Malaria: Research and Operational Issues

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ABSTRACT

Current knowledge is reviewed on the global impact of malaria vis-a-vis the malaria situation in the Philippines for the purpose of identifying areas of concern for research and further development. Since the ultimate goal of research is reduction of morbidity and mortality from disease heretofore, the formulation of rational control strategies, past and present operational issues are examined from an historical perspective. The salient features of a Five-Year Strategic Plan for 1990-94 of the national Malaria Control Program are likewise presented.

From the wholistic standpoint the success of any health program nonetheless depends on the existence of an adequate and well-coordinated organization with the necessary infrastructure, scientific acumen, technological competence, and multi-sectoral involvement particularly the community that it aims to serve. Meanwhile, the importance of recognizing the eco-epidemiological dimensions of disease including socioeconomic considerations cannot be overemphasized.

For malaria will continue to thrive where living conditions are subminimal and where social apathy prevails.

INTRODUCTION

Malaria is the most important mosquito-borne disease in the world today. As it is more than half of the world population live in endemic areas where stagnation and impending epidemics continue to undermine their welfare and socioeconomic progress (Fig. 1). The estimated number of cases is close to 100 million with one million deaths per year. Particularly affected are developing countries in Asia, Latin America in the Amazon region, and tropical Africa (WHO, 1989). Imported malaria (introduced via travellers and immigrants) for that matter, transfusion malaria, constitute a risk even for those residing in non-endemic areas as a result of greater mobility among people and faster means of transportation (Parinassuta and Bunnag, 1984). Malaria however acquired is a cause of maternal and fetal deaths and is a major concern of child survival (Mashaal, 1986).

Two biological phenomena contributed to the malaria problem. These were the development of insecticide resistance in mosquitoes and drug resistance in *Plasmodium falciparum*, the most dangerous of four species affecting man. In practice control methods are directed against vectors and/or human infection, therefore, prompt detection and treatment of cases. Unlike schistosomiasis where there are animal reservoir hosts, man is the only natural source of infection with human plasmodia. On the other hand, malariologists do not have the equivalent of praziquantel that can be given as a single-dose treatment for mass drug administration. In fact, there is yet no antimalarial that cures clinically and parasitologically for prolonged periods of time. The more living factors are involved in the life cycle of parasites, the more difficult it is to control the disease that they cause. Meanwhile, a malaria vaccine may not be forthcoming in the near future.

The concept of global malaria eradication was inspired by the successful elimination of *Anopheles gambiae* in northern Egypt in 1942-45 (WHO, 1954). As early as 1946, resistance of DDT (popularized in the 1940s and the 1950s) was first recognized in two species of *Anopheles*. By 1980, resistance to one or more insecticides has occurred worldwide and in 51 anopheline species (WHO, 1980). Despite the ban on its use in agriculture DDT continued to be the mainstay of vector control because of its relatively low cost and long residual action. Nowadays, there are indications of vector avoidance of DDT-sprayed surfaces and refusal of homeowners to DDT treatment of household premises.

Fig. 1. Global status of malaria as of 1985. (World malaria situation 1985. WHO Statistical Quarterly 40: 142-170, 1987).

Chloroquine resistance is believed to have emerged in the Thai-Kampuchean border ca. 1957-59. It surfaced in Vietnam in 1961 and spread southward as far as Vanuatu where it was reported in 1980. The same occurred in Colombia and Brazil in 1960-61 and in East Africa in 1978 (UNDP, WB, WHO, 1983). Recrudescence following treatment with sulfadoxine-pyrimethamine (Fansidar^{R}) was observed in Thailand in the mid-1970s and has reached the upper limits of drug resistance (RII and RII levels) by *in vivo* tests (Harinasuta, *et al.,* 1982).

The finding of strains refractory to treatment with quinine *per se* or the monosubstance, mefloquine (Lariam^{R}) rationalized the use of triple-drug therapy with the combination mefloquine-sulfadoxine-pyrimethamine (Fansimef^{R}) or alternatively quinine plus antibiotics (tetracycline, clindamycin or erythromycin). Kremsner, *et al.,* (1988) found more than 70% of *P. falciparum* isolates multidrug-resistant in a newly colonized forest area in Acre, Brazil.

A variety of factors precipitated the resurgence of malaria in the 1970s. These were:

* management and organizational problems on the part of national government leading to deficiencies in health care delivery;
* financial constraints;
* civil unrest;
* uncontrolled migration to and from malarious areas;
* behavioral changes in vectors;
* sociological factors hampering the proper and timely implementation of control measures;
* climatological and geographic factors preventing access to affected areas.

This paper attempts to dissect some of the above-mentioned issues for the purpose of identifying areas of concern for research and policy-formulation. A comprehensive review of knowledge on malaria in this country was written in 1988 for the Philippine Council for Health Research and Development (Salazar, 1990). The salient features of that work and a Five-Year Strategic Plan of the Malaria Control Program for 1990-94 are reiterated here.

