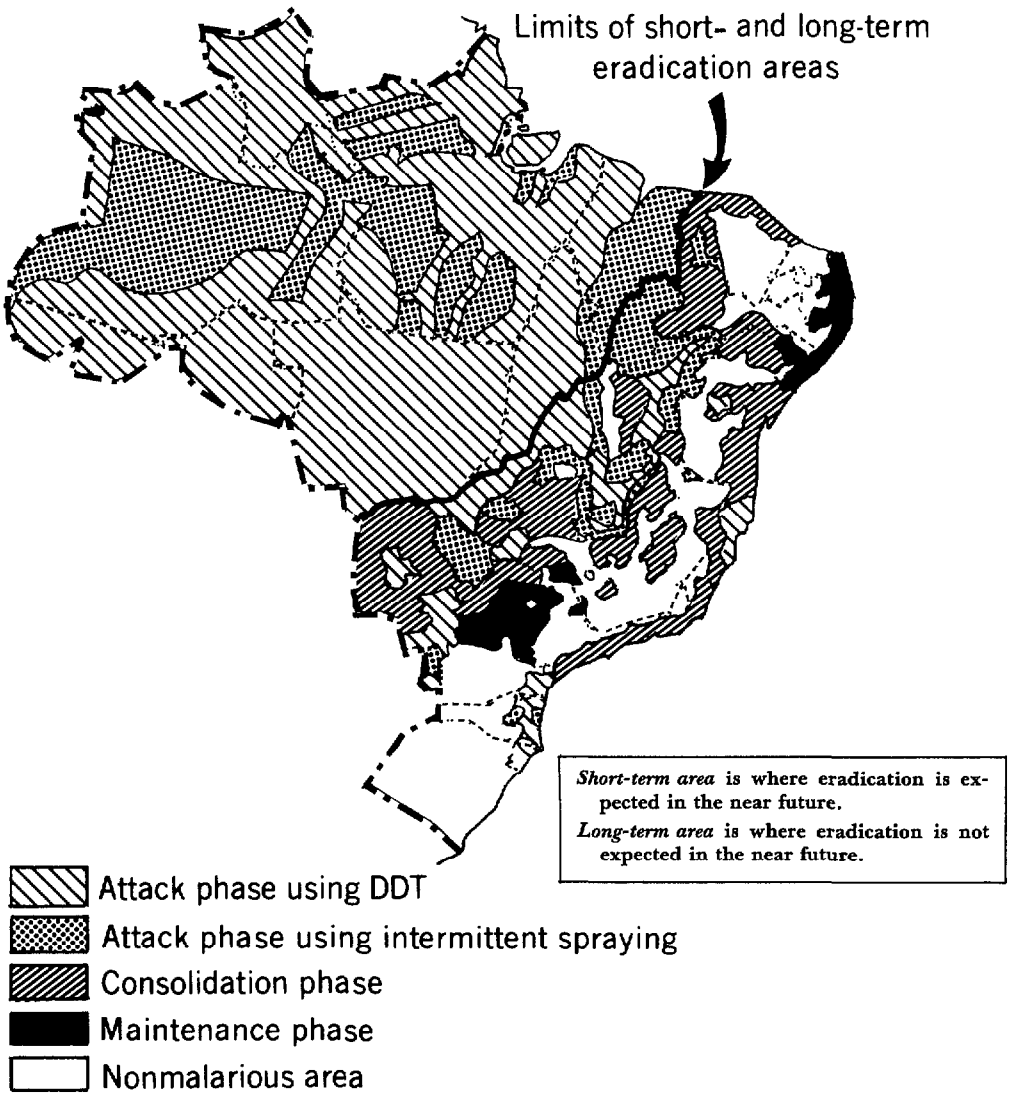
In regard to parasites, studies initiated in 1961 in five states and territories (Amapá, Amazonas, Pará, Rondônia, Roraima) proved the existence of chloroquine-resistant strains of *Plasmodium falciparum.*

Insofar as vectors are concerned, *Anopheles darlingi* is the most important vector species. Though susceptible to DDT, in some places where unwalled or uncompleted houses predominate it is able to transmit malaria—because there are no potential landing places that can be sprayed.