RESEARCH ISSUES

The Malaria Situation in the Philippines

Except for Cebu, Catanduanes, and Leyte endemic areas are found in 72 out of 75 provinces throughout the archipelago (Fig. 2). Varying epidemiological patterns are associated with rural habitats and the presence of one or a combination of four vector species. Perennial rainfall, relative humidity of 84%-89%, temperatures ranging from 20°-34°C, the presence of domestic animals specially the carabao, topography, and vegetation favor the survival of mosquitoes, hence, the perpetuation of the malaria cycle. Like other tropical infectious diseases malaria thrives best where living conditions are subminimal, where ignorance and public apathy are rampant, and where basic services are wanting.

Parasitological indices. The two important etiologic agents of malaria in the Philippines are *Plasmodium falciparum* and *Plasmodium vivax* with the former predominating roughly at a ratio of 65:35. If this were generally true it is a cause for alarm on account of drug resistance and the potential for severe and fatal complications. Nevertheless, long-standing infections with *P. malariae* though rare may predispose to the renal syndrome and glomerulonephritis, *P. ovale* was reported once in Palawan in 1969 and remains to be investigated (Personal communication, D.G. Rivera, 1981). Mixed infections are frequent in hyperendemic areas.

The Annual Parasite Incidence (API) increased in 1973-74 and again from 1984-87. An upward trend was seen in Slide Positivity Rates (SPR)[1] from 1980-87 while Annual Blood Examination Rates (ABER)[2] decreased from 1975-86 (Table 1). Interpretation of these data requires an understanding of each parameter and how they were obtained. Various methods are employed in collecting data. These are active case detection, passive case detection, mass blood survey, epidemiological investigation, individual case investigation, and malariometric survey.

$$^{1}\text{SPR} = \frac{\text{No. of slide confirmed cases (all ages)}}{\text{No. examined}} \times 100$$

$$^{2}\text{ABER} = \frac{\text{No. of blood slides taken and examined during one year}}{\text{Population covered by case detection}} \times 1000$$

Table 2. Malaria morbidity and mortality statistics from 1946-86 (per 100,000 population).*

	YEAR	POPULATION	MORBIDITY		MORTALITY	
			Number	Rate	Number	Rate
	1946	18,434,400	184,482	1000.7	16,783	91.0
	1947	16,785,700	119,395	635.6	12,070	64.3
	1948	19,143,800	85,732	447.8	10,558	55.2
	1949	19,689,800	70,283	357.0	8,801	44.7
	1950	20,315,800	63,075	310.5	7,778	38.3
	1951	20,962,800	54,142	258.3	7,721	38.8
	1952	21,628,300	54,591	252.4	7,170	33.2
	1953	22,316,000	54,119	242.5	6,720	30.1
	1954	23,025,500	71,363	309.9	5,236	22.7
	1955	23,747,600	79,707	335.5	3,714	15.6
	1956	24,513,000	73,560	300.1	2,804	11.4
	1957	25,292,400	60,029	237.3	2,376	9.4
	1958	26,096,600	71,666	274.6	2,253	8.6
	1959	26,926,400	61,645	228.9	1,763	6.6
	1960	27,792,000	55,252	198.8	1,587	5.7
	1961	28,727,000	44,546	155.1	1,373	4.8
first decentralization	1962	29,698,000	40,342	135.8	1,273	4.3
	1963	30,709,000	36,295	118.2	1,114	3.6
	1964	31,270,000	40,854	130.6	976	3.1
	1965	32,345,000	28,988	89.6	1,015	3.1
	1966	33,477,000	33,737	100.8	1,373	4.1
	1967	34,656,000	31,441	90.7	1,147	3.3
	1968	35,003,000	28,354	79.0	1,061	3.0
	1969	37,158,000	31,756	85.5	860	2.3
	1970	36,849,000	28,594	77.6	666	1.8
	1971	37,959,000	25,338	66.8	547	1.4
	1972	39,040,100	27,090	69.4	656	1.7
	1973	40,219,000	31,999	76.6	845	2.1
	1974	41,457,100	27,420	66.1	938	2.3
	1975	42,517,300	27,077	63.7	1,018	2.4
	1976	43,751,300	35,553	81.3	997	2.3
	1977	45,005,300	29,955	66.6	974	2.2
	1978	45,528,500	35,353	77.7	1,077	2.4
	1979	46,580,400	31,779	68.2	1,142	2.5
	1980	48,316,503	39,678	82.1	1,091	2.2
	1981	49,536,022	44,118	89.1	1,071	2.2
	1982	50,783,065	40,496	79.7	985	1.9
	1983	51,973,651	55,019	105.9	1,086	2.1
	1984	53,192,708	107,485	202.1	923	1.7
second decentralization	1985	54,668,332	121,975	223.1	1,166	2.1
	1986	56,004,130	124,153	221.7	1,156	2.1

*Phil. Health Statistics: 1946-86.

statistically invalid measurements when dealing with large populations and organizationally weak infrastructure.

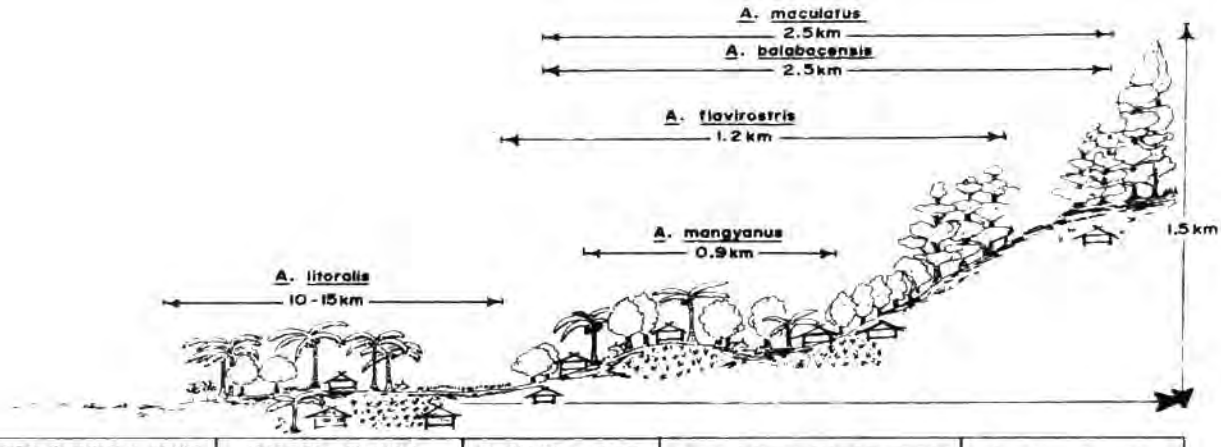
Morbidity and mortality statistics. Malaria was a leading cause of morbidity and mortality from 1898-1951 especially during World War II. It fell to 6th place in 1970 and remained there. Cabrera and Arambulo reviewed data for 1946-70 from the Disease Intelligence Center of the Department of Health (Cabrera and Arambulo, 1977). Morbidity rates decreased from 1000.7 per 100,000 in 1946 to 77.6 in 1970 while the population doubled. Mortality rates likewise decreased from 91 to 1.8 in the same period. The country experienced a resurgence in 1983-86 coinciding with the integration of the malaria control program with general health services (Table 2). This problem is discussed under operational issues.

Vectorial aspects. Four vector species are currently recognized: *Anopheles flavirostris*, the primary vector; *An. litoralis*, a brackish-water breeder; *An. balabacensis*, a sylvatic species; and *An. mangyanus,* an endemic species. These species were incriminated in the past based on strong epidemiological association between the finding of human infection and sporozoites in mosquitoes in the same area (Table 3). Although Ejercito (1934) found that the vectorial status of sporozoites in *An. maculatus* is uncertain. Owing to its versatility and widespread distribution *An. flavirostris* is the important transmitter in mountainous and foothill areas (Fig. 3).

Table 3. Operational strategies of MCP 1990-1994, Department of Health, Philippines.

	CONTROL							
			Vector-Control					
TYPE OF AREA	Chem.	Env.	Bio-measures	Case & Tx	Fdg.	IEC	Vigil.	Surveil.
Malaria-freed	–	–	–	–	x	x	optional	
API < 5/1000	focal only	x	select.	x	x	x	–	x
API > 5/1000 to 10/1000	one cycle per yr.	x	x	x	x	x	–	only up to API < 7/1000
API > 10/1000	two cycles per yr.	x	x	optional	x	x	–	–

The taxonomy and bionomics of Philippine malaria vectors have been adequately reviewed by entomologists in the region



SEA COASTAL ZONE		COASTAL PLAINS	FOOT HILL ZONE	HILLY ZONE/FOREST EDGES	MOUNTAIN RANGE
SEA	MANGROVE, NIPAH, COCONUT PLANTATIONS, RICELAND, RUBBER, ETC		TREES AND OTHER VEGETATIONS	TREES AND OTHER VEGETATIONS, RUBBER, COCONUT PLANTATIONS, KAINGIN	FOREST VEGETATION
	TIDAL ZONE Open lagoons containing brackish water Coconut groves	Fishponds, saltbeds	Slow flowing streams shaded by trees and other vegetations	Scrub forest and secondary jungle; slow flowing streams, seepages in newly opened areas	Mixed secondary wetland and primary forests, stagnant waters in forest areas, animal wallows, logging roads

HORIZONTAL AND VERTICAL DISTRIBUTION OF PHILIPPINE MALARIA VECTORS

Fig. 3. Horizontal and vertical distribution of Philippine malaria vectors. (Salazar N.P. et al. 1988, op. cit.)