Problems related to man, his habits, and his environment also have a marked influence on the epidemiology of malaria. In keeping with Brazil's overall development policy and the aim of increasing the population density in hitherto uninhabited areas, the Government is promoting and conducting agricultural, settlement, mining, and hydroelectric projects, as well as highway construction. These projects have attracted migratory flows of workers and their families from other regions. Some of the migrants later return to their places of origin, and some thereby spread malaria to areas or regions where it was no longer being transmitted.

Despite the fact that the Superintendency of Public Health Campaigns (SUCAM) performs semiannual house spraying as a regular development project activity—as well as collecting blood samples and providing treatment to individuals with fever—the incidence of malaria has not diminished significantly. However, the fact that SUCAM's work is concentrated in the areas at greatest risk increases the number of positive tests, sharply distorting the parasite indexes because of the many houses inspected more than once with positive results. Tables 1 and 2 respectively

Figure 1. Areas and phases of the malaria eradication program, Brazil, 1978.



show the number of DDT house sprayings ($2g/m^2$) and the parasite rates in 1978.

Malaria Control Studies

Considering the technical problems that have hampered malaria eradication in Amazonia, as well as the possibility that such problems may become more serious, studies of the types listed below are urgently needed:

- *Malaria chemotherapy:* Study of the susceptibility of *P. falciparum* to antimalaria drugs; study of the efficacy of the new schemes for treating *P. vivax* infections; and clinical tests and field studies of new drugs.

Table 1. Data on spraying, 1978 (long-term area).

Regional divisions	Directly protected population	No. of houses sprayed
Acre	210,928	47,727
Rondônia	287,077	74,324
Amazonas	313,949	80,609
Roraima	49,905	13,051
Amapá	119,514	24,056
Pará	1,521,179	384,306
Maranhão	1,969,941	560,537
Goiás	559,042	163,317
Mato Grosso	588,422	154,767
Total	5,619,957	1,502,694

Source: SUCAM.

Table 2. Number of slides examined, number positive, and parasite indexes, 1978.

Regional divisions	No. of slides		Index of positive slides	Annual parasite index
	Examined	Positive		
Acre	32,779	6,331	19.3	23.2
Rondônia	96,045	27,989	29.1	175.0
Amazonas	81,699	4,698	5.1	4.0
Roraima	29,971	7,233	24.1	136.0
Amapá	21,494	6,829	31.7	42.4
Pará	289,140	30,150	10.4	10.7
Maranhão	313,967	13,593	4.3	3.8
Goiás	34,796	1,993	5.7	2.3
Mato Grosso	61,711	6,815	11.0	8.7
Total	961,602	105,631	10.9	10.7

Source: SUCAM.

• *Immunology:* Serologic tests for use in diagnosis and epidemiologic surveillance.

• *Vectors:* Study of the ecology and biology of vectors.

• *Control methods:* Application of new insecticides in various epidemiologic situations, biological control of vectors, and combined application methods.

Aware of these needs, SUCAM, with advisory assistance from PAHO/WHO, is undertaking the following research: a general study of the problem areas of Amazonia in order to determine the reason for difficulties in applying control measures and to propose new methods in this field; and tests of a new antimalaria drug (mephloquine) for use against chloroquine-resistant strains of *P. falciparum.*

The Amazonia Development Superintendency (SUDAM), which is responsible for coordinating regional development, has also undertaken a study—together with the ministries of health, social welfare, education and culture, and labor—to define the minimum health and education services to be provided for workers in companies operating within the Amazon region.

Article 2 of Resolution 3, 750/79 of the Governing Board of SUDAM reads as follows:

The minimum health and sanitation services to be provided to company personnel shall have the following objectives:

• Protect the population against regional endemias and prevent the introduction of endemic diseases not present in the region, through measures with collective coverage.