(Cagampang-Ramos, *et al.*, 1985; Tankamoto, *et al.*, 1985; Apiwathnasara, 1986; Catangui, 1985; Salazar, *et al.*, 1988). However, there is a dearth of knowledge here on intraspecific variation at least in *An. balabacensis* and *An. maculatus* which are typical examples of species complexes elsewhere in South Asia (Baimai, *et al.*, 1984; Green, *et al.*, 1985; UNDP/WB/WHO, 1984). Morphologically cryptic species have been uncovered by cytogenetic, biochemical, anatomical, ecological, and behavioral studies in Thailand and Malaysia. Methods are available for large scale screening of natural populations for genetic markers. These populations may vary in their susceptibility to infection, therefore, their ability to transmit malaria or their vulnerability to mosquito control measures. It is yet unclear whether the observed behavioral changes in *An. flavirostris* have a genetic basis.

Seasonality of malaria. Two peaks of transmission are generally observed, one at the onset and the other, after the rainy season. Delay or persistence of monsoon rains affects the abundance of mosquitoes and consequently, upsurge of cases. This is because heavy rainfall flushes out larval habitats and disrupts continuous breeding and survival of mosquitoes. In places where rainfall does not result in flooding mosquitoes are in fact most abundant during the rainy season coinciding with high infection rates with *P. falciparum*.

Drug-Persistent Malaria

Shute and Sangalang (1970) described seven cases of RI/RII recrudescent *falciparum* malaria following treatment with amodiaquine. Six of these were indigenous cases, one patient had just returned from Laos. The report also indicated the existence of 3 foci of resistance namely Palawan, Aklan on Panay Island, and Central Luzon. Recognition of foci of drug-resistant malaria helps in directing appropriate remedial measures where most needed.

Ramos *et al*,. (1971) found 47% chloroquine resistance among patients from Palawan. Cross-resistance to both 4-aminoquinolines was noted for the first time. The result of 14 years study throughout the islands by the Malaria Control Service from 1974-87 using both macro and micro *in vitro* techniques showed 50%-55% resistance to chloroquine majority of which represented RI recrudescence by *in vivo* tests (Fig. 4) Increased resistance to amodiaquine as well as multidrug resistance have been documented in recent years (Smrkovski, *et al.*, 1982; Smrkovski, *et al.*, 1985; Watt, *et al.*, 1986; Long, *et al.*, 1989; Watt, *et al.*, 1987).

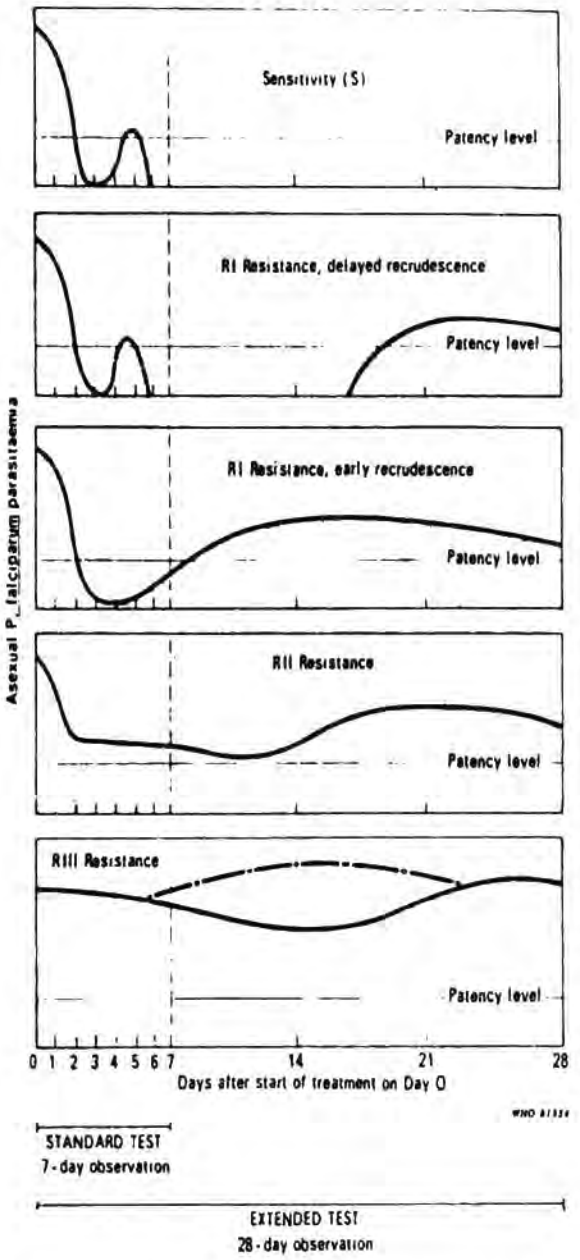


Fig. 4. *In vitro* response to chloroquine in falciparum malaria.

Because amodiaquine has been available and used widely since the 1950s the evolution of resistance to this antimalarial may be attributed to selective drug pressure. On the other hand, resistance to mefloquine developed in Thailand before its widespread application in the field Ruebsaeng (1986). Rather than selection pressure or induction resistance might have been triggered by some mechanism probably resulting from the indiscriminate use of chloroquine or quinine since these compounds are structurally alike. This serves to explain how multiple resistance may occur in the absence of multiple drug pressure. By and large, further studies are needed on the emergence and possible containment of drug-resistant malaria.

The Search for Alternative Antimalarials

The advent of drug-resistant malaria stimulated the development and clinical testing of new drugs or drug combinations (Canfield and Rozman 1974). For instance, more than 250,000 compounds were tested under the drug development program at the Walter Reed Army Institute for Research in the U.S.A. Two of these, mefloquine and halofantrine, (Horton, 1988). have been introduced for use in Southeast Asia. Clinical trials of investigational drugs such as these must conform with ethical procedures as stipulated in the Helsinki Declaration of 1975. Drugs are screened for safe use in human subjects and for efficacy against drug-resistant *P. falciparum* infections. The administration of antimalarials even when used in optimum doses have both biological and pharmacological contraindications especially when dealing with severe, complicated malaria, pediatric or geriatric patients, or those with concomitant disorders. The proper place of these newer compounds should be in the treatment of multidrug-resistant and complicated cases.

Successful clinical trials on alternative antimalarials were conducted in the Philippines by several workers (Sy and Cabrera, 1979; Cabrera, *et al.*, 1982; Alcantara, *et al.*, 1985). The drugs used were sulfamonomethoxine-pyrimethamine, clindamycin, cloroquine plus quinine, mefloquine, mefloquine plus Fansidar, quinine-quinidine-cinchonine combination, and halofantrine. From the ethical standpoint physicians have the ultimate responsibility of making the right choice at the right time for their patients. Self-medications and noncompliance with prescribed treatment could only exacerbate the drug resistance problem.

Vector Control

To obviate the difficulties encountered with chemical pesticides medical scientists have begun to explore the possible use of natural enemies (parasite, pathogens, predators) of mosquitoes as biological control agents (UNDP/WB/WHO, 1985). Among these are strains of *Bacillus thuringiensis; B. sphaericus; Lagenidium giganteum,* a larvicidal fungus; *Coelomomyces,* another fungal pathogen; and mermithiid nematodes. The future application of biotechnology presages the enhancement of toxin production by bacilli, selection of agents and formulations that are suited to tropical conditions, mass production, and extensive field trials. Other innovative approaches include the use of sound-trapping, insect growth regulatory hormones (IGR), neem *(Azadirachta indica),* and *Azolla.*

Application of Modern Biological Tools

The conventional methods for assessing malaria including vector population surveys and examination of peripheral blood smear or spleen present certain disadvantages. Aside from being labor-intensive and time-consuming, they oftentimes lack specificity and sensitivity as thresholds of infection in both humans and mosquitoes fall below microscopic detection levels. Convenience and applicability in the field are desired attributes of any diagnostic or epidemiologic tool.

Molecular biologists have come up with some satisfactory methods but which at the moment require technological sophistication. The recent availability of these modern biological tools has facilitated a better understanding of the intricacies of the malaria cycle.

A number of studies have been initiated among RITM researchers, the College of Public Health, and the Philippine Nuclear Research Institute. One of these employs an immunoradiometric assay (IRMA) that can detect and measure antisporozoite antibodies in sera. The assay now needs to be evaluated for its applicability to:

- assess the correlation between antisporozoite antibodies and susceptibility to malaria infection in populations from endemic areas.
- obtain indications of the level of malaria transmission so that areas of high transmission may be targetted for further study with classical entomological and clinical techniques.

- provide an indicator to monitor control programs, and particularly those that aim at reducing man/vector contact which could result in a drastic reduction of vectors.

This project is part of a new Coordinated Research Program under the International Atomic Energy Agency and is being conducted *vis-a-vis* 6 other institutes in the U.S.A., Burma, Columbia, Italy, Nigeria, and Thailand. The study area is in Morong (pop. ca.15,000), Bataan located 174 km from Manila and near the Philippine Refugee Processing Center. The area typifies the topography and ecology surrounding the majority of malaria endemicity in the country.

A second project aims to establish the degree of variability *P. falciparum* strains in the Philippines using the S-antigen as indicators. This group of heat stable soluble antigens have now been characterized in considerable detail at the molecular level. The methodology involves ELISA, SDS-PAGE, Western blotting, and immunodiffusion.

A third project is in collaboration with the Queensland Institute of Medical Research in Brisbane, Australia. The primary aim of this project is to examine, in detail, factors resulting in stable low level malarial endemicity in Morong, then to apply the results to the development of more effective control programs for use in similar areas in the Philippines and elsewhere.

OPERATIONAL ISSUES

Eradication versus Control from an Historical Perspective

Organized efforts to use all available tools in treating the disease and interrupting transmission dates back from the international sanitary conferences initiated in 1907 to the establishment of a Malaria Commission under the League of Nations in 1923. Later on, an Expert Committee on Malaria was designated in 1947, a year before the founding of the World Health Organization (WHO). Even at that early stage health planners and policy-makers already recognized the need for research and special training of malaria personnel while strengthening intersectoral collaboration to reduce morbidity and mortality from malaria. The prevailing thought was to begin with improving the social condition of populations at risk.