• Promote individual medical care, for which purpose the officers of the companies included within the scope of this article shall:

1. Promote, in collaboration with the Superintendency of Public Health Campaigns (SUCAM/MS), the training of employees for the performance of malaria and schistosomiasis prevention, diagnosis, and treatment activities and for vaccination against jungle yellow fever.

2. Install a small laboratory on the premises of the company for diagnosis of malaria and schistosomiasis in accordance with specifications provided by SUCAM/MS.

3. Build, close to the laboratory, a dwelling properly covered with mosquito netting and having complete vertical walls, for malaria examination and treatment of patients.

4. Construct dwellings and houses which, even if rustic or temporary, have complete vertical walls on all sides; these should be situated in places well-removed from pools of stagnant water or vector breeding grounds and be surrounded by an area with a radius of about 50 m having no vegetation.

5. Supply SUCAM/MS with detailed information on the routes of access roads to the area of the company, the annual program, the times at which clearing operations are carried out, the number of workers to be used, and their probable date of arrival at the worksite.

The Association of Amazonia Businessmen (AEA) has signed an agreement with

SUCAM with the aim of combating malaria at the site of agricultural projects. The following three clauses of that agreement are particularly worthy of note:

1. An AEA employee should be assigned to SUCAM to carry out the spraying and the epidemiologic activities.
2. A small laboratory should be installed in the project area for malaria diagnosis.
3. Antimalaria drugs provided by SUCAM should be administered in all cases in accordance with the treatment scheme recommended by SUCAM.

Source: Pan American Health Organization, *Epidemiological Bulletin* 1(3):6-8, 1980. Based on material from the Ministry of Health of Brazil, *Boletím Epidemiológico* 9(26), 1979.

IMMUNIZATION LEVELS IN CALIFORNIA SCHOOLCHILDREN

In recent years it has become apparent that rigorously enforced school and preschool child care center immunization laws are the most effective means of further reducing the incidence of vaccine-preventable diseases in the United States. School and preschool entry immunization requirements have the potential for ultimately eliminating these diseases as public health problems.

In 1977 California passed legislation strengthening and systematizing requirements that children attending school must have diphtheria, tetanus, pertussis, poliomyelitis, and measles immunizations. In the ensuing three years, California schools, with very little outside financial assistance, have made a concerted effort to bring all pupils into compliance with these requirements. This year, school entry immunization requirements for rubella and mumps will take effect in California, focusing primarily on entrants at the kindergarten level and below.

Some data on progress in implementing these laws are available. Between 1977 and the present an effort was made to assess immunization levels for the more than four million pupils in the state's public and private schools. As of 30 July 1980, immunization records of over 96 per cent of the pupils had been reviewed. The percentages reported as being adequately immunized were as follows: DTP/Td (4 or more doses of DTP or 3 or more doses of Td), 91 per cent; polio (3 or more doses), 92 per cent; measles, 94 per cent; rubella, 55 per cent; and mumps, 48 per cent. Immunization against the last two diseases was not required at the time of this assessment. Also, not all of the schools reported on immunization levels for mumps and rubella.

Annual assessments are made of the state's over 330,000 kindergarten entrants. In the fall of 1979, percentages of entrants adequately immunized against the above diseases were as follows: DTP/Td, 85 per cent; polio, 89 per cent; measles, 91 per cent; rubella, 82 per cent; and mumps, 78 per cent. Several regional surveys have provided estimates on the completeness of the follow-up of inadequately immunized kindergarten entrants. After follow-up the percentages of adequately immunized kindergarten children rose to the following levels: DTP/Td, 93.5 per cent or higher; polio, 95 per cent or higher; and measles, 98 per cent. One reason why the levels for DTP/Td and polio were not higher is that some schools have not carried out the legal mandate to order exclusion of pupils remaining inadequately immunized. Comparable data are not yet available for rubella and mumps immunizations.

While the overall effort of schools and local health departments has been excellent, problems have occurred. Occasionally, due to lack of staff, lack of understanding, or lack of com-