Under the WHO malaria control strategies evolved in stages from a period of control (1946-54) with emphasis on DDT

indoor residual spraying to eradication from 1955-69. A Second Asian Malaria Conference was held in Baguio City in 1954 resulting in a recommendation that the ultimate goal of nationwide malaria control programs should be eradication of the disease (WHO, 1956). The following year, a joint WHO/UNICEF Committee on Health Policy endorsed support of national and regional malaria eradication projects and the immediate change of plans from control to eradication.

In time, program implementation in many developing countries fell short of expectations. Eradication campaigns proved to be beyond the capability of these countries in terms of scientific acumen and organizational efficiency. Varying eco-epidemiological patterns of the disease and socioeconomic considerations were not given due attention. As a rule guidelines were based on generalizations and emperical formulas derived from the attainment of malaria eradication in more advanced countries.

Global malaria eradication began to be seen as a continuing financial liability precipitating withdrawal of foreign assistance, disillusionment of program managers and public health administrators and further exacerbation of the malaria problem. Thereupon, the 22nd World Health Assembly back-tracked in 1967 and advocated a return to the policy of malaria control with the ultimate goal of eradication (Salazar, 1990).

Somehow the period of 1969-78 did not foster the development of new methods in problem identification and problem solving. Beleaguered countries, therefore, had to transform ineffective malaria eradication programs into control programs without benefit of substantial indications and in the face of dwindling manpower and material resources. This predicament led to the integration of existing malaria control programs with general health services and a return to the vertical approach to malaria control as part of Primary Health Care (PHC).

On that note, the 31st World Health Assembly promulgated in 1979 four tactical variants for malaria control namely, reduction of morbidity, reduction of mortality, reduction of prevalence, and eradication (WHO, 1978). The choice of variant was left to the discretion of governments depending on their willingness to support antimalaria activities on a continuing basis and that of communities to share the responsibility as a partner. Other prerequisites included thorough knowledge of the biological, ecological, social, and economic dimensions of the disease, hence, the use of epidemiological methods in program planning. To facilitate the development of new improved tools for these

multifarious tasks a Special Programme for Research and Training in Tropical Diseases (TDR) was established jointly by the UNDP, World Bank and WHO in 1975.

The National Malaria Control Program Then and Now

Systematic malaria control in the Philippines began in 1921 with assistance from the Rockefeller Foundation. Five years later, a Malaria Control Division was established under the Bureau of Health. Paris green, an arsenical, was introduced as a larvicide in addition to mechanical and naturalistic control measures e.g. the use of automatic siphons and modification of mosquito larval habitats (stream-clearing, damming, ditching, sloping, etc.).

After World War II and the granting of political independence malaria control operations became part of a comprehensive Philippine Public Health Rehabilitation Program of the U.S. Public Health Services from 1946 to 1950. DDT was used against *Anopheles flavirostris* along with agro-engineering methods. Chloroquine was the drug of choice plus primaquine for the radical treatment of cases. A nationwide control program with DDT as the main weapon was launched in 1954 under centralized administrative set up with assistance from WHO and U.S.A.I.D (Ejercito, 1936).

The Department of Health was mandated to decentralize its operation under RA 997 in 1959. The program was managed by eight Regional Malariologists under the technical supervision of the Division of Malaria. In line with the promulgation of the 22nd World Health Assembly the program was centralized under RA 4832 of 1966 which created a Malaria Eradication Service (MCS) again with assistance from U.S.A.I.D and WHO. U.S.A.I.D support was eventually phased out in 1973 and WHO retrenched. These transitions were no less accompanied by administrative and financial constraints amid political strife, global economic recession, and the growing pains of nationhood while the malaria situation continued to deteriorate (Echeverri, 1985; Santos, 1990).

By the 1980s (under Martial Law) the thrust of the national Malaria Eradication Program (MEP) was based on a selective application of control within the context of Primary Health Care (PHC) whose relevant features are appropriate technology, sectoral linkages, community participation, and self-reliance (Annual Report 1981, Malaria Eradication Service, Ministry of Health). Areas under malaria risk (ca. 16 million pop.) were categorized by priority as follows:

- P-1 = high incidence areas of economic importance where residual house spraying were conducted twice a year.
- P-2 = high incidence area adjacent to and which provide risk of transmission to areas of low endemicity and where residual spraying were undertaken only when necessary.
- P-3 = low endemicity areas which are under selective surveillance/vigilance, and
- P-4 = high endemicity areas with sparse populations and/or security problems where appropriate antimalarial measures were instituted when needed.

Innovations were introduced as a step towards the implementation of PHC such as the hiring of local spraymen through contractual service agreement between MES and barangay captains. Local spraymen were trained and supervised by MES personnel. Stream-cleaning were accomplished through community participation and biological control (i.e. the use of larvivorous fish) was the principal activity of a centralized MES.

Blood smears were collected from persons actually suffering from fever or those with recent history of febrile episodes by active and passive case detection. Theoretically, while these should be extended to entire populations, in all localities, at all times, in practice only those persons presenting with a high index of suspicion were selected for examination.

Rivera (1983) presented a schema of specific disease surveillance in malaria based on case detection and treatment by barangay health workers (BHWs). Malaria detection posts (MDP) were designated for every cluster of 20 families including schools and labor camps. These MDPs would be under the supervision of midwives. The strategy required among others the provision of adequate facilities and reagents for microscopic diagnosis as well as drugs for treatment at the municipal level via Rural Health Units (RHUs). A monitoring system would be needed to help identify newcomers. Migrants from known endemic areas who are found positive for gametocytes and outgoing residents would be treated accordingly. Mobile microscopy units would be fielded during outbreaks. This plan did not materialize.

Under Executive Order No. 851 of 1982 and reiterated by Executive Order No. 119 of 1986 the malaria program was to be integrated with general health services. Thus, the program became the responsibility of the Integrated Provincial Health Office. The function of MES, now MCS, was confined to matters of policy, planning, and evaluation. Administrative su-

pervision and fiduciary control emanated from the Regional Health Office. By 1984 the strategy has reverted from eradication to an open-ended control program.

The timing could have not been more anachronistic. Malaria recurred in previously cleared areas. Both field service units and communities were ill-prepared for the tremendous tasks that integration and PHC entailed. As it happened to be malaria was not always a high priority item in the agenda of local government authorities. Logistics and security problems hampered the delivery of basic health services.

At present the national Malaria Control Program is administered through Regional and Provincial Coordinators. Adequate financial support has been assured through Department Circular No. 2 dated October 16, 1987. The Malaria Control Service is under the Office of the Undersecretary for Public Health and is headed by a Program Manager or Director.

The Malaria Control Program: A Five-Year Strategic Plan for 1990-94.

In the course of underwriting this plan, the Malaria Control Service identified the following to be the deficiencies of past program implementation:

- rapid decentralization without provisions for training and proper supervision of incumbent personnel given new assignments on malaria.
- poor management of the distribution and storage of supplies and materials leading to unnecessary losses and wastage.
- low priority given to vector control operations so that only 27.4% of target houses were sprayed in 1986 therefore, insufficient coverage of endemic areas.
- frequent turn-over and drop-outs among volunteer spraymen who, in addition, lacked the special skills and commitment needed to perform their tasks well.
- shortage of trained personnel on vector control procedures under the Field Health Services. Vacancies have not been filled.
- lack of spray cans, insecticides, and transportation facilities for field operations especially in remote hyperendemic areas.

The basic components of this present plan are:

- stratification of endemic areas and adopting appropriate modes of control (Table 3).

- residual spraying of 90% of target houses by locally hired and trained spraymen as follows:
  - barangays with API < 5/1000- focal spraying only
  - barangays with API of 5-10/1000- one cycle per year
  - barangays with API > 10/1000 2 cycles per year
- modification of mosquito breeding sites
- biological control e.g. use of natural enemies of mosquito larvae
- intensified and stratified case-finding and treatment
- vigilance/surveillance according to level of endemicity (Table 4)
- intensive health education campaigns
- research, monitoring and evaluation
- re-organizing the Malaria Control Program (MCP) and
- training.

The goal of MCP is to reduce API from 14.2/1000 pop. at the end of 1988 to 2.0/1000 in 1994, the level at which, it is presumed, will not interfere with the socio-economic activities of people residing in endemic areas.

Table 4. Components of vigilance/surveillance strategy of MCP 1990-94.

COMPONENT	LEVEL OF ENDEMICITY		
	Malaria-Freed	API >7/1000	API <7/1000
Passive detection	x	x	incidental case finding
Active detection (mass blood surveys/ suspects examined	x	x	–
Presumptive tx	x	x	–
Radical treatment	w/ lab. confirm.	x	x (even w/o blood exam)
Epi. remedial measures appropriate action	x	x	x
	Vigilance measures	Surveillance measures	

Current Policies on MCP

Under Department Order No. 167, the Provincial Health Office is responsible for the control of malaria in his respective area of jurisdiction, particularly the vector control component. He is to be aided by the District Health Officer in case finding and treatment through the network of hospitals, RHU, BHS, and when necessary through hired malaria canvassers and volunteer workers.

Emphasis is to be placed on vector control through chemical means or insecticide residual spraying of household premises. A semivertical operation at the provincial level will be undertaken under the direct supervision and control of the Provincial Coordinator for MCP. The spray operation team shall consist of a sector chief and a squad leader for every 3-4 spraymen (Fig. 5).

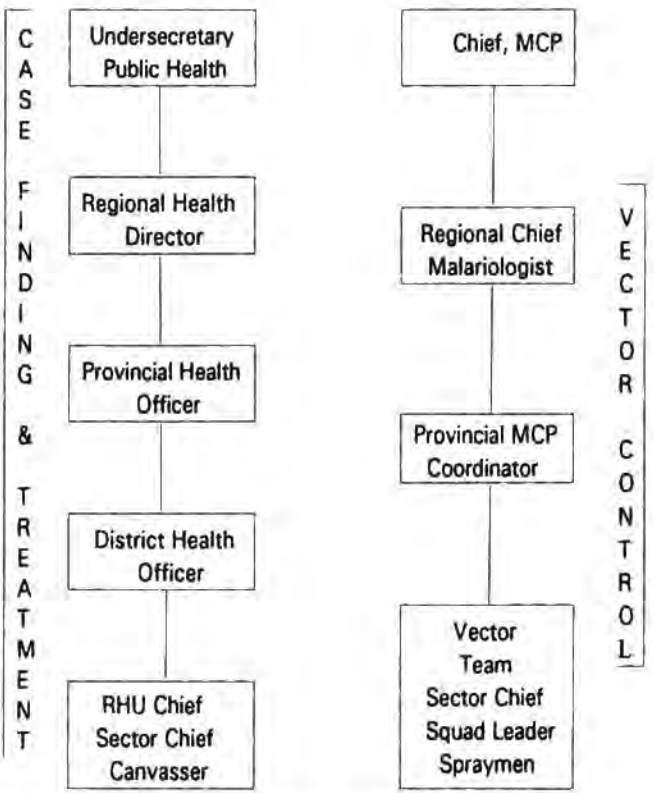


Fig. 5. A semivertical operation plan of MCP 1990-1994.

Surveillance shall be under the direction and control of the District MCP Coordinator who may assist the Provincial Coordinator in areas where there are more than two squad leaders. The District Coordinator will work through the RHU and canvassers for active case-finding and treatment.

In view of the new organizational support system and changes in the operation of malaria control, a training program shall be implemented at various levels to upgrade personnel skills on both technical and management aspects of program operation.

CONCLUSION AND RECOMMENDATION

In a developing country like ours where research tends to be regarded as a luxury, its immediate goal should be the application of knowledge and skills in mitigating disease as a public health problem then as a clinical entity. This translates in terms of protecting the greatest attainable number of persons at risk, in a given place, at the soonest possible time, and in the most affordable manner. The ultimate goal of research should be that of preserving or maximizing the benefits to be gained from its short-term goals.

Because of the biological complexity of malaria the aim of control is to eliminate the vectors of disease and its causative agents at source i.e. in mosquitoes and in man while serving the need of individual patients to be relieved of the clinical attacks of malaria. In principle, equal emphasis should be given to both vector control and the rational use of antimalarials based on prompt diagnosis and treatment of cases. These prerequisites suffer from many constraints and are easier said than done.

For any strategic plan to be realized, the following provisions should be in place:

- an adequate, organized, well-coordinated and efficient infrastructure for vector control operations
- effective surveillance mechanisms at the barangay level
- sufficient preparation of the community to accept and to have acquired the capability to participate in the implementation of the program
- viable and continuing support for research training
- wholistic approaches to community development to effect concomitant improvements in people's living conditions, heretofore, attitudinal changes

- development of a scientific career structure and a critical mass of research-oriented professionals.

Something needs to be said about the qualities of a good health worker. He or she should be a dynamic person, committed to his/her mission, versatile, charismatic as to inspire and move people, knowledgeable in his/her field of specialization, adept in problem-solving and identification, and possessing appropriate communication skills. Solutions must be found first to extricate people from the vicious cycle of poverty and disease, then to educate them, and finally to teach them the meaning of responsible citizenry.

The goal of socioeconomic research is to understand the factors which tend to impede control measures. Knowing that, ways could be found to ensure community participation and the involvement of all segments of society including mass media communicators. If primary health care is to be actualized, barangay health workers (BHWs) are vital to a system that emanates and ends with its clientele. This initial and close contact with people is strategically important.

Local government should encourage and support the work of functional Barangay Health Brigades whose members should be identified, their qualifications and interests being related to their tasks. They should be trained and modest incentives, provided. Training of BHWs should include not only the acquisition of technical knowledge and skills but communication skills and positive attitudes to be effective facilitators of concerted community efforts.

Research on the economic implications of disease should consider the priorities of administration so that their results may be made to bear on policy formulation and decision. Cost-effectiveness analysis of malaria control will convince business sector that it stands to gain more by maximizing human productivity and improving people's way of life. Well-documented studies on factors relating to disease impacts and demand for interventions are sorely needed.

Finally, opportunities for advancement and the pursuit of a scientific career in health should be available to those who possess the qualifications, at par with other professions in both government and private sectors. If research is to be accorded its proper place in the health care delivery system, then, efficient management, direction and control must go hand-in-hand with available resources, and an environment that is conducive to creativity and prolificacy. For scientists are like artists, if they cannot be truthful, they are not worth supporting, and their findings, not worth believing.

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